

Restoration Case study Seminar series 1.0

Proposed Seminar - Case study summary – 1989/90 \$1,700,000

Part One Rooftop plaza restoration

This case Study describes how certain design details combined with environmental factors caused the premature failure of a roof top parking slab in Denver Colorado.

- The failure cause(s) are identified and their effects on integrity and serviceability outlined
- The re-detailing for Proper system DRAINAGE, isolation and movement were developed
- The repair/replacement methods and procedures were engineered
- The constructions plans and specifications were prepared and
- The demolition and replacement construction is presented
- Lastly a 15 year check up was performed photo logged



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Case study 2- Pedestrian plaza reconstruction - This case study describes the redesign of a plaza (over a parking deck) with certain traffic use and extensive landscaping and special features detailing. It outlines the construction sequencing and details needed to provide a state of the art, 100% replacement of an existing wear surface while keeping the adjacent facilities operating at normal capacity. Concurrent with the plaza restoration the Parking deck slabs below were removed and replaced as well. Project coordination and staging are reviewed. This presentation will relate the same items and issues described (bulleted above) in the first presentation. Project 2006, \$2,400,000

Rebuild of existing failed plaza system @ 20 years with;

- **Membrane-Drainage/Insulation and isolation layer**
- **Isolated Wear slab as Universal base**
- **Drains (Promenade type with subsurface capacity)**
- **Hard-scape features of Brick pavers and concrete**
- **Snow Melt system integrated Concrete and Bricks**
- **Green-scape features including sod areas, Tree wells, common planters**



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Case study # 3 – Structural Slab and frame replacement beneath a modern 25 story high rise – 1992/92, \$1,100,000

A 30 year old Parking slab system near Chicago was removed and replaced along with the CMU Masonry façade. CIP frame repairs and selective replacements were completed. This case study outlines.

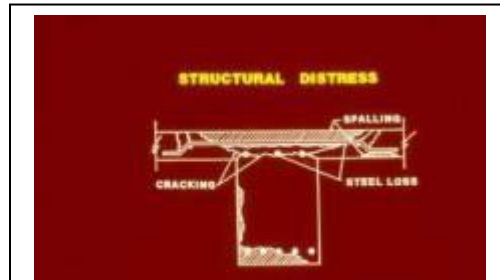
- **Structure evaluation and reporting**
- **Explanation of the Principle deterioration mechanisms**
- **Primary design considerations**
- **Special Shoring/stabilization requirements**
- **Demolition methods and reconstruction sequence**
- **Special durability design procedures (epoxy coated steel and high performance concrete)**
- **15 year performance review and commentary**



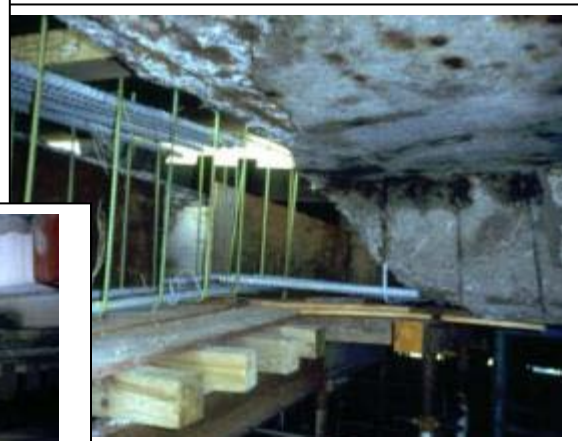
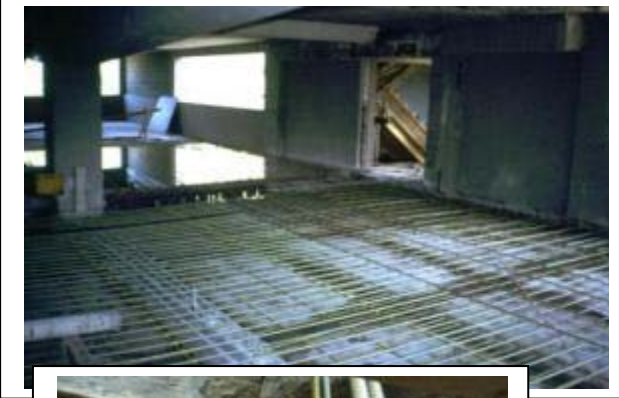
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Case Study # 4 Parking Slab Removal Replacement Restoration (1989 at Flint) \$2,700,000

- Existing 30 year old "Parking" slab has corrosion (of embedded reinforcing bars) damage on over 40% of the surface and 25% of the ceiling – Making it essentially unsalvageable
- Isolated "haunched" main beams were showing shear type failure and certain (spandrel) or strut beams were cracked at their junction with the mains.
- Expansion joint beams (and columns) were showing irregular cracking patterns and judged to need stiffening.
- 25 year service life restoration plan was requested by owner with low maintenance expectations.
- Full slab removal and replacement on the lower 3 floors was recommended. Bonded High Performance Overlay was called out for the roof
- Construction was sequenced to;
 - Replace the slab out to (and under) the parapet wall
 - Thicken all expansion joint beams and support columns
 - Repair damaged interior "Main" beams first before slab work
 - Do an Outer ring demo and putback first and then continue with an inner ring sequence 2nd
 - Replace the closed in Stairtower masonry with glass curtain walls
 - Provide an all new electrical and mechanical system (and service vault)
- Project was finished on time and within budget and is performing well after 20 years of service with the anticipated low maintenance. Some marriage line issues (between new and old concrete are now showing up.



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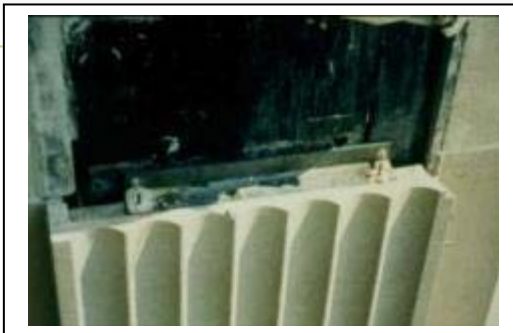
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Case study # 5 – Historic Building Exterior Façade Restoration – 1930’s – This structure is clad in ornate limestone panels with major connector and shelf support angle problems. Corrosion damage on many of the angles caused failure of the limestone connectors by spalling of both surface (and backside) limestone sections resulting in indeterminate behavior. Damage panels were dismantled catalogued/inventoried and repaired, primarily by Dutchman methods (partial section removal and replacement). Project Date; 1991---Budget \$750 - \$850,000

New anchors were installed in the Virgin panel sections remote from the original failure. Following dismount connector angles/assemblies were removed and replaced with galvanized steel and new connector pins were fabricated for inlaying and concluding repairs to the remaining panels in place.



- Panel spalling – Face & Backside
- Tieback overstressing/pullout
- Shelf angle corrosion/displacement
- Stone to stone Connector pin failure
- Backup material failure
- Steel frame Corrosion



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Case Study # 6 – Historic Auto park restoration and up grading - This project qualifies as one-of-a-kind. A reinforced concrete auto park seven stories tall near the core of Boston was completely restored and refitted; Project Date 1997/98, Budget \$21,000,000

Garage interior

- **The parking garage floors beginning at the first level were completely restored and, in certain cases, removed and replaced. (The damage pattern observed was typical with the lower floors showing more severe and extensive corrosion related distress because of the higher amount of chloride deposited. Upper floors were less chloride contaminated therefore the corrosion damage was somewhat less.**
- **A new lighting system was installed with upgrades to more efficient fixtures**
- **a new drain system was installed and in certain cases floors were re-profiled slightly for better drainage**
- **The ramps between floors were removed and replaced**
- **New Ramps were added to a roof (8) level (historically covered by a ballasted membrane) and the new parking surface area was installed for an additional 215 cars. The roof level was then coated with a high-performance vehicular deck coating.**
- **Special note deck coating was subsequently installed on the lower floors (1-7)**

Garage exterior

- **The original cast stone facing material and window system along with certain venting features was removed and replaced. The new panels were so designed as to accommodate replacement of nearly 80% of the building façade (a pentagon shaped footprint of 905 feet long by 8 Stories High. Special note Tracy Restoration Engineers performed the original façade survey 1993 indicating certain replacement options.**
- **The damage parapet stones (original limestone in some cases weighing 1500 pounds each) were removed and replaced with GF RC precast concrete elements weighing a fraction of the amount.**
- **The entry and exit lanes were redone to accommodate better traffic flow within the historic structure.**
- **A new garage advertising sign and replicating the original 1930s neon sign was fabricated and hung on Massachusetts Avenue side.**

Garage basement - The basement was rebuilt and reconfigured to accommodate ballroom and convention type space for large dinner parties one story below street level.

Garage street-level -The garage street-level was totally reconfigured to accommodate a high-end restaurant and specialty food store (Legal Seafood and Magianno's)

- **Elevators were installed between the second level and the specialty stores and restaurants**
- **The lobby was reconfigured in rebuilt for improved pedestrian flow**
- **Parking access revenue control systems were updated for improved key card access**
- **Sidewalk entry aprons were redone and pedestrian security features also emplaced.**

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Detroit Metro Airport Blue Deck Restoration - This Restoration involved a 5500 car parking deck situated near the old North terminal at Detroit Metro Airport. It was undertaken in a three-year consecutive stage /phased project between 2005 and 2008. Coordination with demolition and re-construction of the new North terminal and construction an adjacent parking deck nested in the blue deck notch was also done. This project was completed on schedule and within the \$6.2 million budget. **It was selected for an award of excellence by The Institutional and Municipal Parking Congress in 2009, (largely on the administrative and project management effort) and an award of excellence by The International Concrete repair Institute during 2010, (primarily on the technical complexity and construction administration services).**



- 1) **Drain basin restoration** -Drain basins on the rooftop, originally constructed to accommodate the pre-casters production system had leaked sense the earliest days of facility operation. Leaking caused rapid/ progressive corrosion of the connectors, pipes, fittings and constant staining the vehicles below. Double drains installed as part of original construction were replaced with larger single drains encased in substantial concrete block-outs to avoid leaking and movement. The new drain eliminates piping and provides for easier maintenance with the appropriate clean outs.



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- 2) **Expansion joints repairs** - Expansion joints were cast into conventional concrete nosing with little if any taper and slope to reduce leakage. Metal retainer assemblies had experienced snowplow damage and The leaking through these joints was also a problem soon after construction and continued until Carl Walker's restoration 2006. Nosings were reconfigured and rebuilt using latex modified concrete consistent with the overlay material. Watson Bowman strip seals were installed on the new tapered nosing. Joint openings were reduced slightly to accommodate the actual structural movement.



- 3) **Shear wall refitting** - The shear walls along the central corridor portion of the deck had marginally bonded concrete caps and were structurally disconnected, or only marginally connected to the frame. Wall tops (the connection zone) were reconfigured and structurally reinforced to provide positive connection between the shear wall and the double tee floor system.



- 4) **Flange connector repair** - Flange connectors (double T. to double T.) experience major damage because of the original design/construction tolerances, difficulty with field welding, corrosion during service from sealant failure and severe loading during winter snow removal. This combination of conditions produced widespread failure and complete disconnection of numerous T. flanges. Complete redesign of the tee flange reinforcing was performed and integrated into the overlay to correct all of the above conditions with a 3 step process; mesh reinforcing, stitch rod installation, re-welding failed original connectors, including aggregate interlock and joint width reductions. This process corrected the previous condition of joint leaking associated with the failed connectors, with this multi task process.



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- 5) **Transfer beam installation** - Many of the expansion joints show differential movement from tee to tee during vehicle transit. Previous assemblies, angles installed in pairs, had worked loose during service and, experience loosening or failure. This combined with joint leaking above and corrosion problems had produced an unacceptable assembly and system. Existing connectors were reconditioned to provide proper contact. Additionally, transfer beams were used in the main driveline for severe loading of winter maintenance operations.



- 6) **Overlay placement - drainage grade improvements** The existing deck surface consisted of lightweight aggregate double Tees of the Pretopped variety. Although designed the grade lines provided satisfactory macro drainage, many of the T's were installed with variations in the upper flange surface. This produced micro ponds on many of the T's in the drain line region and caused considerable difficulty during snowplowing when the equipment damaged elevated tee edges.



- 7) **To correct these numerous conditions**, the existing deck surface was milled down 1 in. for a new 1-1/2in. thick overlay of latex modified concrete. The new surface provides improved long-term durability over the lightweight Aggregate concrete, improves drainage gradients to reduce micro ponding, accommodated providing smaller joints, and eliminates differentials, improving the overall ride and reducing future distress from snowplowing operations.



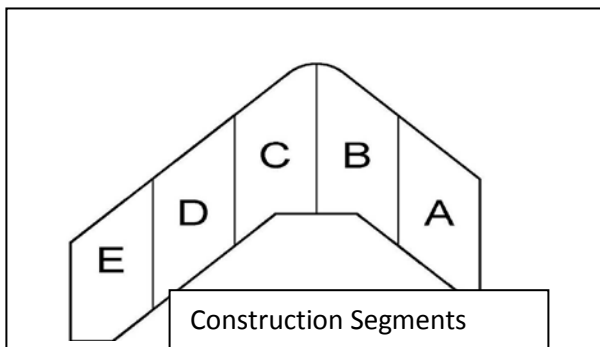
- 8) The current project was proposed in two phases The first to be completed on the west bank during the summer of 2006 and the balance of cotton tract to be completed on the stack of during the spring of 2007. this approach continues On schedule with the winter shutdown and return of service planned on are Bob November 15 in advance of the holiday season

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Sea-Tac airport parking deck (Largest in north America at 13,800 cars)

Investigation and condition assessment of a 4 generation (phased original construction) parking deck and development of a rooftop restoration program with 600,000 SF per floor. 2010/11 \$6.75 million. Identified the principle deterioration mechanisms, affecting structure integrity and serviceability, within the following work groups;

- Floor surface conditions (all 4 design types and ages)
- Joint Condition (seismic design features) for upgrade and durability enhancements
- Ceiling surface conditions
- Drainage and drivelane overlay considerations
- Stairtower upgrades and improvements
- Exit apron reconfigurations for refit joints



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Source Restoration Engineering Inc.

Dedicated to preserving our infrastructure – One Building at a time!



Bob Tracy P.E.

Education

Master of Science, Civil Engineering, Michigan Technological University, 1975
Bachelor of Science, Civil Engineering, Michigan Technological University, 1974

Professional Registrations

Michigan Minnesota Ohio
Indiana Illinois

Employment

Principle Investigator and Restoration Engineer- Source Restoration Engineering Inc., Chelsea Mi. - 2011
Senior Consultant—Restoration Engineering, **Carl Walker, Inc.**, Kalamazoo, Michigan (2004-2011)
Estimator/Principal Investigator, Construction problem Troubleshooter - RAM Const Services, Detroit, MI, (2000-2004)
Vice President Restoration, Walker Parking Consultants, Ann Arbor, Boston, Elgin (1994-2000)
Owner/CEO, Tracy Restoration Engineers (1984-1994)
Restoration Services Group Manager, Walker Parking Consultants, Kalamazoo (1979-1984)
Research Projects Engineer – MNDOT Bridge Deck deterioration Analysis and restoration programing (1975 - 1979)

Professional Activities

American Society of Civil Engineers—ASCE—Member
American Concrete Institute—Former Committee Member
Transportation Research Board—Former TRB Committee Member
National Cooperative Highway Research Program
American Consulting Engineers Council

Publications

“Floor Slab Removal and Replacement on a Rigid Concrete Frame”, *Concrete International*, American Concrete Institute, 1992
“Restoration of Deteriorated Post-Tensioned One-Way Slab”, Part II, *Concrete International*, American Concrete Institute, 1992
“Evaluation of a Deteriorated Post-Tensioned One-Way Slab”, Part I, *Concrete International*, American Concrete Institute, 1991

Speaking Engagements

“Case Study in Post-Tensioning Repair,” American Concrete Institute, Chapter Meeting, Columbus, Ohio, 1990
“Concrete Durability and Repair,” Michigan State University, 1990
“Bridge Deck Rehabilitation,” National Concrete Engineering Conference, 1989
“Restoration Engineering,” University of Missouri, Rolla, Missouri, 1989
“Deterioration of Continuously Reinforced Concrete Pavement and Experimental Cathodic Protection,” Transportation Research Board, 1980, 1982
“Factors that Influence Rigid Concrete Overlay Performance,” Transportation Research Board, 1980
“Durability of Parking Structure Design Systems,” National Society of Corrosion Engineers

Engineering Seminars

Managing Structure Repairs, Detroit, MI – One-day professional seminar to present proven approaches for restoration of plazas, buildings and parking decks as well as program approaches with case study examples; conducted 1993 and 2000.

Bob has devoted his professional career to concrete deterioration analysis and restoration program development. With over 35 years of professional experience, he has been responsible for various Bridge & parking garage and building façade restoration projects, as well as building envelope investigations throughout the U.S.

Mr. Tracy has extensive experience in the analysis of concrete/Masonry deterioration mechanisms and has evaluated the performance of repair and protection systems used for bridge deck restoration, prepared and implemented bridge rehabilitation plans, and created standard procedures based on successful bridge deck repair technology.

Mr. Tracy joined Carl Walker & Associates in 1979 to develop a Restoration Services Division focused on solving parking facility repair and maintenance problems. This was accomplished with a structured approach to:

- Facility condition appraisals and reports
- Restoration-engineered standards and specifications
- Consistent on-site construction observation practices
- Comprehensive Maintenance programs
- Integrated durability design features

In 1984, Mr. Tracy established his own consultation practice and expanded his engineering activities in plaza system evaluation and restoration programming. He also developed building façade inspection and evaluation procedures, and investigated and repaired numerous parking structures that experienced failed post-tensioning slab and beam tendons.

Most recently Mr. Tracy served a large restoration construction company with technical support in the area of project scope development, cost estimating, and troubleshooting field construction problems.

Mr. Tracy has joined **Carl Walker, Inc.** to provide technical support and program development expertise to its restoration services division that focuses on solving parking structure, building and plaza repair and maintenance problems.

In 2011 Bob Returned to Private Practice to pursue Greater involvement in Historic Structures restoration

Representative Projects

Parking Deck Restoration and Maintenance

Paragon Towers Building—Newton, MA - Renovation

City of Lansing DECKS—Lansing, MI - City Parking Decks Restoration and Repair

City Deck #1 Restoration—Lowell, MA - Post-Tensioned Slab Repairs

Motor Mart Garage—Boston, MA - Floor Slab and circulation ramp restoration, repair, slab protection and rooftop parking design and construction Administration.

Mott Community College—Flint, MI - Parking Deck Slab Removal & Replacement

Parkade at the Biltmore Hotel—Providence, RI - Parking Slab & Spiral Restoration

Portland Jetport Parking Facility—Portland, ME - Parking Deck Reconfiguration, Floor Repairs

Franklin Washington Facility—Boston, MA - Post-Tensioning Beam Repairs

Blue Deck and McNamara Terminal Deck Restoration Detroit Metro Airport

West Wells Street Restoration - Milwaukee Wisconsin.

SEA TAC Airport Parking Deck RESTORATION Study and Schematic Design

Bluff Street Parking Deck Restoration Study, Design and Construction Administration

Big Deck Study and Restoration Design – Houghton Michigan

Building Façade Restoration/Repair

Buhl Building—Detroit, MI - Architectural Repairs & Terra Cotta Tile

Guardian Building—Detroit, MI - Architectural Repairs & Terra Cotta

Motor Mart—Boston, MA - Condition Appraisal, Façade Removal and Replacement, Structural Slab Restoration and Protection

St. Mary's Cathedral—Grand Island, NE - Façade Restoration

Kresege Building—Detroit, MI - Façade Restoration – Limestone Removal and Restoration

Jackson State Prison—Jackson, MI - Building Rehabilitation

First National Building—Detroit, MI - Building Renovations

Cloverland Powerplant Wall structural repairs and strengthening – Saulte St. Marie Michigan

Plaza Deck System Investigations/Redesign

Businessmen's Assurance Corporation Headquarters - Kansas City, MO

Plaza condition investigation and restoration and maintenance needs evaluation, producing a report of; findings, conclusions, and restoration program maintenance recommendations.

Johns Manville Roof-Top Parking Slab - Denver, CO

Investigation of concrete slab surface and drainage features/conditions, and failure mechanism(s). Slab system redesign consulting/recommendations. Expert witness services and construction observation services.

Phoenix Center Plaza Restoration – Pontiac, MI

Slab restoration investigation, repair/re-waterproofing, new plaza system, drains and drainage system behavior construction observation services. Field troubleshooting of construction problems.

Renaissance Center Plaza – Detroit, MI

Field investigation of existing conditions, (wear slab deterioration and membrane leaking), structural slab repairs, drainage system behavior analysis and system redesign and replacement combined with new planter design and field construction observation services.

City of Southfield - Southfield, MI - Plaza surface disintegration and drains and drainage system behavior restoration and re-waterproofing.

Brickyard Shopping Mall - Chicago, IL - Rooftop parking plaza investigation of concrete wear slab deterioration, joint system failure, drains and drainage system behavior, membrane leaking, “IRMA” type system performance. Report of findings; conclusions and restoration recommendations.

State of Michigan – Lansing, MI – Hannah and Ottawa Tower Plaza redesign, waterproofing and drainage re-detailing, snowmelter design and planter restoration design, expansion and joint system design development.

Bridge Restoration Construction Engineering

Beaubien Street Bridge Restoration - Detroit, MI - Slab removal and replacement, as-built detailing, field problem troubleshooting.

QMHA - Project engineering Budget

Task	Description	Fee	Hours	expense	total	Comments
1	Final Scope	\$2,975	30.00	\$525	\$3,500	Field assessment and final report
2	Design Documents	\$3,188	32.00	\$562	\$3,750	Includes site trip for as built
3	Bidding	\$1,913	20.00	\$337	\$2,250	Includes site trip for prebid walk thru
4	Coordination	\$2,338	23.50	\$412	\$2,750	Includes site trip for final documnetrs review
5	Construction Admin	TBD	TBD	TBD	TBD	TBD
6	Total thru Award	\$10,414	105.00	\$1,836	\$12,250	
7	Billing rate \$100/hr					
Source Restoration Engineering Inc.						