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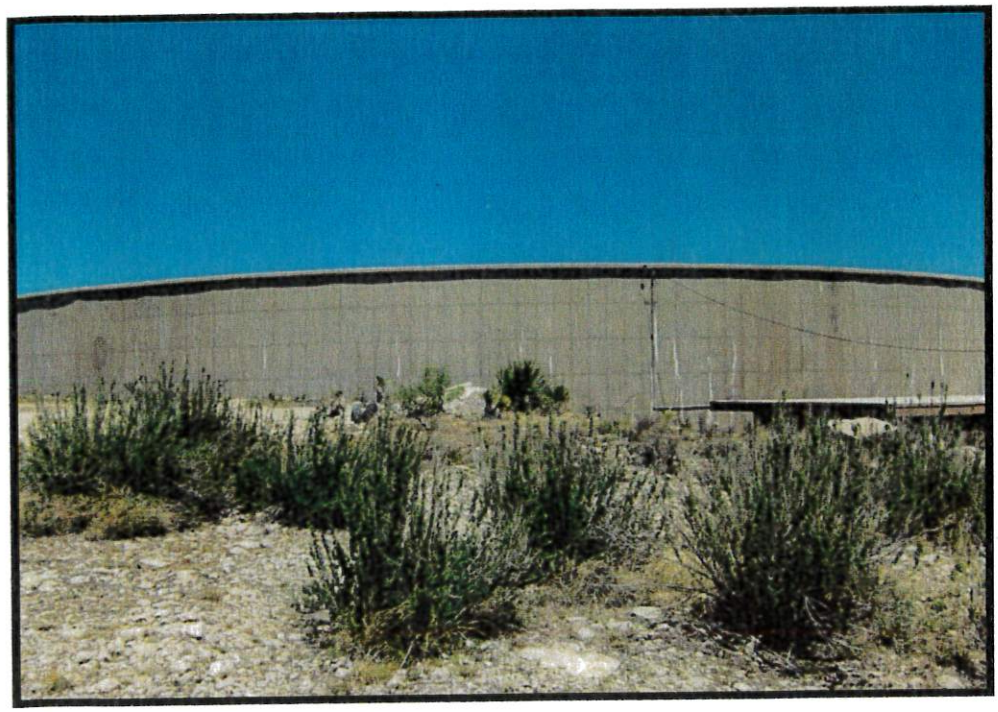

EVALUATION OF THE

5,000,000 GALLON CONCRETE GROUND STORAGE TANK

"RESERVOIR NO. 2"
CARLSBAD, NEW MEXICO

FOR

SOUDER, MILLER & ASSOCIATES
ALBUQUERQUE, NEW MEXICO

April 27 through May 5, 2016

14.240.S1545.003

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May 20, 2016

SUBJECT:

The subject of this report is the field evaluation of the 5,000,000 gallon concrete ground storage tank in Carlsbad, New Mexico. The tank was owned by the City of Carlsbad and was known as "Reservoir No. 2." The field evaluation was performed on April 27 through May 5, 2016 by Gregory P. Cannon, Chad D. Mitchell, Jamie L. Stewart, and Cody W. Griffin of Tank Industry Consultants. The Owner's representative on the site at the time of the field evaluation was Jamey Schwiger. The column supported roof tank was of reinforced concrete construction. Measurements taken during the field evaluation indicated the tank diameter was approximately 206 ft and the nominal shell height was approximately 20 ft 2-1/2 in.

OBJECTIVE:

The purpose of this washout and evaluation was to determine the condition of the tank interior, exterior, exposed foundation, and accessories. The purpose of this report is to present the findings of the evaluation and to make recommendations for repairing and maintenance. Budget estimates for the work, anticipated life of the structure, and the replacement cost of the tank are also included.

AUTHORIZATION:

This washout, evaluation, disinfection, and report were authorized in the Master Subconsultant Agreement Amendment No. 1 dated November 17, 2014 signed by James D. Smith.

EXECUTIVE SUMMARY:

The interior surfaces had isolated areas which were in very poor condition with spalled concrete and exposed reinforcing bars. Tank Industry Consultants recommends repairs be performed on the interior within the next year. The exterior surfaces appeared to be in generally good condition; however, the exterior roof exhibited spider web looking cracking at the apparent locations of the interior columns. This roof cracking is of a potential structural concern and should be repaired. These areas of the roof should continue to be monitored when the tank is regularly evaluated. Tank Industry Consultants recommends that the exterior surfaces be repaired when interior repairs are performed as it would likely be more cost efficient.

ANSI/OSHA and Safety-Related Deficiencies: There were OSHA and safety-related deficiencies on this tank. These deficiencies included:

- exposed electrical wiring was noted in the valve vault,
- the shell was not equipped with manholes,
- severe corrosion and metal loss were observed on the interior ladder,
- the interior ladder was equipped with only one pair of brackets at the top and was not secured at the bottom,
- the interior ladder was not equipped with a safe-climbing device,
- the width between interior ladder side rails did not meet the required minimum (29 CFR 1910.27(b)(1)(iii)),
- the toe room at the top rung of the interior ladder did not meet the required minimum (29 CFR 1910.27(c)(4)), and
- the interior ladder side rails did not meet the required minimum (ANSI A14.3).

If the Owner wishes to fully comply with OSHA and safety-related standards, it is recommended that these deficiencies be rectified.

AWWA and Operational Deficiencies: There were sanitary and operating deficiencies on this tank as well. These deficiencies included:

- the protective screening on the gooseneck roof vents did not appear restrictive enough to prevent the ingress of insects into the tank, and
- some daylight was visible near the end of the roof support beam on the northwest side.

These deficiencies should be corrected.

The safety-related, sanitary, and operating deficiencies listed above are not intended to be a complete list of deficiencies on this tank. The Owner should refer to the complete report text and accompanying photographs for a complete account of all observed deficiencies.

This evaluation and the reporting of the condition of this tank do not warrant the original structural condition of the tank or any of the original design for seismic loadings. Likewise, recommendations for this tank do not include modifications which may be required for compliance with present structural codes.

PHOTOGRAPHS:

Color photographs were taken of the visible portions of the tank interior and exterior and are included as a part of this report. The significant photographs are keyed to the observations.

NOMENCLATURE:

The terms used in describing the various components of water tanks are unique to the industry. In fact, the terms vary from firm to firm and from person to person. In an attempt to define the terms used in this report, a sketch of the general type of tank covered is included at the end of the narrative portion of this report. **Warning: Some appurtenances on this tank may be referred to as erection or rigging attachments, lugs, or brackets. This does not mean that they are safe for rigging. Each attachment for each tank should be evaluated on an individual basis by a structural engineer or an experienced rigger before being used. These devices may have been intended for only the original erectors and painters to use with specialized equipment.**

HEAVY METALS TESTS:

A sample of the exterior overflow pipe coating was sent to a laboratory for inductively coupled plasma-atomic emission spectrometry analyses. The test results were as follows:

	Cadmium		Chromium		Lead	
	mg/kg	percent	mg/kg	percent	mg/kg	percent
Exterior Overflow Pipe	<0.51	<0.0000.51%	48	0.0048%	55	0.0055%

Tank Industry Consultants performs this test only to determine if there is lead, cadmium, or chromium present in the coating sample. To limit damage to the existing coating, only small areas were tested. The small number of samples taken and the difficulty of retrieving all primer from the steel profile may cause the tests performed to not accurately represent the total coating system. Variations in thickness, types of coatings applied, and the interim cleaning and painting operations will also affect the actual readings. The reliability of the results is also dependent on the amount of primer included in the sample. Additional testing to determine the amount of leachable contaminants present in the spent cleaning debris will need to be performed following cleaning operations at the time of repainting. Results from the laboratory analysis are included as a part of this report.

OBSERVATIONS:

A. Foundation and Site

SITE:

Size: approx. 300 ft x 270 ft

Fence:

Type: chain link, with 3 strands of barbed wire and razor wire

Height: 7 ft

Gates:

Location: east side of site

Widths: 20 ft and 12 ft

Locked: yes

Nearest Structures:
Type: building
Direction: east
Distance: approx. 9 ft 6 in.

Type: pump house
Direction: south
Distance: approx. 22 ft

Type: antenna building
Direction: east
Distance: approx. 35 ft

Nearest Overhead Power Lines: attached to tank on east and south sides

FOUNDATION:
Type: mat
Projection Above Grade:
North: below grade
South: below grade to 21-1/2 in.
East: flush to 4 in.
West: below grade
Sealant: none

VALVE VAULT:
Location: approx. 10 ft 6 in. south of tank
Size: 51 in. x 48 in. x 73 in. deep
Access:
Size: 22-1/4 in. I.D.
Locked: no

1. **Site Location**: The tank was located at the end of Holland Lane in Carlsbad, New Mexico. The tank was located in an open area on a hillside to the west beyond residential areas of Carlsbad. Overhead power lines were attached to the tank on the east and south sides. Access to the site was by a dirt and gravel road and was through gates on the east side of the site. (See photos 1-4)

2. **Site Conditions**: The tank site was covered with sand and gravel and was graded to typically slope to the east. The tank site was fenced. The chain link fence was topped with barbed wire and razor wire and was equipped with two gates on the east side of the site. A bent fence post was noted and areas of the fence and barbed wire appeared to need repair. Two small buildings, an antenna tower, and a generator were located on the east side of the site. A vault and a pump house were located south of the tank. (See photos 1-7)

3. **Foundation**: The tank foundation appeared to be a concrete mat continued from the reinforced concrete floor of the tank. Except for hairline cracks and minor chipping, the exposed surface of the foundation appeared to be in nearly its original structural condition at the time of this field evaluation. The foundation was completely below grade on the north and west sides of the tank

and projected above grade on the south and east sides. No coating was visible on the exposed concrete surfaces at the time of this field evaluation. (See photos 15-17)

4. **Valve Vault**: **There was a safety deficiency noted: exposed electrical wiring was noted in the valve vault**. There was a valve vault located on the south side of the tank site. Access into the valve vault was not locked prior to or after this field evaluation. The piping in the valve vault appeared to be in adequate condition with only minor corrosion observed. (See photos 7-9)

B. Exterior Surfaces

DESCRIPTION:
- Construction: concrete
- Diameter: approx. 206 ft
- Shell Height: approx. 20 ft 2-1/2 in.
- Roof Type: column supported

OVERFLOW PIPE:
- Size: approx. 16 in. diameter pipe within 24 in. diameter pipe with 16 in. diameter discharge pipe
- Visible Air Break: yes
- Protective Screen: none
- Flap Gate: yes

ROOF OPENINGS:
- Manhole:
  - Size: 34 in. square
  - Type: concrete curb with removable steel cover
  - Curb: 4 in. projection above roof x 4 in. wide
  - Cover Overlap: 4-1/2 in.
  - Locked: yes
- Roof Vents:
  - Number: 6
  - Type: gooseneck vent
  - Height: 27 in. total, 10-3/4 in. from roof to screened end
  - Diameter: 8 in.
  - Screen:
    - Orientation: horizontal
    - Size: 8 x 8 mesh

1. **Exterior Shell Condition**: **There was a safety-related and OSHA deficiency noted: the shell was not equipped with manholes**. The contour of the tank shell appeared to be adequate. No coating was observed on the concrete. Minor areas of exposed aggregate and previous repairs were noted on the shell. Exposed form wires and tie wires were observed. The shell concrete appeared to be in fair and generally sound condition with some hairline cracking and efflorescence noted. It was reported from the Owner that at one time there was a leak with ponding water adjacent to the east shell; there was no indication of such a leak at the time of this field evaluation. Conduits extended vertically

up the east and south sides of the shell with a horizontal conduit extending between the vertical conduits on the south and east sides. A second apparently abandoned horizontal conduit was also located near the bottom of the shell. A 36 in. wide x 12 in. tall plaque was fastened to the lower east shell and read "RESERVOIR NO. 2 CAP. 5 MIL. GAL." (See photos 17-28)

2. **Overflow Pipe and Drain Pipe**: The overflow pipe appeared to be an approximately 16 in. diameter pipe within an approximately 24 in. diameter standpipe located approximately 40 in. outside the tank shell. The top of the standpipe was equipped with two approximately 2 in. diameter gooseneck vents with 8 x 8 mesh screens which appeared to be in generally good condition. The coating on the exterior of the overflow standpipe appeared to consist of a coal tar primer and an aluminum finish coat. The coating exhibited fair adhesion to the steel. Approximately 1% coating failure to the underlying coating and less than 1/2% coating failure to rust were noted on the overflow standpipe. A flanged discharge section of pipe with a flap gate was located at the bottom of the standpipe for the overflow. This flanged discharge section had been temporarily removed by the Owner at the time of the evaluation in order to access the drain valve. The drain pipe opening appeared to be the same pipe opening as that for the overflow pipe inside the tank. The drain pipe extended below grade and discharged above grade adjacent to the tank. The discharge end of the drain pipe was equipped with a flap gate which appeared to be in good condition. (See photos 11-14)

3. **Roof Condition**: The roof appeared relatively flat, and some evidence of ponding water was observed on the roof. The concrete roof measured approximately 6 in. thick at the roof perimeter. A large chip was noted at the north end of the roof construction joint at the roof perimeter. A bituminous sealant was located in the roof construction joints. The sealant appeared to be in poor condition and was missing in places. Vegetation was observed within the roof construction joints and in a few cracks in the roof. Some rocks and debris were noted on the roof. Isolated spots of exposed steel reinforcing were observed in the roof, and widespread locations of tie wires projecting from the exterior roof were noted. The exterior roof exhibited spider web looking cracking at the apparent locations of the interior columns. (See photos 29-42)

4. **Roof Manhole**: The roof was equipped with one manhole. The manhole was equipped with a locked steel cover. The roof manhole was locked prior to and after this evaluation. The steel cover was not painted and was rust covered. Minor chipping in the concrete curb of the manhole was noted. (See photos 51-52)

5. **Roof Vents**: **There was a potential sanitary deficiency noted: the protective screening on the gooseneck roof vents did not appear restrictive enough to prevent the ingress of insects into the tank**. The roof was equipped with six gooseneck roof vents. The end of each vent was equipped with a galvanized screen clamped to the vent. The coating on the steel vent pipes had weathered and wide spread coating failures to underlying coating and rust were observed on the vents. (See photos 42-50)

C. Interior Surfaces

ROOF SUPPORT SYSTEM:
- Beams:
  - Number: 5
  - Size: approx. 12 in. x 12 in. square
- Columns Supporting Beams:
  - Number: 31
  - Size: 12 in. diameter concrete post
- Columns Directly Supporting Roof:
  - Number: 112
  - Size: 12 in. diameter concrete post

INTERIOR LADDER:
- Number of Rungs: 21
- Width: 14-3/4 in.
- Rung Size: 3/4 in. diameter
- Spacing: 12 in. on center
- Side Rails: 2 in. x 3/8 in., flat bar
- Toe Room: 1-1/8 in. at top rung, greater than 7 in. typical
- Head Clearance: 32-1/2 in.
- Brackets:
  - Construction: bolted to concrete roof manhole curb and welded to ladder
  - Size: 2 in. x 3/8 in., flat bar
  - Spacing: only one pair of brackets at top of ladder
- Safe-Climbing Device: none

INTERIOR PIPING:
- Inlet Pipe:
  - Size: 36 in. diameter
  - Projection: 48-1/2 in. above floor
- Outlet Pipe:
  - Size: 36 in. diameter
  - Projection: 14-3/4 in. above floor
- Overflow/Drain Pipe:
  - Size: 16 in. diameter
  - Projection: flush with floor

1. **Interior Roof Condition**: **There was a potential sanitary deficiency noted: some daylight was visible near the end of the roof support beam on the northwest side.** The concrete roof support structure consisted of two parallel beams extending across the roof and three beams extending in a line across the center of the roof perpendicular to the pair of parallel beams. These concrete beams were supported by concrete columns from the floor. Several other concrete columns from the floor supported the roof directly without beams. Hairline cracking with random efflorescence was noted in the beams, and spalled concrete and exposed reinforcing bars were observed in isolated

spots on the beams. The concrete columns appeared in generally good condition. Widespread spalling of concrete, exposed reinforcing bars, exposed form wires, and cracking were observed in the concrete roof. The interior of the concrete roof was not coated. (See photos 54-60)

2. **Shell Condition**: The interior of the concrete shell was not coated. The shell was discolored due to mineral staining from the water. Cracking, efflorescence, bug holes, and isolated exposed reinforcing bars were noted in the concrete shell. Some spalled concrete was observed along the top of the shell. Previously repaired areas were noted on the interior shell. No evidence of any existing leaks was noted in the shell at the time of this field evaluation. (See photos 61-68)

3. **Interior Ladder**: **There were safety and ANSI/OSHA deficiencies noted: (1) severe corrosion and metal loss were observed on the ladder, (2) the ladder was equipped with only one pair of brackets at the top and was not secured at the bottom, (3) the ladder was not equipped with a safe-climbing device, (4) the width between side rails of 14-3/4 in. did not meet the required 16 in. minimum, (5) the 1-1/8 in. toe room at the top rung of the ladder did not meet the required 7 in. minimum, and (6) the 2 in. x 3/8 in. side rails did not meet the required minimum of 2-1/2 in. x 3/8 in. side rails**. The interior ladder was welded to brackets which were bolted to the concrete roof manhole curb. The bottom of the ladder was not equipped with brackets. Widespread corrosion and metal loss were observed on the ladder. The interior ladder appeared to be in poor condition. **It is the opinion of Tank Industry Consultants that the existing interior ladder should not be used for personnel access.** (See photos 52-53)

4. **Floor Condition**: The interior of the concrete floor was not coated. Previously repaired areas were noted on the interior floor. Random spots of exposed reinforcing bars and some hairline cracking were observed in the interior floor. No evidence of any existing leaks was noted in the floor at the time of this field evaluation. (See photos 68-76)

5. **Interior Piping**: The inlet pipe was located in the tank floor and projected 48-1/2 in. above the floor. The outlet pipe was located in the tank floor and projected 14-3/4 in. above the floor. The tank was equipped with an apparent overflow/drain pipe in the floor which was flush with the floor. Widespread corrosion, tubercles, and possible mill scale were observed on the pipes. The pipes were not equipped with protective covers. A 44-1/2 in. square apparently abandoned tray, which may have been a cover for piping, was located in the tank. (See photos 77-80)

RECOMMENDATIONS:

A. Foundation and Site

1. **Site Maintenance**: The site should be maintained so that proper drainage away from the tank continues. Any damaged fencing should be repaired or replaced. The gates should continue to be locked at all times to deter unauthorized entry and limit liability for the Owner.

2. **Site Access and Restoration**: The fenced, open area adjacent to the tank should be adequate for a contractor to stage equipment. Provisions should be included in the specifications for the restoration of any fences or other surfaces and structures disturbed by the contractor's work.

3. **Tank and Site Security**: Water tanks have been defined by some courts under certain circumstances as attractive nuisances. As such, there may be a significant potential liability to the Owner for injury to persons on the tank and tank site, even if access is not authorized. Recent events have prompted the entire water industry to consider measures that inhibit intentional acts that could threaten the water supply. A review of the security requirements for the tank and site is recommended to confirm that the existing measures are consistent with the Owner's security requirements for their water system. Primary tank and site security should be focused on eliminating, preventing, and detecting unauthorized access to the tank. Such security measures might include routinely and periodically verifying all manholes and gates are locked. Other security measures might include installing no-trespass signs, improving the fence, installing new site lighting, adding motion detectors on the site, installing surveillance cameras, installing alarms on gates, doors, and tank manholes, and arranging more frequent site visits by law enforcement agencies.

4. **Overhead Power Lines: All overhead power lines within 40 ft of the tank, including those attached to the tank, should be relocated underground in order to prevent potential electrical shock to personnel working on the tank.** The relocation of the power lines should be performed in accordance with the National Electric Code (NEC) guidelines.

5. **Valve Vault**: The valve vault access should be locked at all times in order to limit liability to the Owner and to protect water system security. The exposed electrical wiring in the vault should be enclosed in accordance with the National Electric Code (NEC) guidelines.

B. Exterior Surfaces

1. **Exterior Concrete Surfaces**: The exterior surfaces appeared to be in generally good condition; however, the exterior roof exhibited spider web looking cracking at the apparent locations of the interior columns. This roof cracking is of a potential structural concern and should be repaired. These areas of the roof should continue to be monitored when the tank is regularly evaluated. Tank Industry Consultants recommends that the exterior surfaces be repaired when interior repairs are performed as it would likely be more cost efficient. The exterior should be washed and scrubbed without damaging the concrete. Any unsound concrete should be chipped to sound material and the concrete should be brush-off blasted. Any deteriorated areas or voids found in the concrete should have a bonding agent and a concrete patching material applied to build up the surface to its original contour. Any exposed reinforcing steel should be cleaned prior to patching the concrete. The chip noted at the north end of the roof construction joint at the roof perimeter should be repaired. Significant cracks should be filled with a cementitious crack compound to prevent moisture collection from causing additional damage to the tank. The Owner may consider coating the exterior surfaces for added weathering resistance, to seal cracks, and to provide a more aesthetically pleasing appearance.

2. **Roof Cracks at Columns**: The spider web looking cracking in the exterior roof at the apparent locations of the interior columns is of a potential structural concern and should be repaired. When the tank is regularly evaluated, the areas of the exterior roof above the apparent locations of the columns should continue to be monitored to verify the condition is not worsening.

3. **Roof Construction Joints**: The existing bituminous sealant which appeared to be in poor condition and the vegetation should be removed from the roof construction joints and the joints resealed.

4. **Recommended Coating System:**

a. **Complete Cleaning and Repainting**: The recommended coating system presently available for the exterior of this tank is an acrylate coating system. The typical life of the properly applied coating system is approximately 8 to 12 years. These coatings are also presently manufactured to meet current VOC requirements.

b. **Coating Application**: The exposed exterior surfaces should be cleaned to SSPC-SP 13, surface contaminants removed, and the surfaces coated. The existing metal surfaces on the tank exterior, such as the roof manhole cover, vents, and the overflow standpipe should be cleaned to the equivalent of an SSPC-SP 6, Commercial Blast Cleaning and an epoxy primer, epoxy intermediate, and polyurethane finish coat system applied.

5. **Effective Service Life**: Tank Industry Consultants defines the life of a coating as the amount of time before repainting becomes necessary due to coating failure. During the coating life the Owner should expect the coating to lose its gloss, start to chalk, and show signs of weathering. Future touch-up may be required on isolated coating failures. If aesthetics are a concern, the Owner may have to topcoat the repainted tank prior to the end of the expected service life. However, future topcoating would be less expensive than complete cleaning and recoating and could delay the next complete cleaning and repainting for many years.

6. **Other Systems**: With air emission volatile organic compounds (VOC) restrictions being put in place around the nation, alternative coating systems may become available which would be viable options for this tank. The Owner should review the available systems prior to preparing specifications for the recoating project.

7. **Coating Curing**: It would be more economical to paint the tank exterior at the same time the interior is painted, since the tank must be drained while the exterior is painted, and the applied coatings cure. This will also reduce mobilization and observation costs.

8. **Rehabilitation Schedule**: To obtain the lowest possible prices for the work outlined in the recommendations, the Owner should have the specifications prepared and the work bid in the early fall, with the work scheduled to start in early winter.

9. **Plaque**: The existing plaque on the tank shell should be removed for the cleaning and coating of the tank. The plague should be cleaned and reattached to the tank using the existing brackets.

10. **Electrical Apparatus**: All unused electrical conduit and equipment should be removed from the tank and tank site. All required equipment should be repaired and maintained in accordance with the National Electric Code (NEC).

11. **Shell Manholes**: Tank Industry Consultants interprets OSHA standards as defining a water storage tank as a confined space, and as such, at least two means of emergency egress and ventilation during maintenance and cleaning and coating operations are required. The AWWA D110 standard for wire-wound circular prestressed-concrete water tanks does not address accessories as does the AWWA D100 standard for welded steel tanks which requires two shell manholes in standpipes and reservoirs, and states that additional manholes may be needed for ventilation during painting.

However, adding manholes to a reinforced concrete tank is extremely expensive and if not done properly may threaten the structural integrity of the tank. Design of such manholes would require removal of large sections of the concrete shell and installation of additional reinforcement to distribute loads around the opening being created. Therefore, in lieu of installation of such manholes it is recommended the tank be considered to a permit-required confined space for personnel entry.

12. **Gooseneck Vents**: The gooseneck vents on the roof should be equipped with more restrictive screens to prevent the ingress of insects into the tank while maintaining the required air flow.

13. **Clog-Resistant Vent**: The AWWA D100 Standard (applicable for steel tanks) recommends that all vents with screening against insects be designed to ensure "fail-safe" operation if the insect screens become occluded. However, a concrete roof is typically capable of withstanding more pressure or vacuum than a steel roof. If the Owner desires to provide the utmost in safety, a clog-resistant vent should be installed.

14. **Roof Manhole**: The roof manhole and cover should be locked to improve water system security.

C. Interior Surfaces

1. **Interior Concrete Surfaces**: The interior surfaces had isolated areas which were in very poor condition with spalled concrete and exposed reinforcing bars. Tank Industry Consultants recommends repairs be performed on the interior within the next year. Areas of spalled concrete should be cleaned and patched and formed to their original contour. Any exposed reinforcing steel should be abrasive blast cleaned prior to the concrete patching. Any significant cracks should be filled with a cementitious crack compound to prevent moisture collection from causing additional damage to the tank. Any deep cracks should be epoxy-injected. An elastomeric coating could be considered for the interior shell and floor surfaces.

2. **Metal Piping**: The existing metal piping should be cleaned to the equivalent of an SSPC-SP 10, Near-White Blast Cleaning and a three-coat epoxy coating system or 100% solids elastomeric coating system, that is NSF certified, applied. If the Owner desires to return the tank to service more quickly, an underwater-curing epoxy could be used.

3. **Interior Ladder**: Interior ladders may be susceptible to accelerated rates of corrosion. If the Owner decides to keep the interior ladder, the ladder should be replaced by a ladder which complies with current industry standards and should be equipped with a corrosion-resistant safe-climbing device. **It is the opinion of Tank Industry Consultants that the existing interior ladder should not be used for personnel access.**

4. **Abandoned Tray**: The 44-1/2 in. square apparently abandoned tray should be removed from the tank.

ECONOMIC FACTORS:

Item	Cost
Replacement of tank with a new one	$4,000,000[1]

The following is a complete list of repairs and estimated costs for their respective recommendations found in the RECOMMENDATION section of this report.

Item	Sanitary & Safety	Scheduled Maintenance Repairs
Clean and Paint Exterior Concrete Tank		$ 650,000
Clean and Paint Exterior Metal Surfaces (Overflow, Vents, and Roof Manhole Cover)		30,000
Clean and Paint Interior Concrete Tank		700,000
Clean and Paint Interior Metal Surfaces (Exposed Piping in Floor)		15,000
Concrete Spall Repair		30,000
Concrete Crack Repair		30,000
Sealant Along Roof Construction Joints		15,000
Interior Ladder Removal	$ 1,000	
Interior Ladder Replacement	3,000	
Interior Ladder Safe-Climbing Device	1,000	
Screens for Gooseneck Vents on Roof and Overflow Standpipe	1,000	
Clog-Resistant Vent	8,000	
Contingency Items	10,000	15,000

Estimates are believed to be a high average of bids that would be received in 2016.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	Cost
Clean and Paint Exterior Metal Surfaces (Overflow, Vents, and Roof Manhole Cover)	$ 30,000
Clean and Paint Interior Metal Surfaces (Exposed Piping in Floor)	15,000
Concrete Spall Repair	30,000
Concrete Crack Repair	30,000
Sealant Along Roof Construction Joints	15,000
Interior Ladder Removal	1,000
Screens for Gooseneck Vents on Roof and Overflow Standpipe	1,000
Contingency Items	25,000
Total of Engineer's Recommendations	**$147,000**

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and

qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank Industry Consultants performs all facets of the engineering services which would be required for this project. Estimated fees for engineering and resident observation will be furnished upon request.

CLOSURE:

Brief Summation: The City of Carlsbad owns and operates a 5,000,000 gallon concrete ground storage tank in Carlsbad, New Mexico. The interior surfaces had isolated areas which were in very poor condition with spalled concrete and exposed reinforcing bars, and the exterior roof exhibited spider web looking cracking at the apparent locations of the interior columns. Tank Industry Consultants recommends repairs be performed within the next year. Proper maintenance after completing the recommendations herein would include periodic washouts and evaluations approximately every 3 to 5 years in accordance with AWWA recommendations.

Contractor Selection: The work should be performed by a competent bonded contractor, chosen from competitive bids taken on complete and concise specifications. The coatings used should be furnished by an experienced water tank coating manufacturer, supplying the field service required for application of technical coatings.

Standards for Repairs and Coatings: All work done and coatings applied should be applied in accordance with NACE, ANSI/NSF Standard 61, the manufacturer's recommendation, ACI, and the SSPC: The Society for Protective Coatings.

Observation of Work: Observation of the work in progress by experienced personnel will offer additional assurance of quality protective coating application. Observations can be performed on a continuous basis or spot (critical phase) basis. The actual cost of observation may be less using spot as opposed to full-time resident observation; however, with spot observation it is often necessary for work to be redone to comply with the specifications. This somewhat lowers the quality of the finished product, lengthens the job, and is frequently a cause of conflict between the contractor, Owner, and field technician. Resident full-time observation minimizes the amount of "rework" required.

Anniversary and Maintenance Evaluations: An anniversary evaluation should be conducted prior to the end of the one year bonded guarantee. Washouts and coating, structural, sanitary, safety, and corrosion evaluations should be conducted not less than every 3 to 5 years.

Time Frame: If the work is not performed within the next 18 months, the structure should be reevaluated prior to the preparation of specifications and solicitation of bids.

Specifications and Bidding Documents: The recommendations in this report are not intended to be specifications on which a contractor can bid. Complete bidding documents must include general and special conditions, detailed technical specifications, and other information necessary for the competitive bidding process. To properly protect the interests of the Owner, Contractor, and Engineer; the initial evaluation, the technical specifications, legal portions of the contract documents, and the observation should be performed by the same firm or with close coordination of all parties involved.

Limitations of Evaluation: It is believed that the conditions reported herein reflect the condition of the tank as observed on the date of the evaluation, using reasonable care in making the observations, and safety in gaining access to the tank. Should latent defects be discovered during the cleaning of the structure, they should be brought to the attention of the Owner and the Engineer.

Seismic and Wind Loadings: This tank is located in a region of low seismic activity. This evaluation and the reporting of the condition of this tank do not warrant the structural condition of the tank or any of the original design for seismic loadings. Likewise, recommendations for this tank do not include modifications which may be required for compliance with present structural codes. It is possible the tank was erected in compliance with pre-existing industry standards which have since been replaced by more restrictive standards.

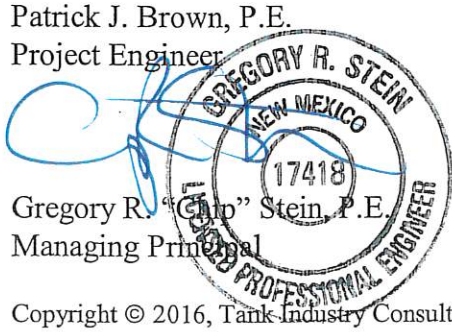
Hazardous Materials in Coatings: It should be taken into consideration that Federal, State, and local environmental agencies have placed stricter controls on the removal of lead-based and other heavy-metal based coatings from structures by the use of conventional abrasive blasting techniques. Paint and blast residue may be considered to be hazardous waste depending on the concentration of lead or other particles in residue.

Please contact Tank Industry Consultants if you have any questions or comments.

Respectfully submitted,

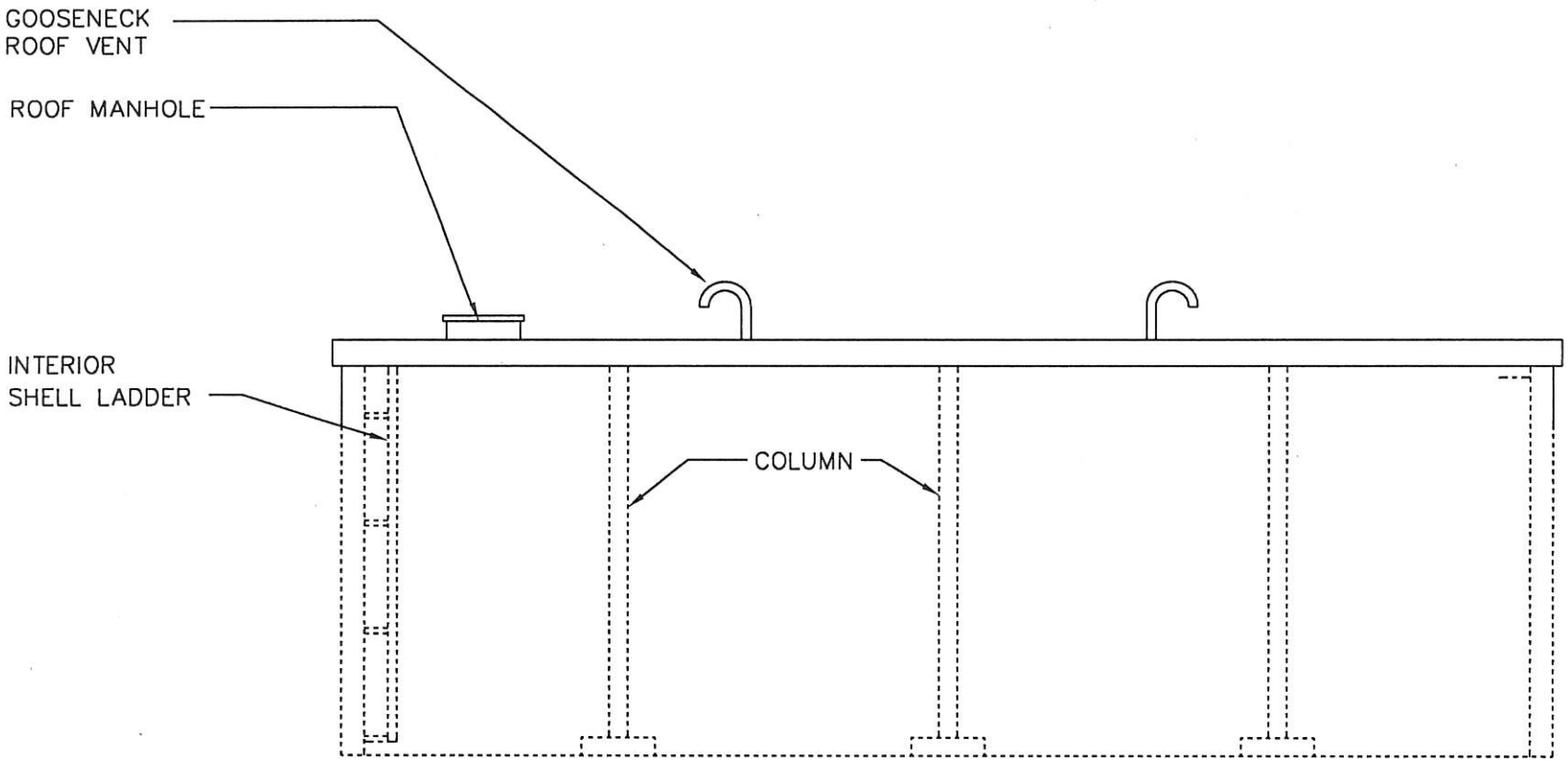
Tank Industry Consultants

Patrick J. Brown, P.E.
Project Engineer



Gregory R. "Chip" Stein, P.E.
Managing Principal

CONCRETE RESERVOIR



NOMENCLATURE

EMSL Analytical, Inc.
2001 East 52nd St., Indianapolis, IN 46205
Phone: (317) 803-2997 Fax: (317) 803-3047 Email: indianapolislab@emsl.com

Attn: **Bruce Hobbs**
Tank Industry Consultants
7740 West New York Street
Indianapolis, IN 46214
Phone: (317) 271-3100
Fax: (317) 271-3300

5/17/2016

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 5/10/2016. The results are tabulated on the attached data pages for the following client designated project:

14.240.51545.003

The reference number for these samples is EMSL Order #161607942. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (317) 803-2997.

Reviewed and Approved By:

Doug Wiegand, Laboratory Manager

EMSL Analytical, Inc.
2001 East 52nd St., Indianapolis, IN 46205
Phone/Fax: (317) 803-2997 / (317) 803-3047
http://www.EMSL.com indianapolislab@emsl.com

EMSL Order: 161607942
CustomerID: TICO62
CustomerPO:
ProjectID:

Attn: **Bruce Hobbs**
Tank Industry Consultants
7740 West New York Street
Indianapolis, IN 46214

Phone: (317) 271-3100
Fax: (317) 271-3300
Received: 05/10/16 12:05 PM
Collected: 4/28/2016

Project: **14.240.51545.003**

Analytical Results

Client Sample Description 1
ext. overflow pipe

Collected: 4/28/2016 ***Lab ID:*** *0001*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date*	*Analyst*	*Analysis Date*	*Analyst*
3050B/6010C	Cadmium	ND	0.51	mg/Kg	5/11/2016	TD	5/11/2016	TD
3050B/6010C	Chromium	48	1.3	mg/Kg	5/11/2016	TD	5/11/2016	TD
3050B/6010C	Lead	55	1.3	mg/Kg	5/11/2016	TD	5/11/2016	TD

Definitions:

ND - indicates that the analyte was not detected at the reporting limit
RL - Reporting Limit

1. Tank and site.

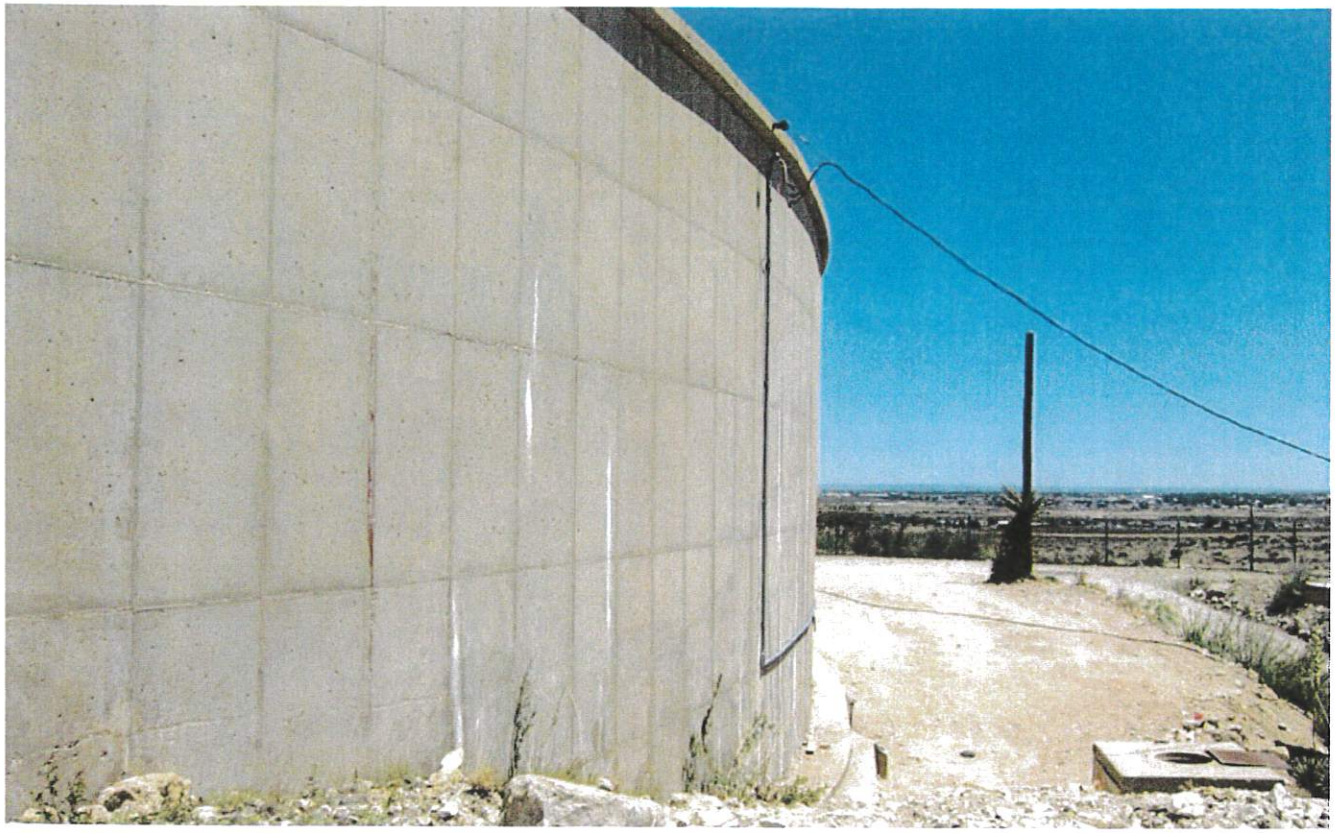
2. Tank and site.

3. Site access.

4. Site access.

5. Bent fence post.

6. Tank and site. Note antenna tower.

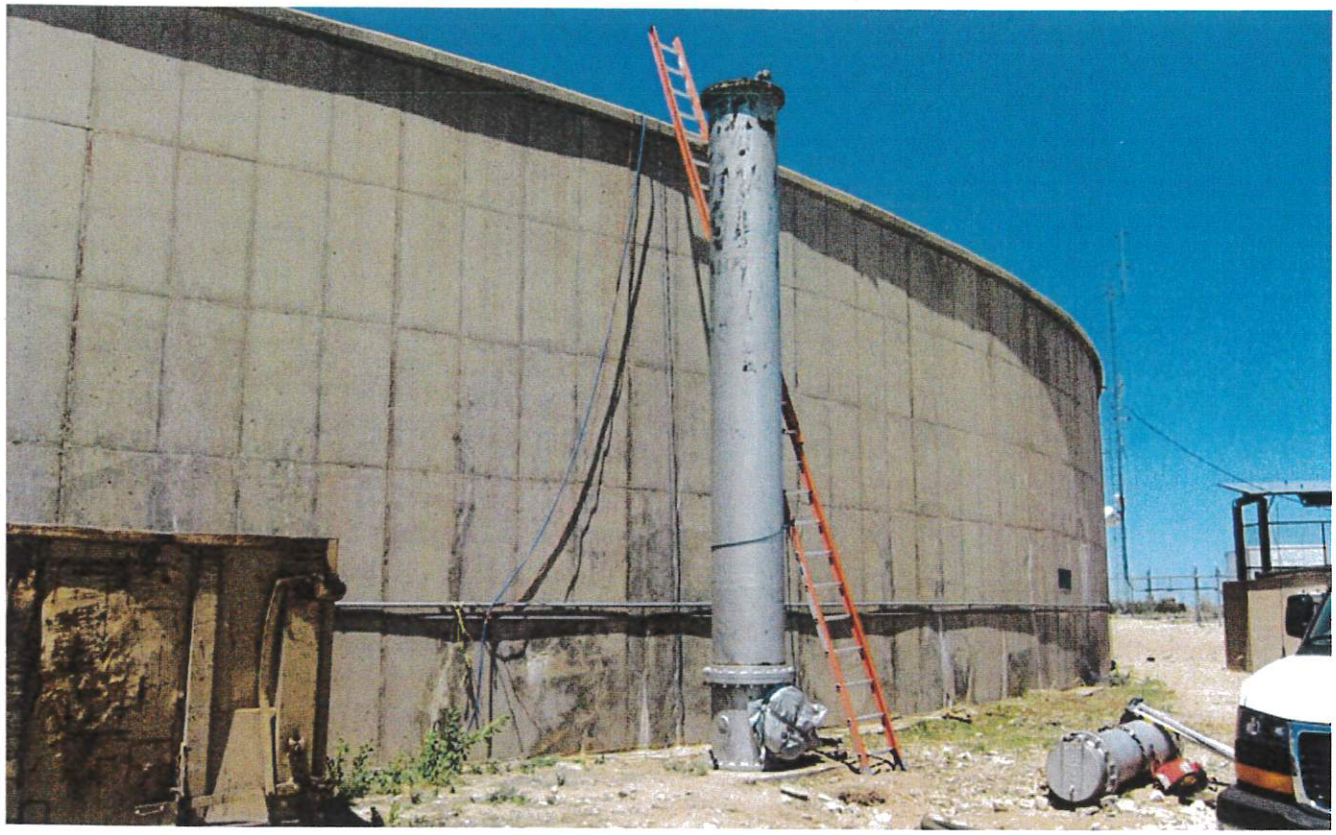


7. Overhead power lines attached to tank. Note valve vault adjacent to tank.

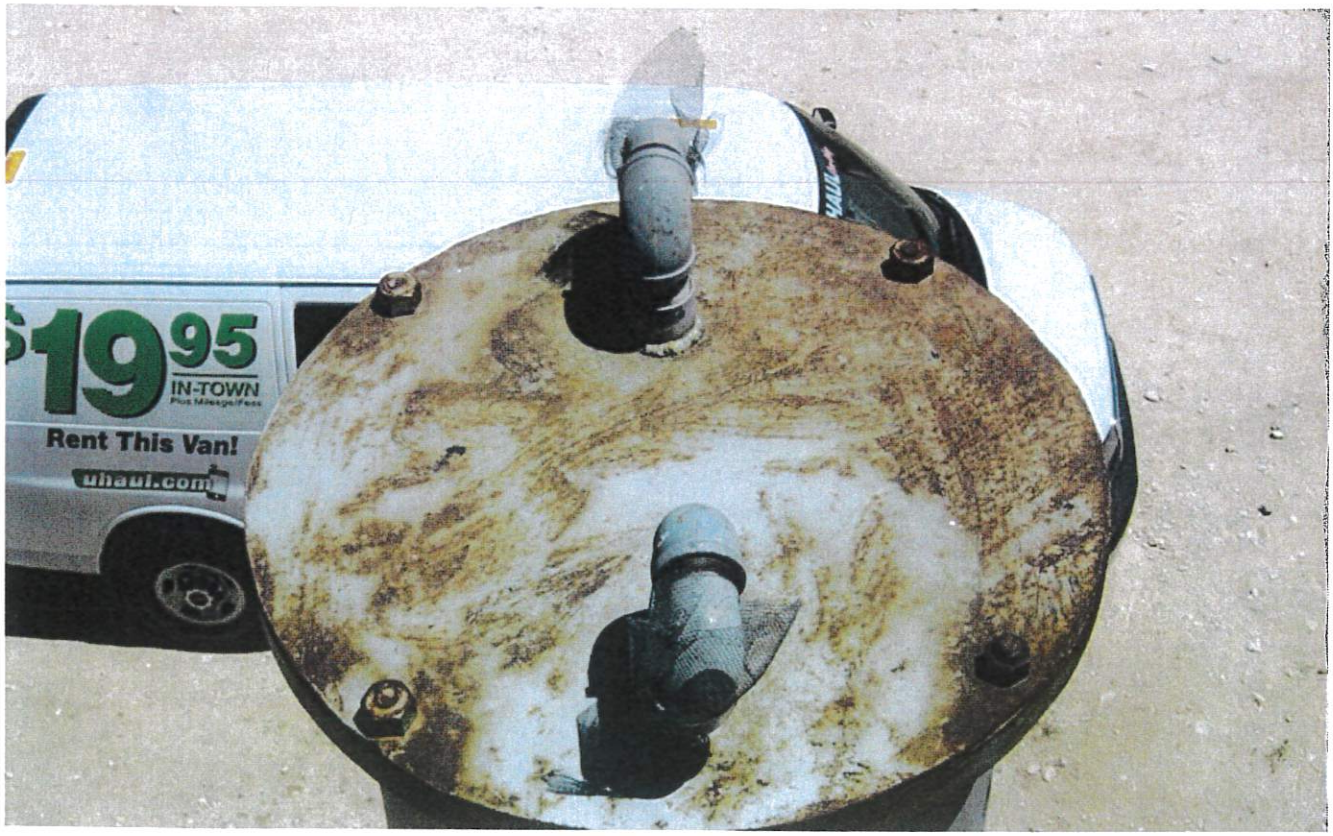
8. Valve vault.

9. Piping in valve vault. Note electrical wiring.

10. Sign on tank.

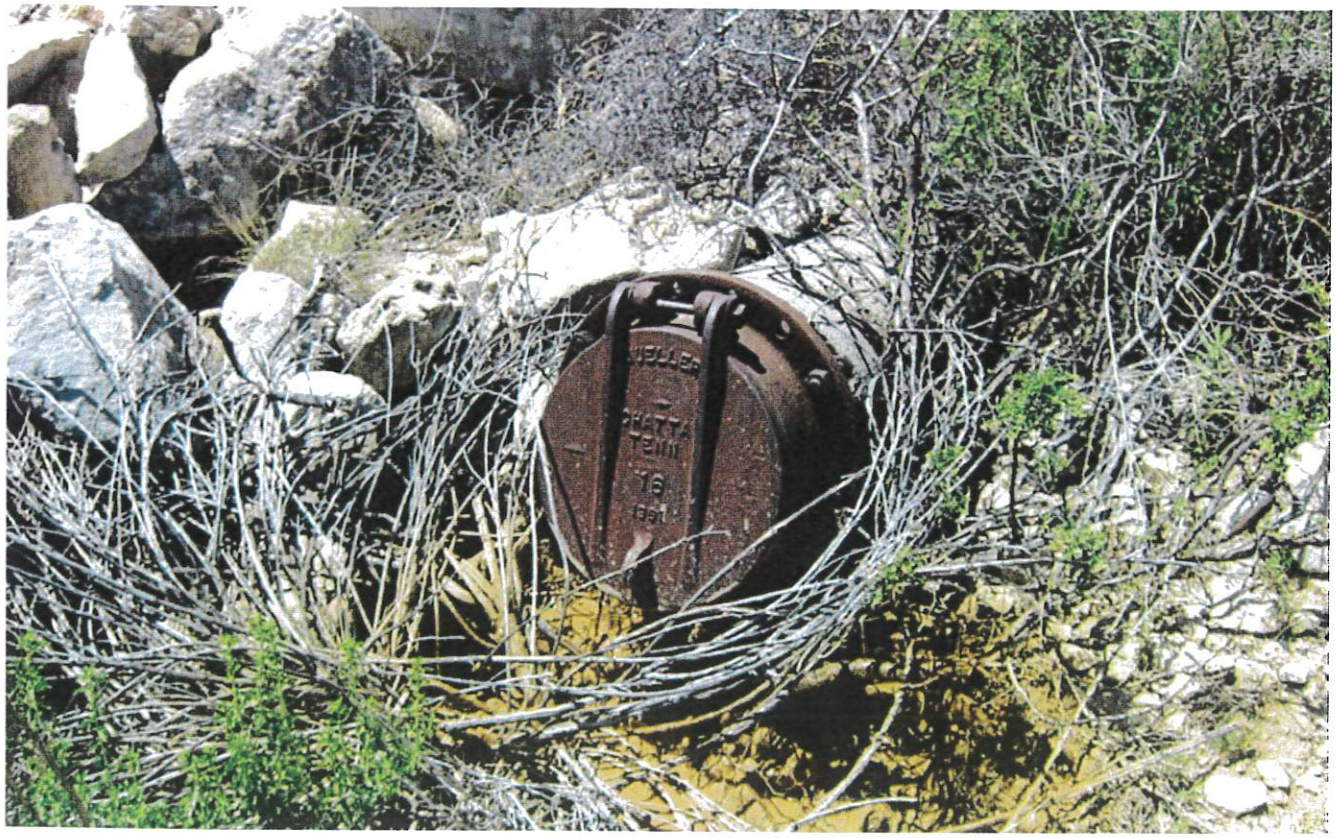


11. Overflow standpipe adjacent to tank. Note section of overflow pipe temporarily removed in order to access drain valve.



12. Screened vent pipes at top of overflow standpipe.

13. Section of overflow pipe temporarily removed in order to access drain valve.

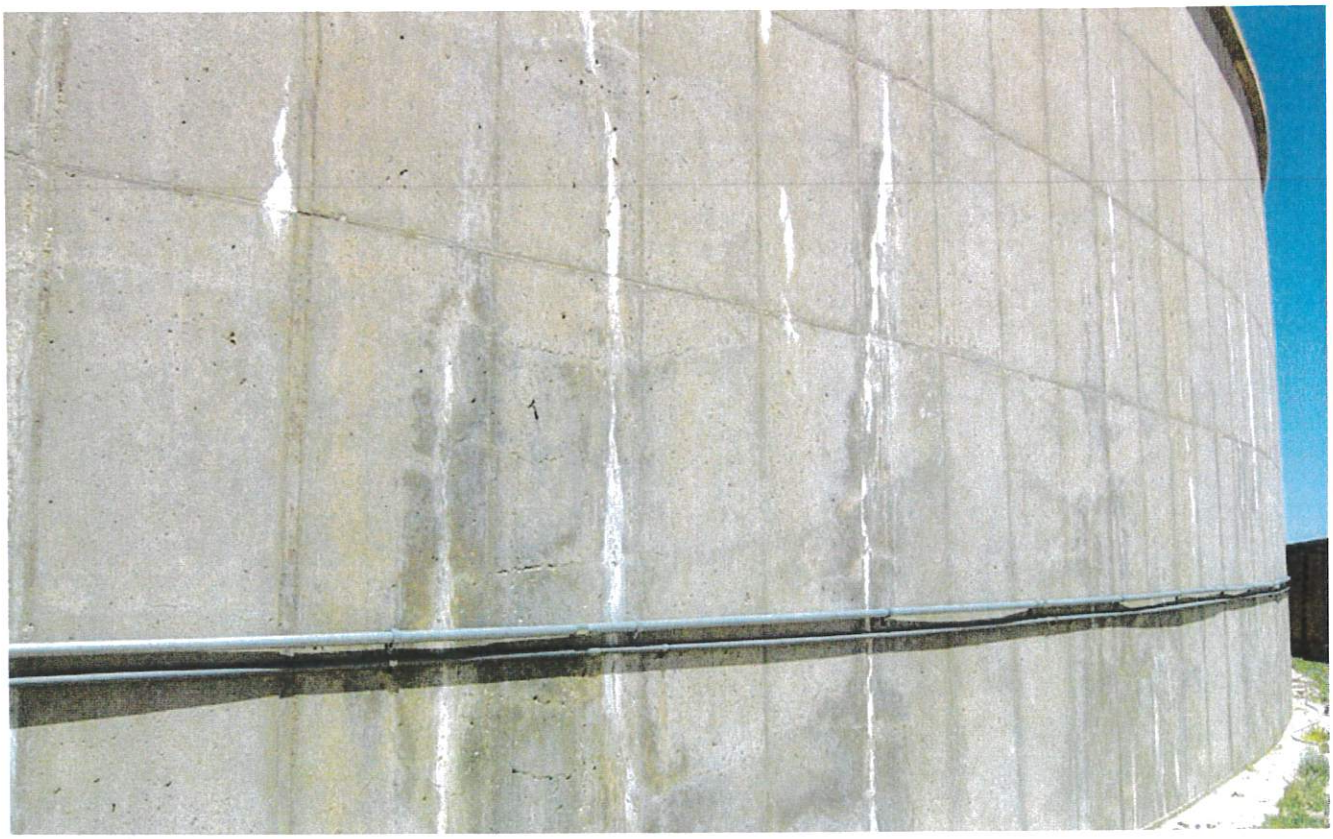


14. Flap gate at discharge end of drain pipe.

15. Concrete tank foundation.

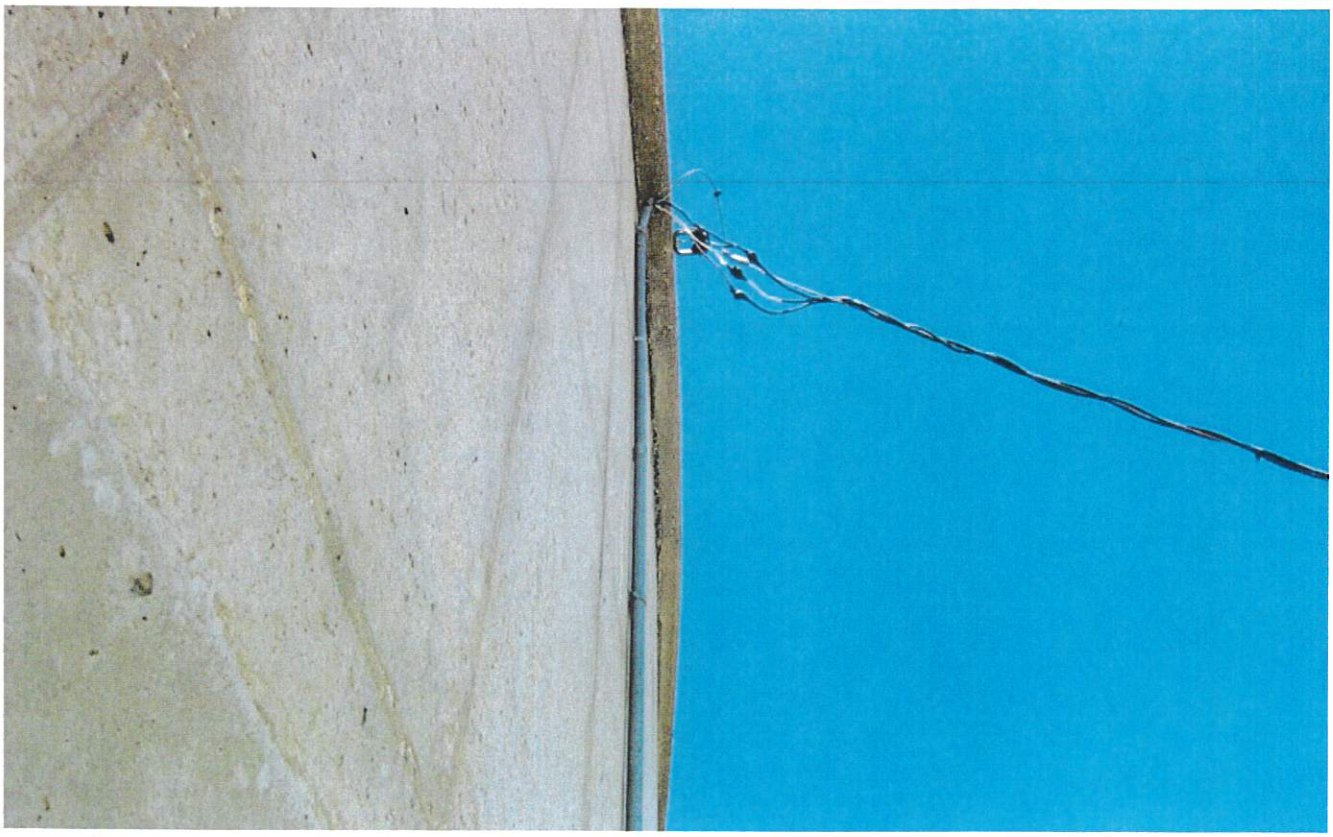
16. Concrete tank foundation.

17. Concrete tank foundation and conduits on concrete shell.



18. Conduits along concrete tank shell.

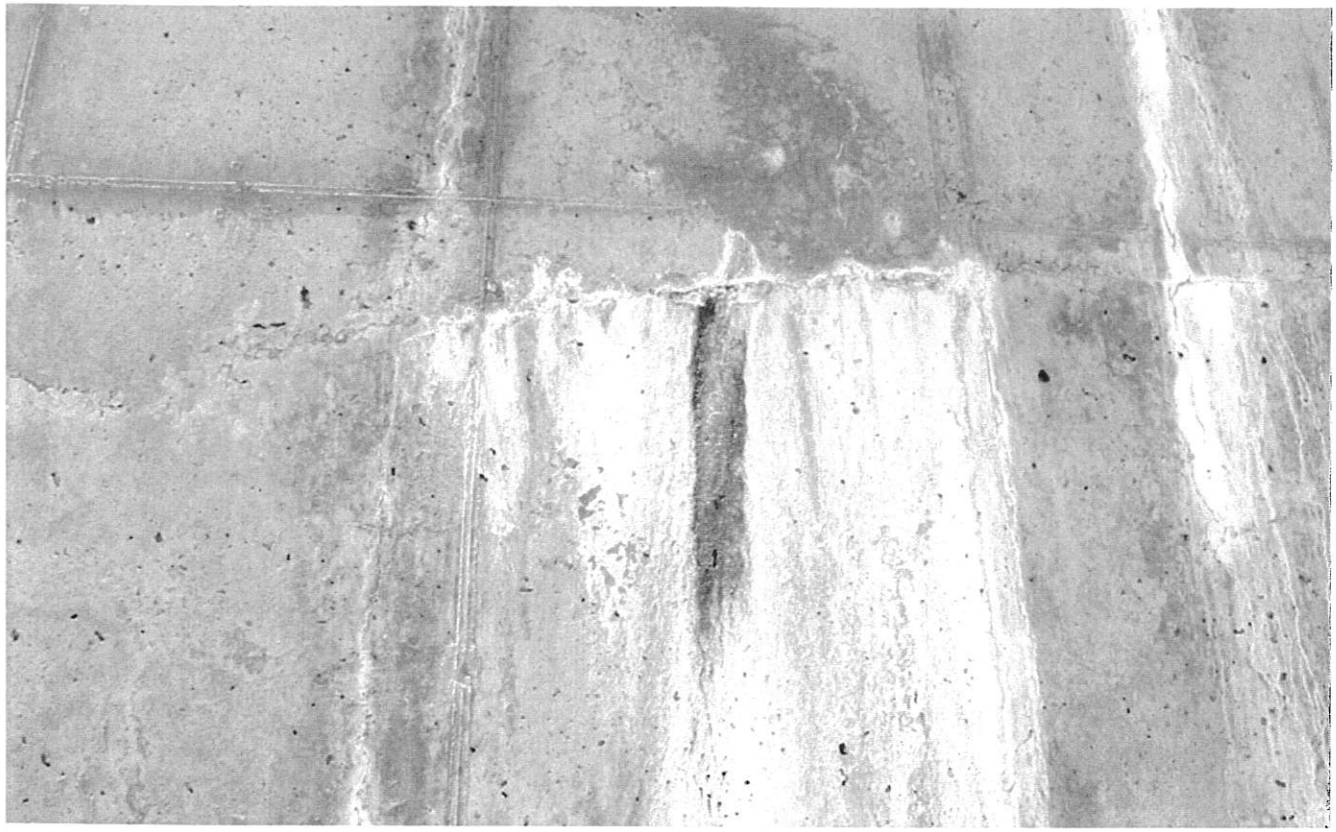
19. Conduits on shell.



20. Overhead power lines attached to tank.

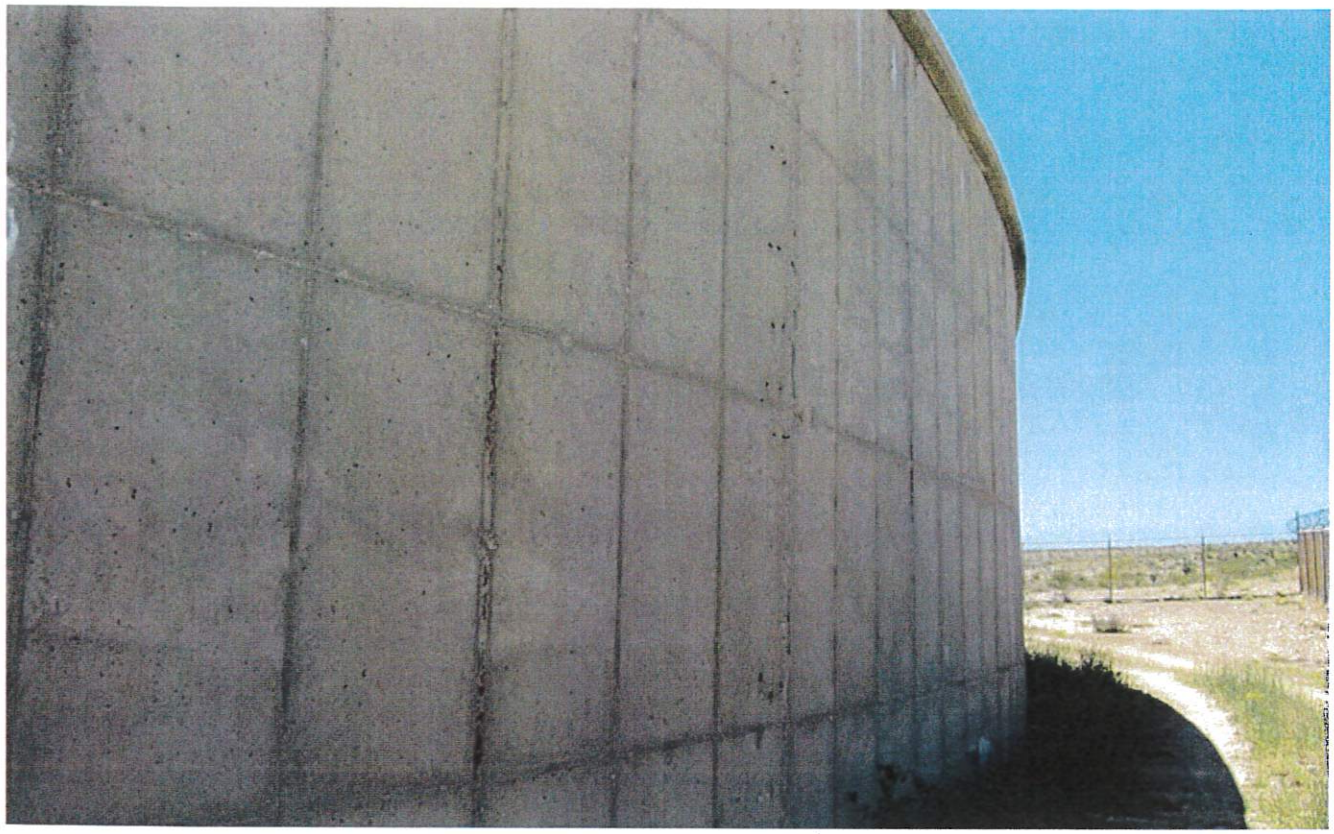
21. Cracks and efflorescence at bottom of shell.

22. Cracking in shell.



23. Crack in shell with efflorescence.

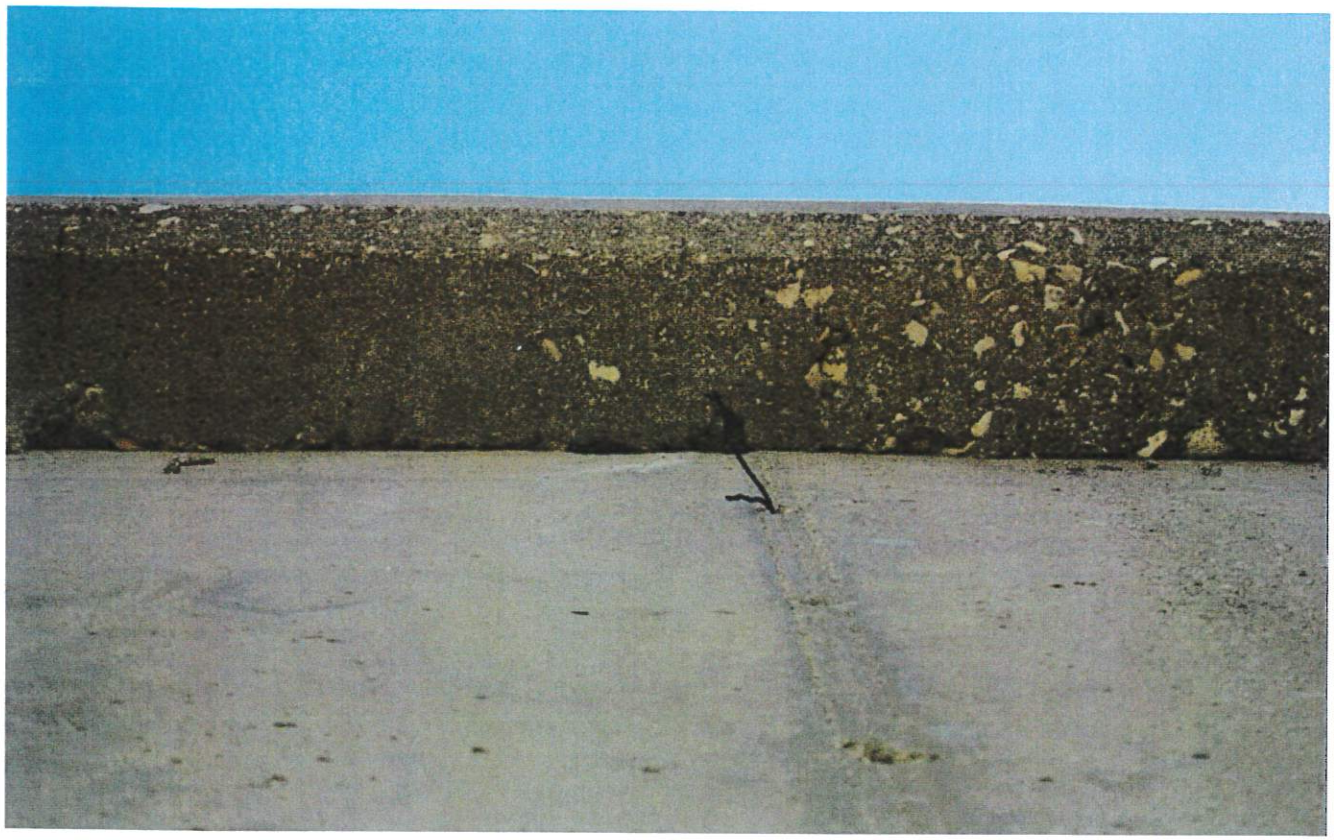
24. Exterior concrete shell.



25. Exterior concrete shell.

26. Exposed aggregate in shell.

27. Tie wires in shell.



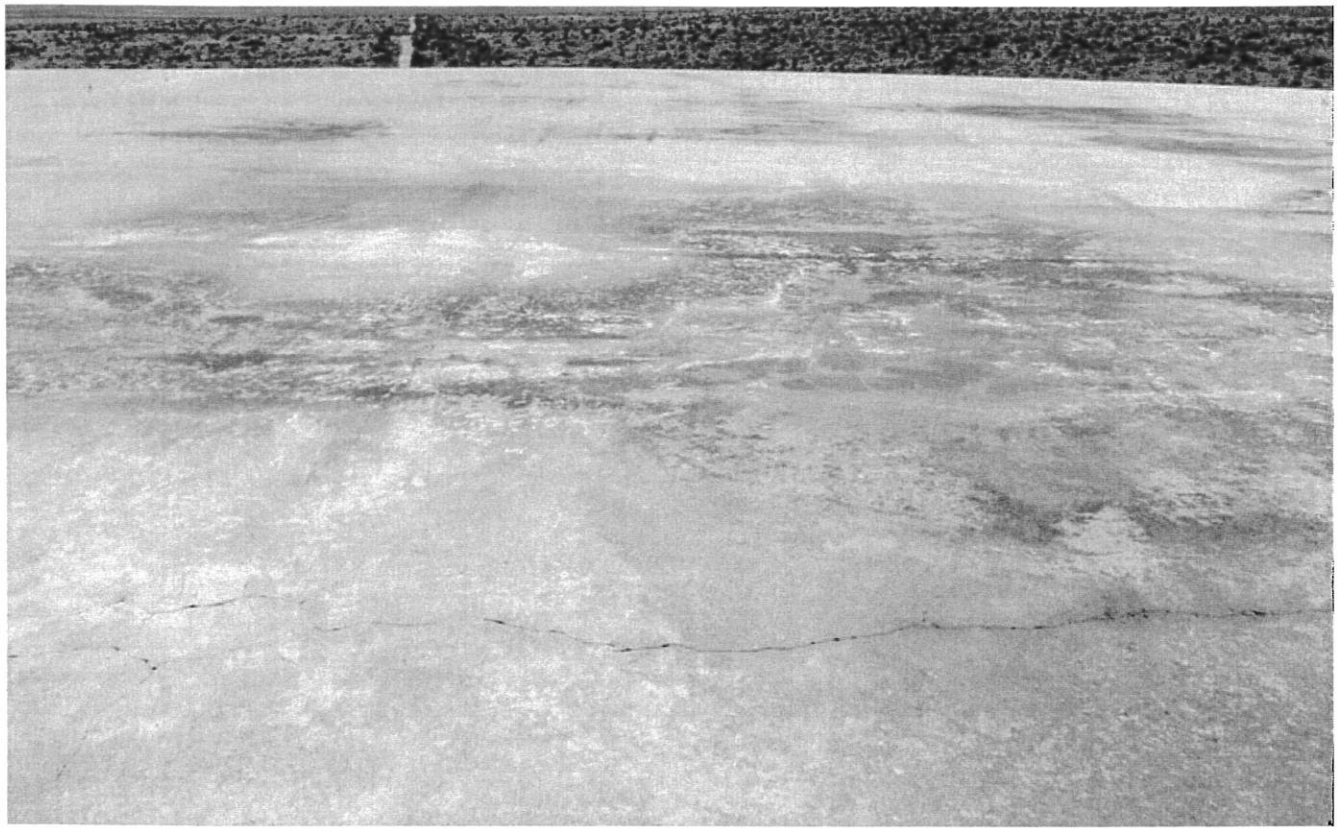
28. Tie wires at top of shell.

29. Roof perimeter.

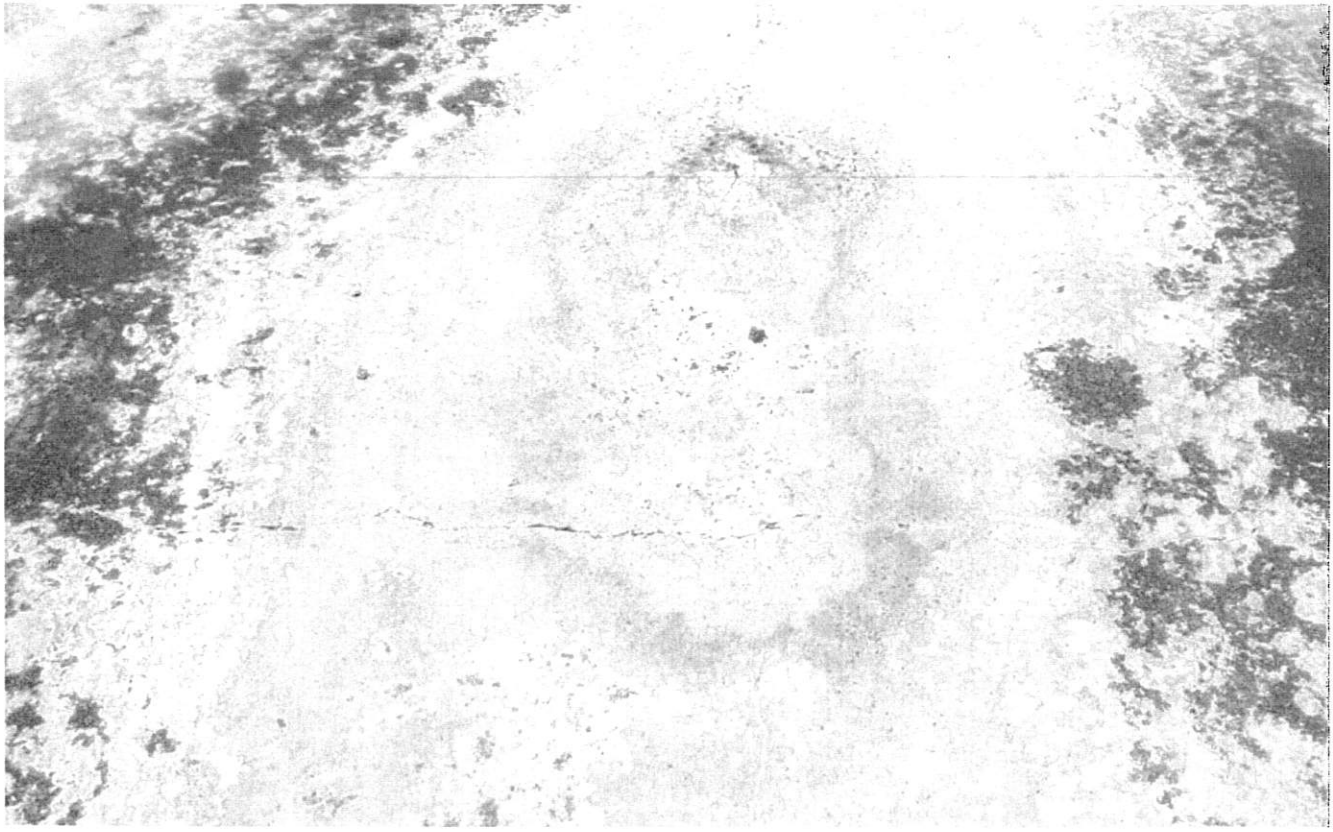
30. Chipped concrete at end of construction joint at roof perimeter.

31. Chipped concrete at end of construction joint at roof perimeter.

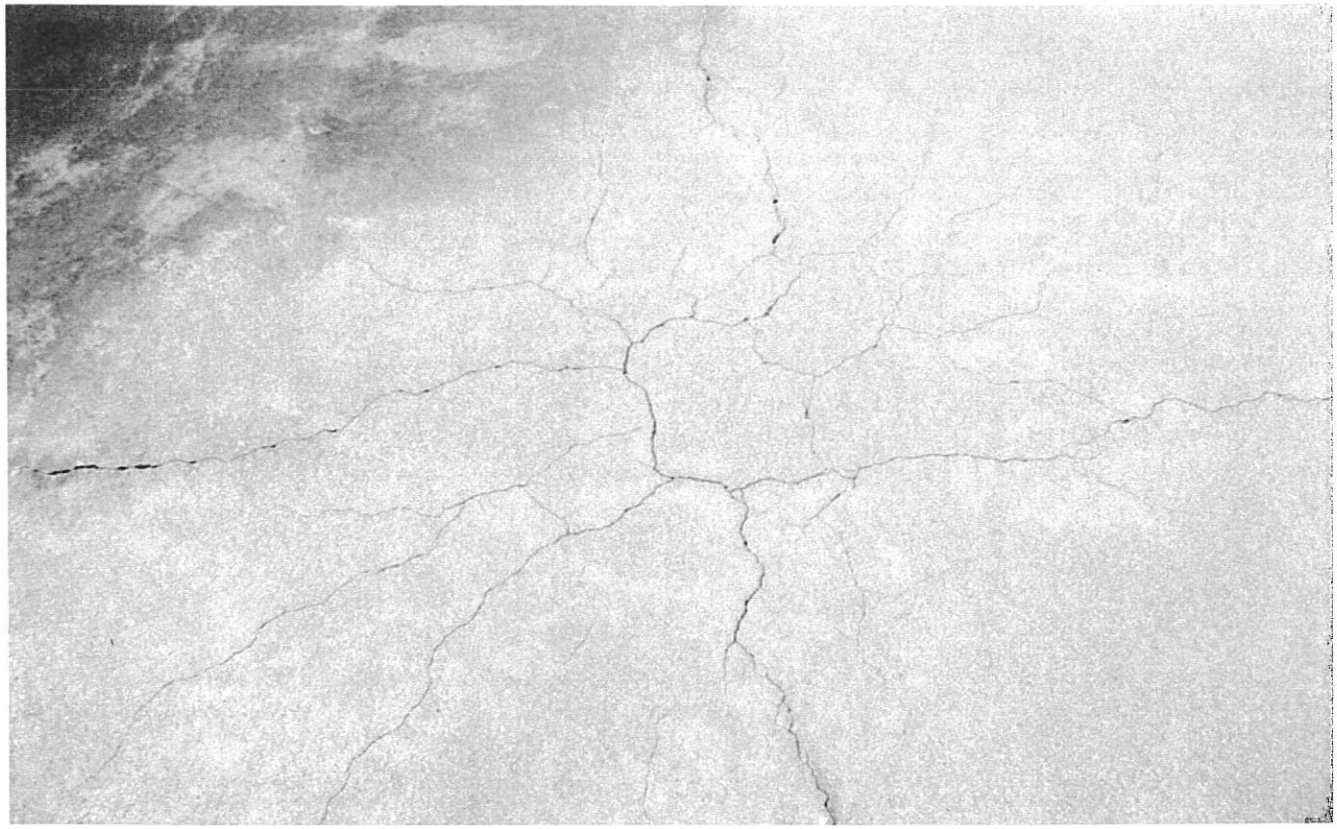
32. Exterior roof.



33. Exterior roof.

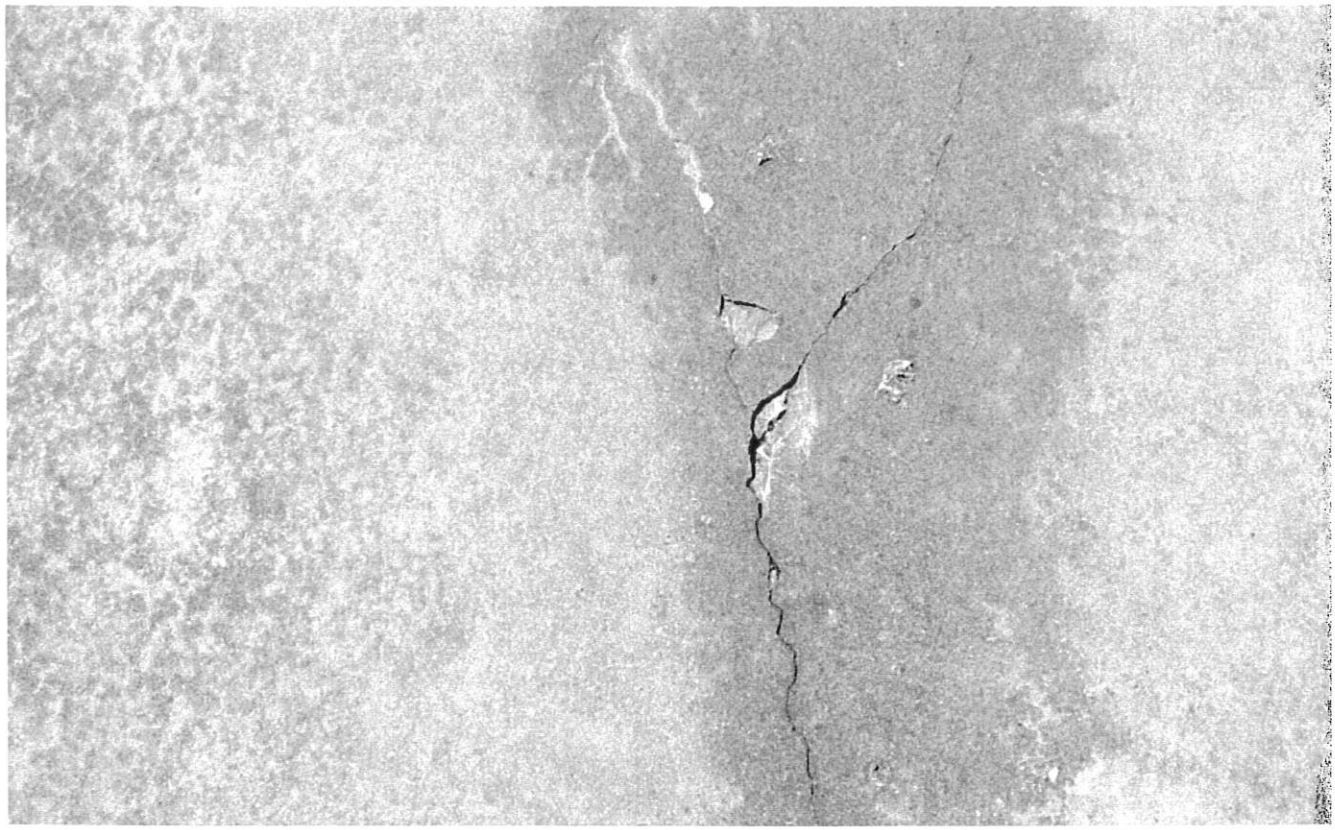


34. Evidence of ponding water on roof.

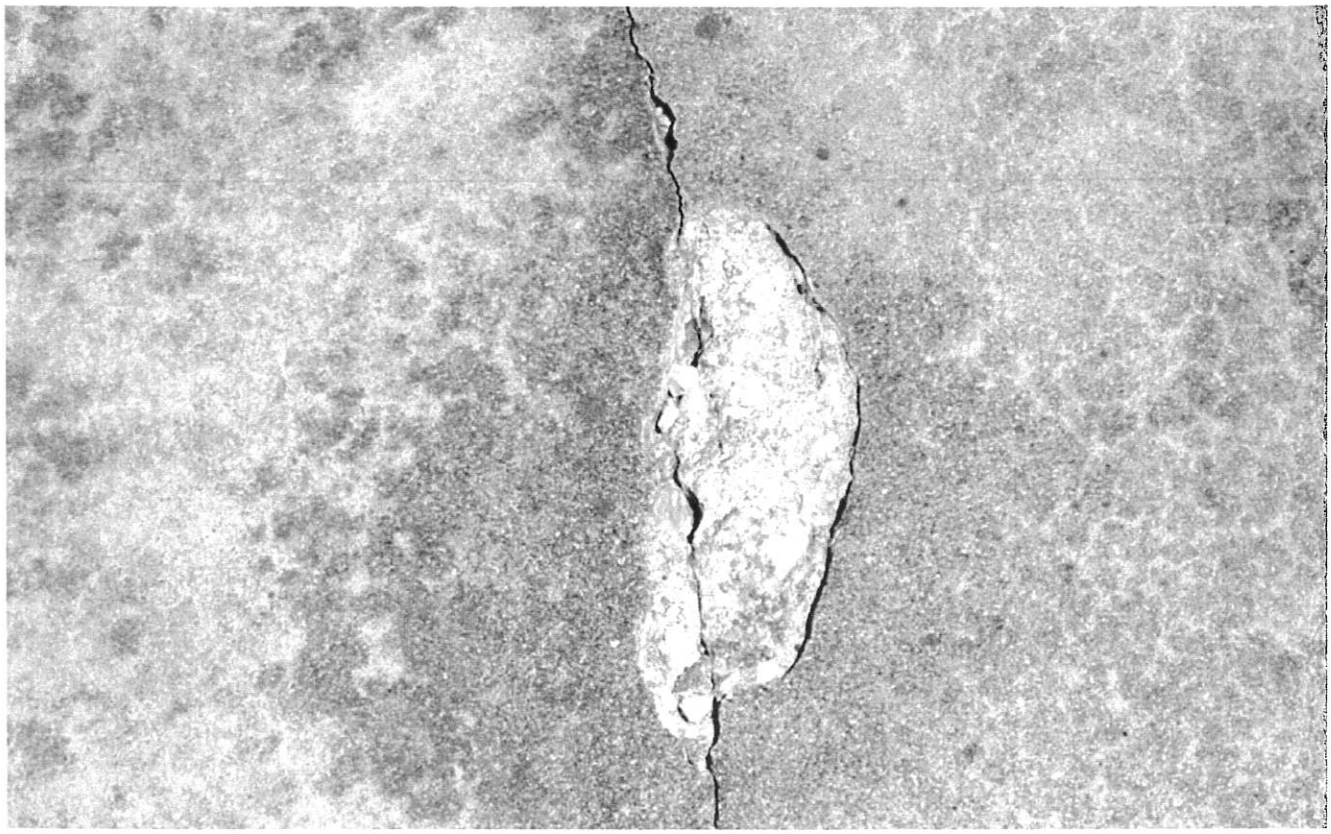


35. Cracks in exterior roof above apparent location of interior column.

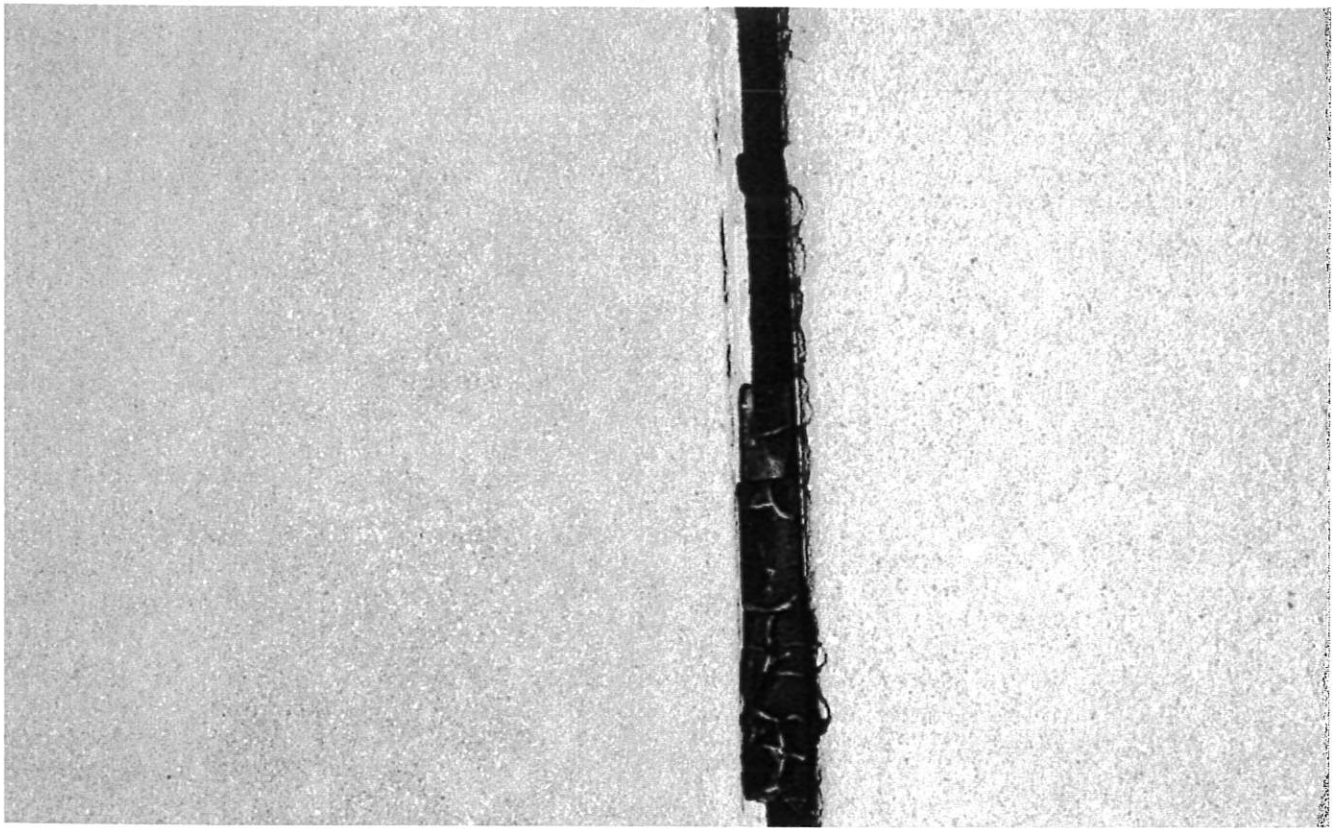
36. Cracks in exterior roof above apparent location of interior column.



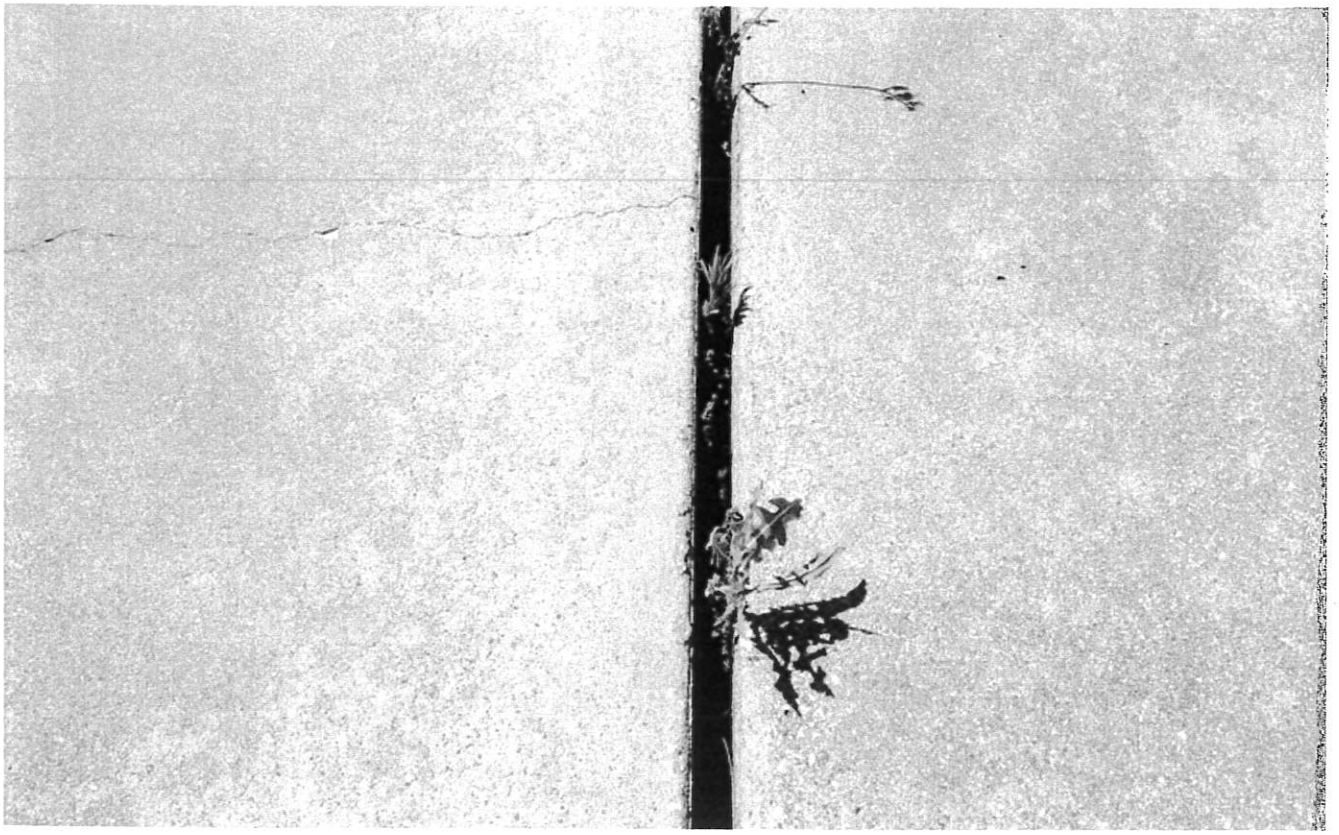
37. Crack in exterior roof.



38. Cracks in exterior roof.

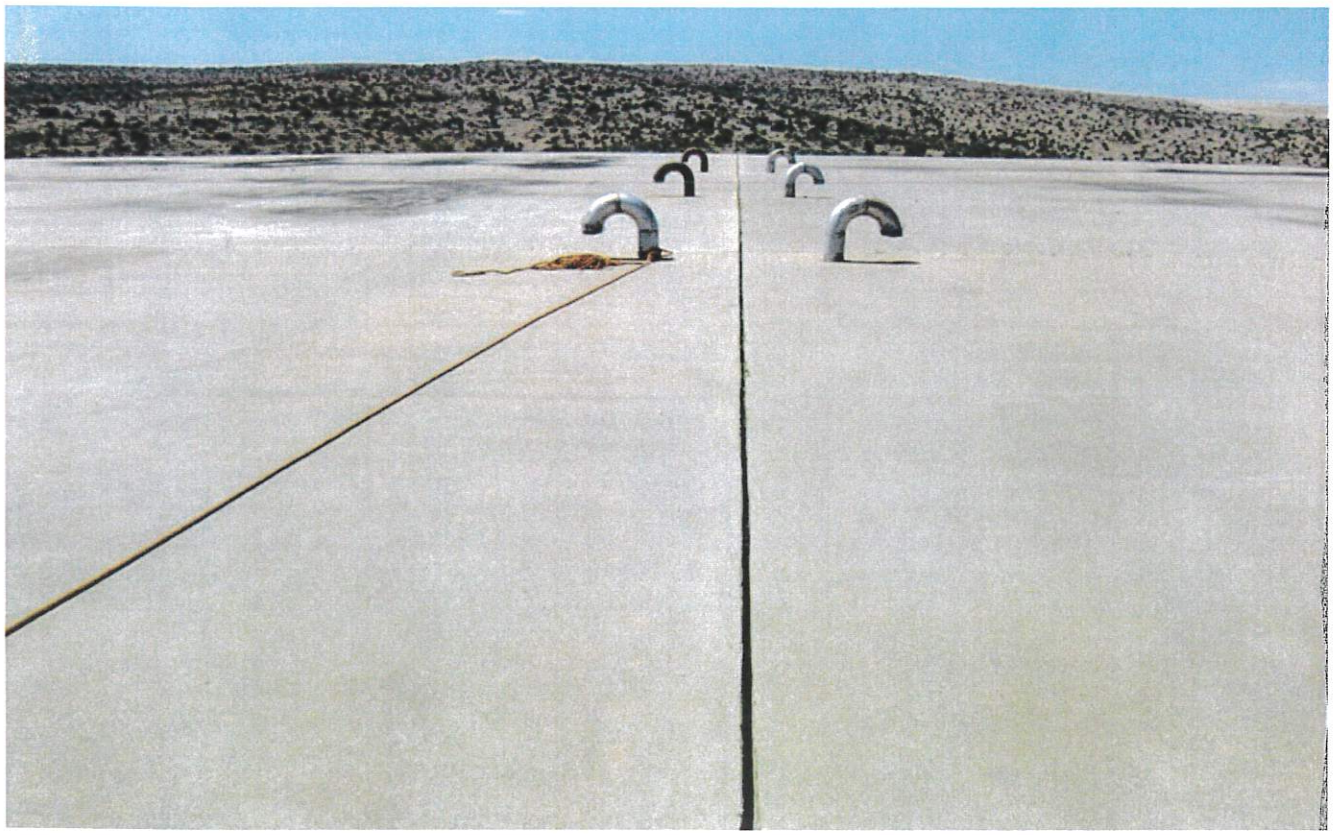


39. Sealant missing from construction joint in roof.



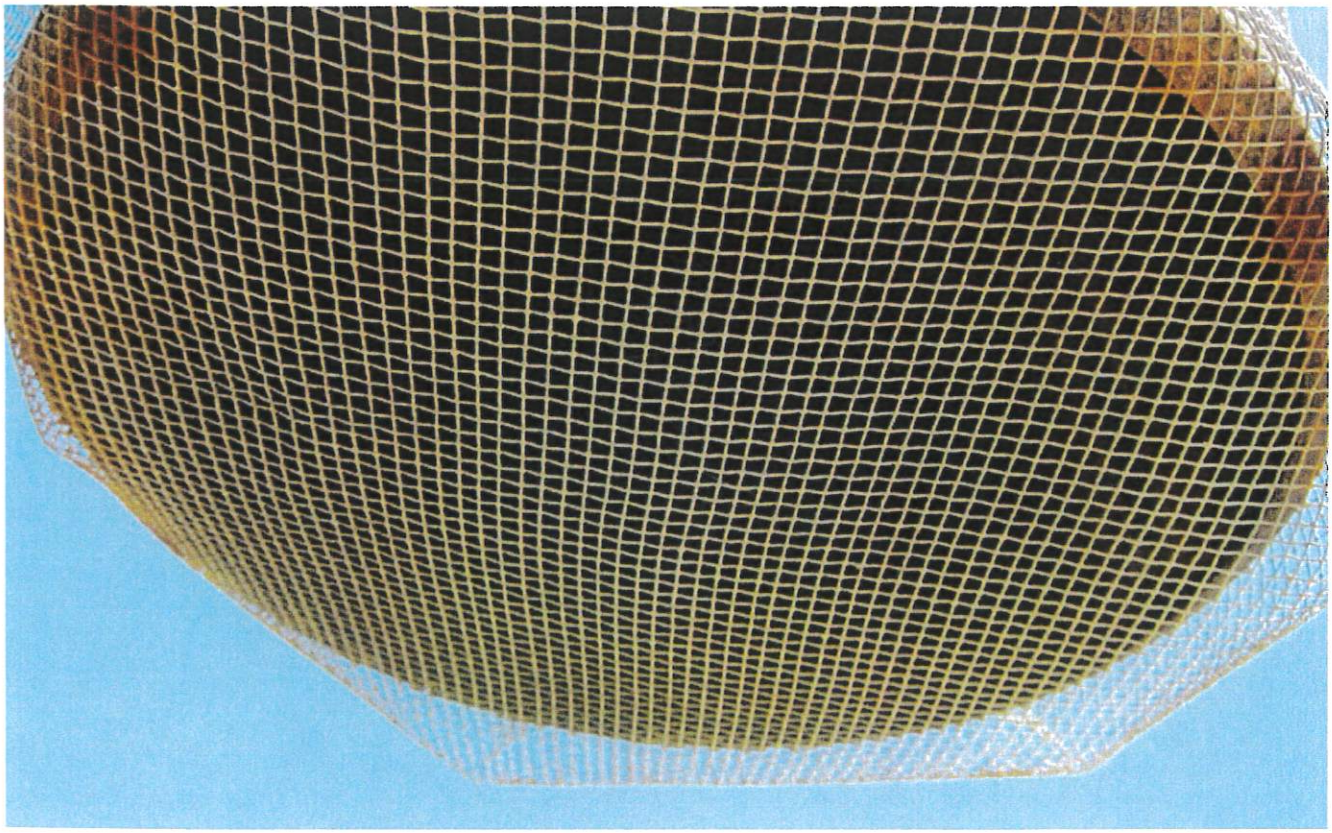
40. Vegetation in roof construction joint.

41. Vegetation in roof construction joint.



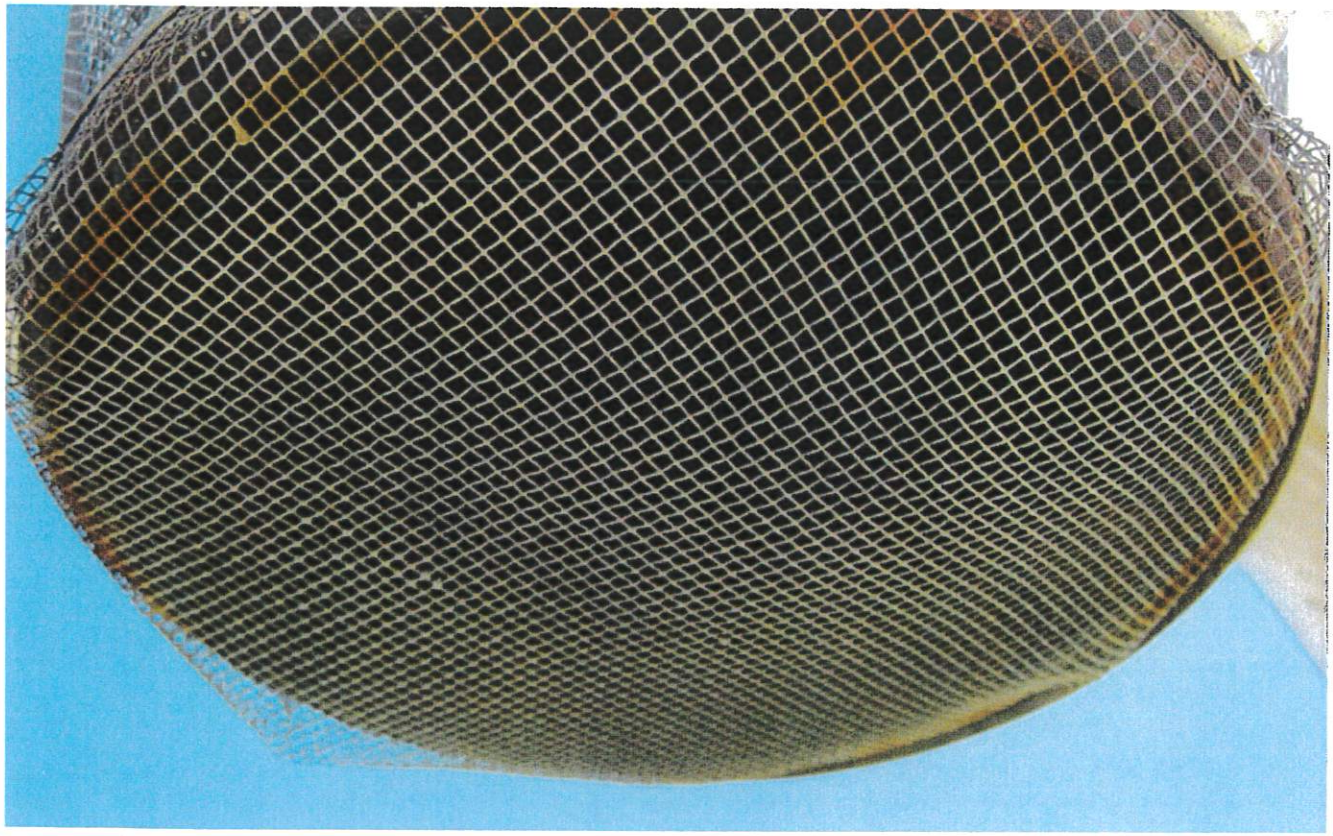
42. Gooseneck roof vents.

43. Gooseneck roof vent.



44. Gooseneck roof vent screen.

45. Gooseneck roof vent.



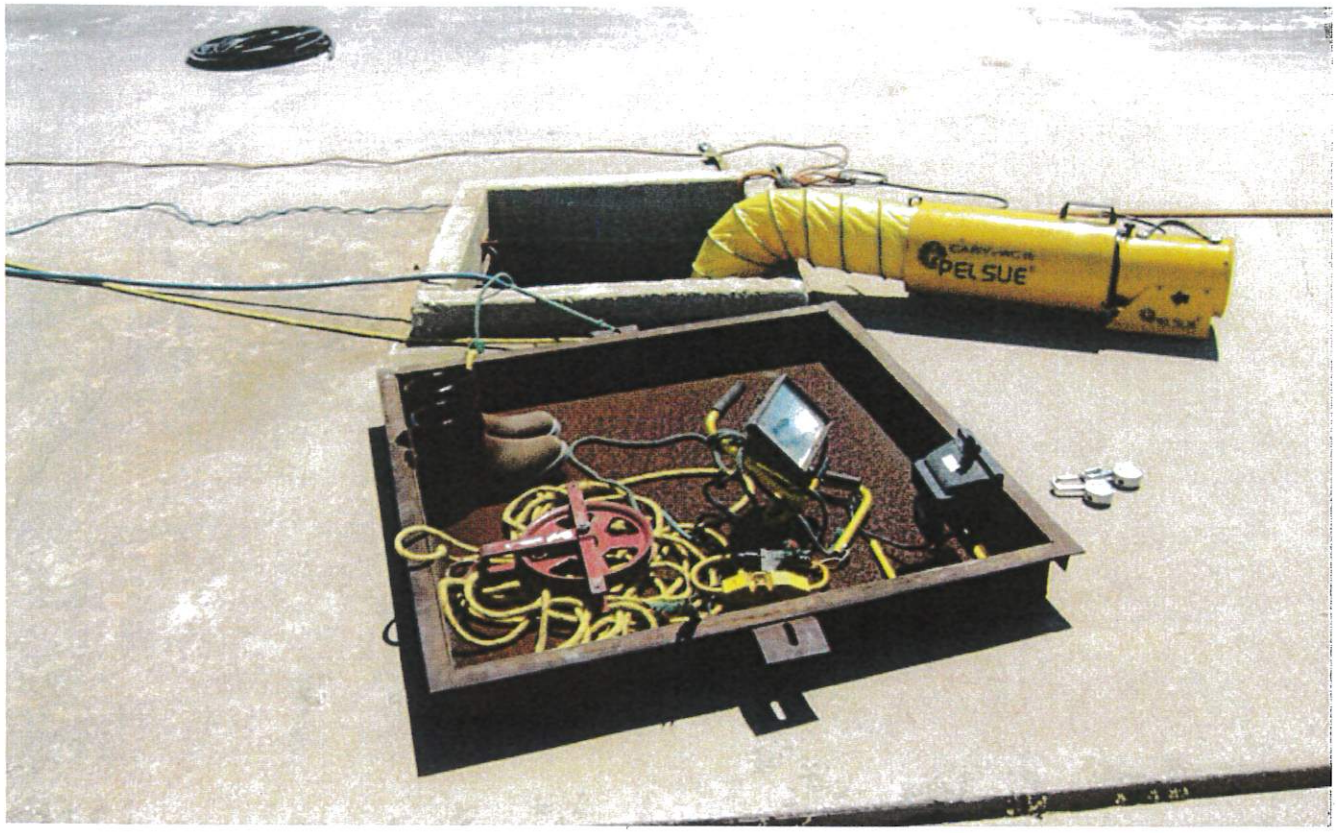
46. Gooseneck roof vent screen.

47. Gooseneck roof vent.

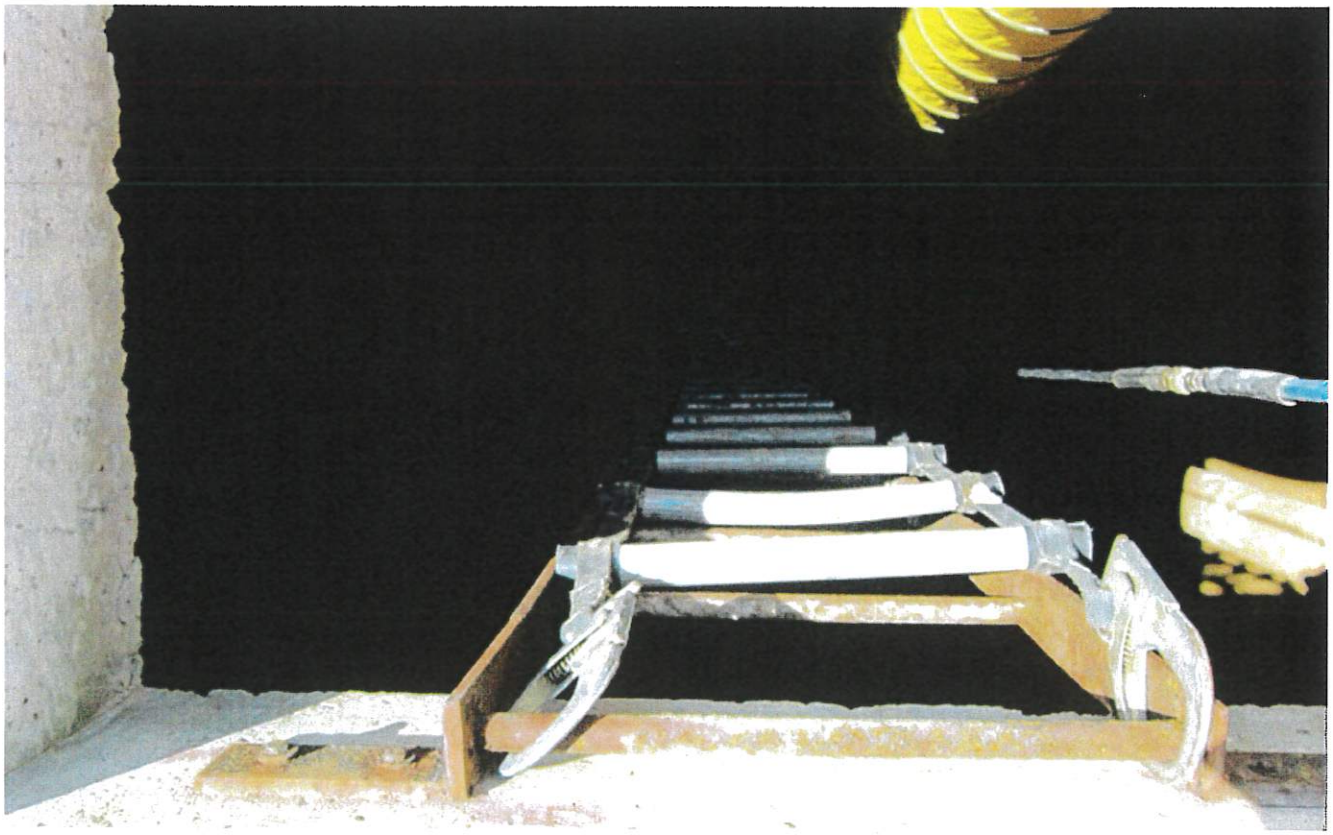
48. Gooseneck roof vent.

49. Gooseneck roof vent.

50. Gooseneck roof vent.

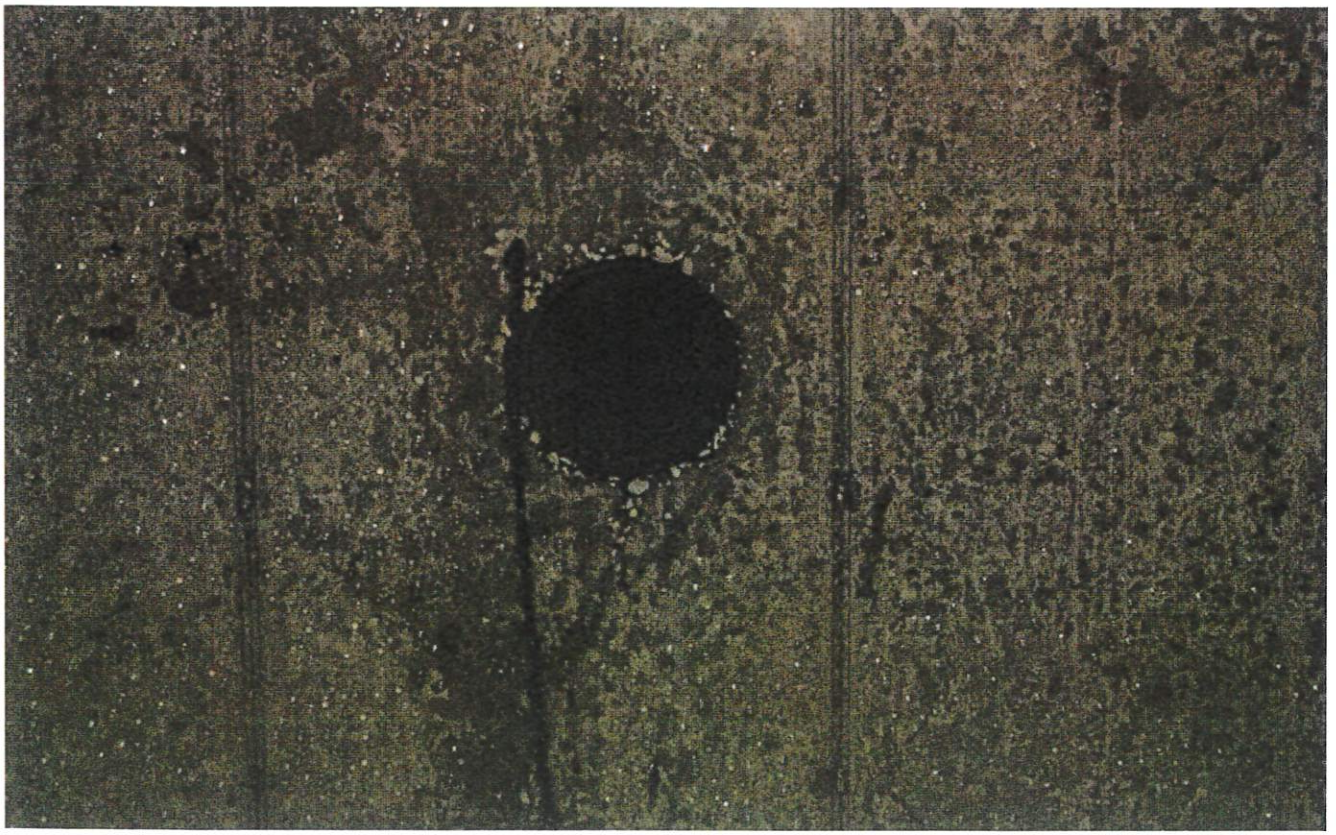


51. Roof manhole. Note rusted cover.



52. Interior ladder at roof manhole.

53. Corrosion and metal loss on interior ladder.



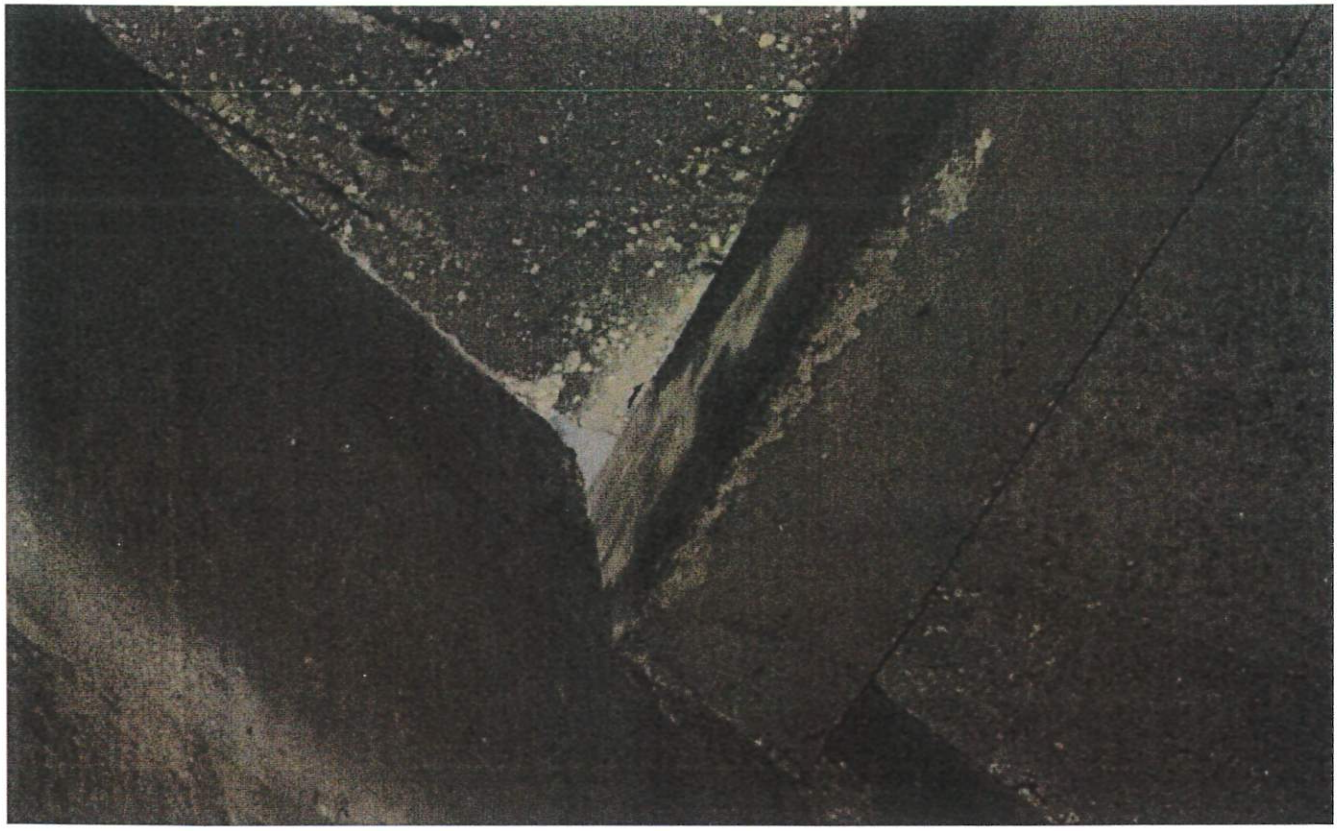
54. Interior roof at vent opening.

55. Exposed reinforcing bars in interior roof.

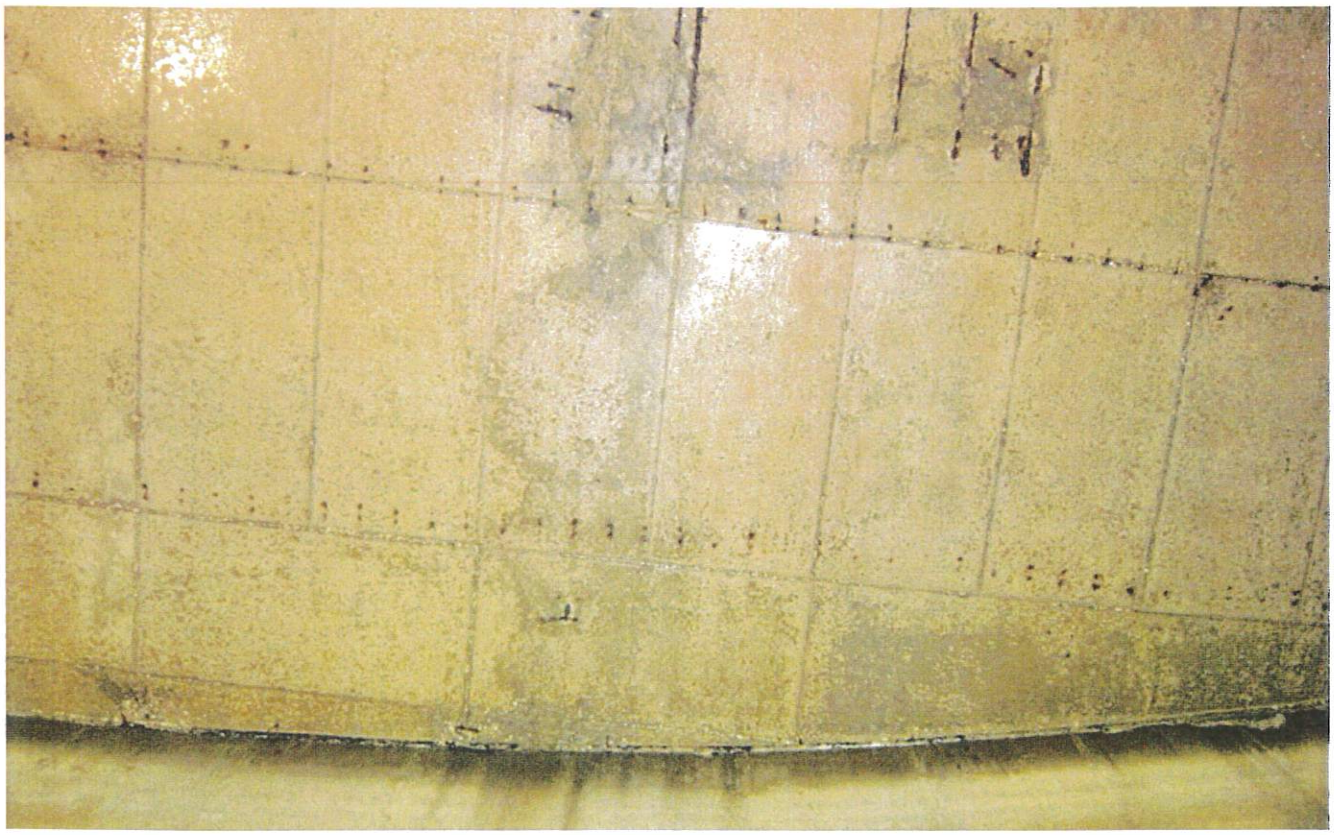
56. Interior roof and column.

57. Interior roof, beams, and column.

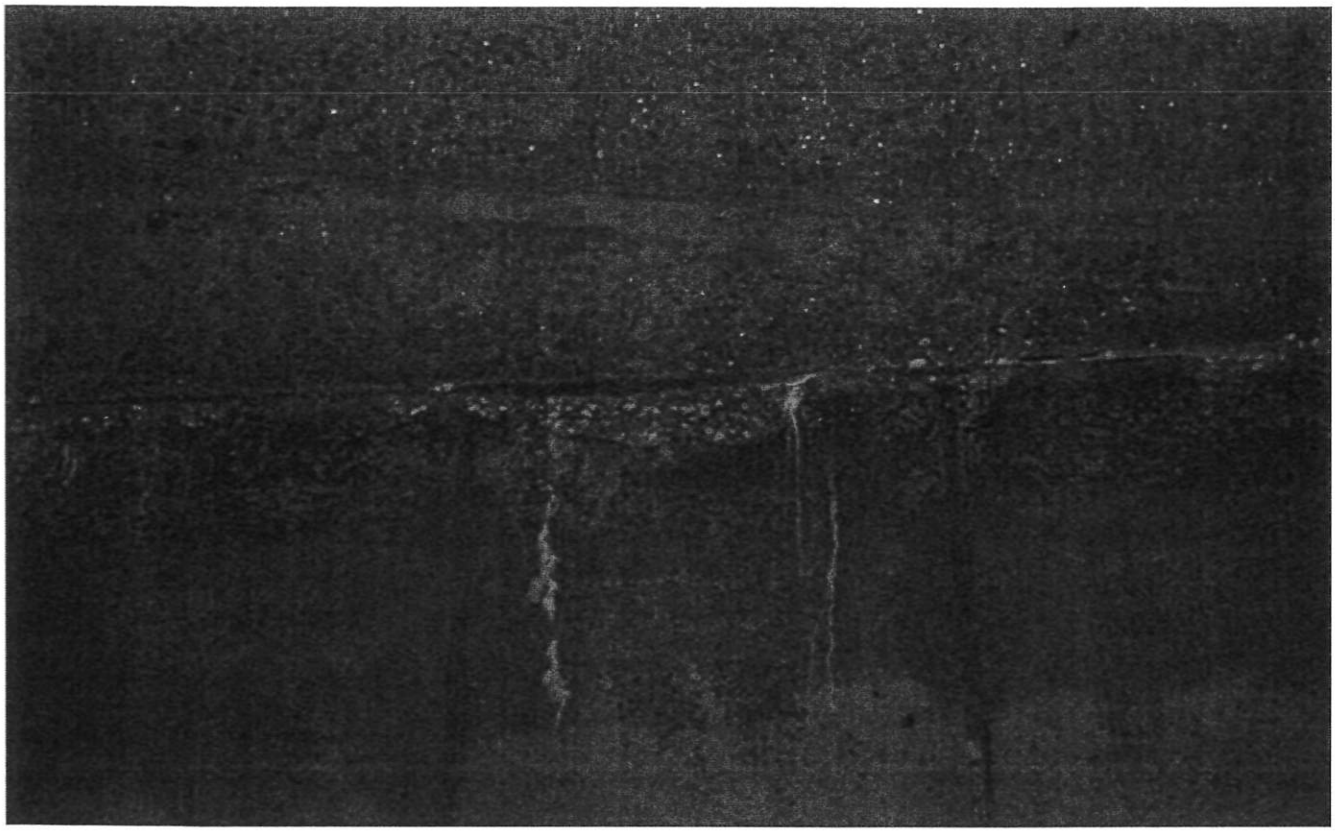
58. Interior roof beam.



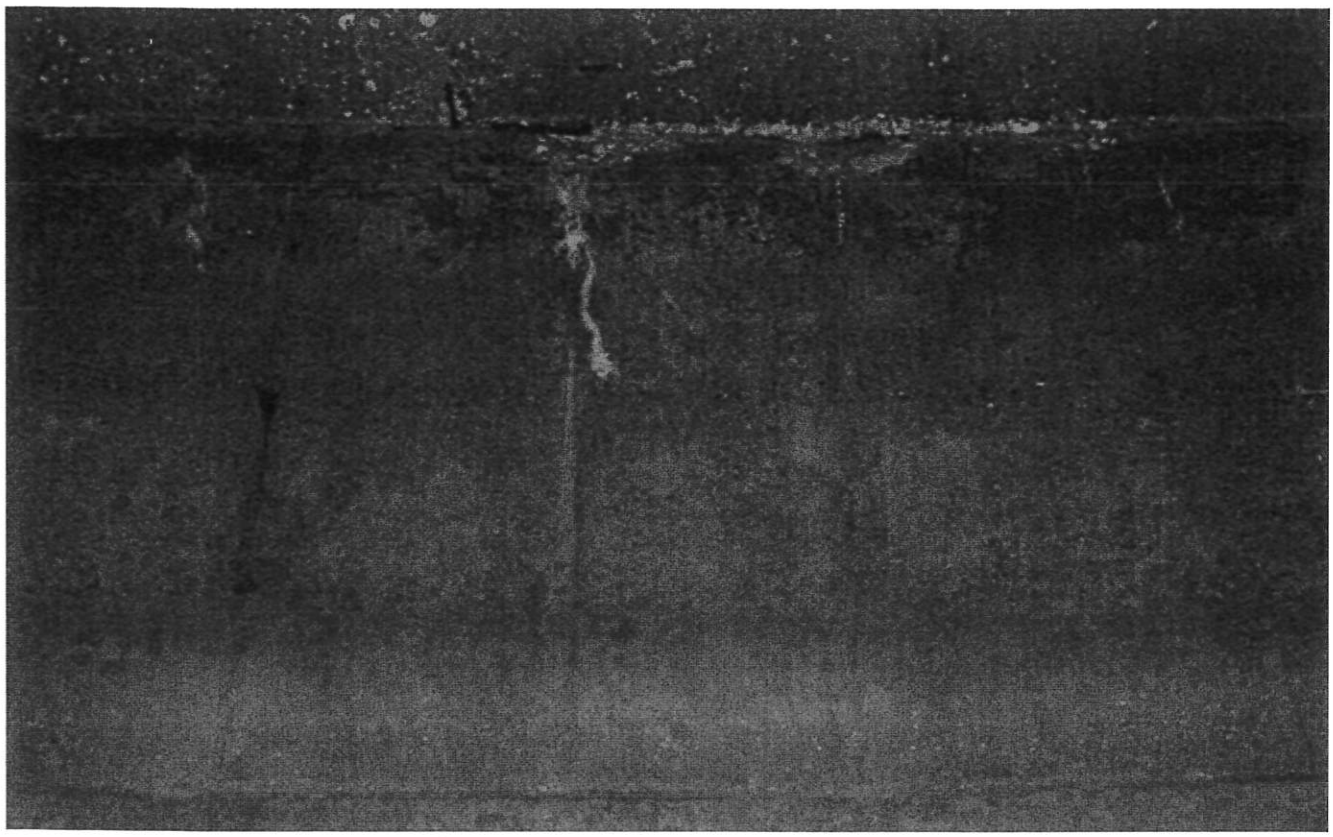
59. Interior roof beam.



60. Exposed reinforcing bars and tie wires in interior roof.



61. Spalled concrete at top of interior shell.



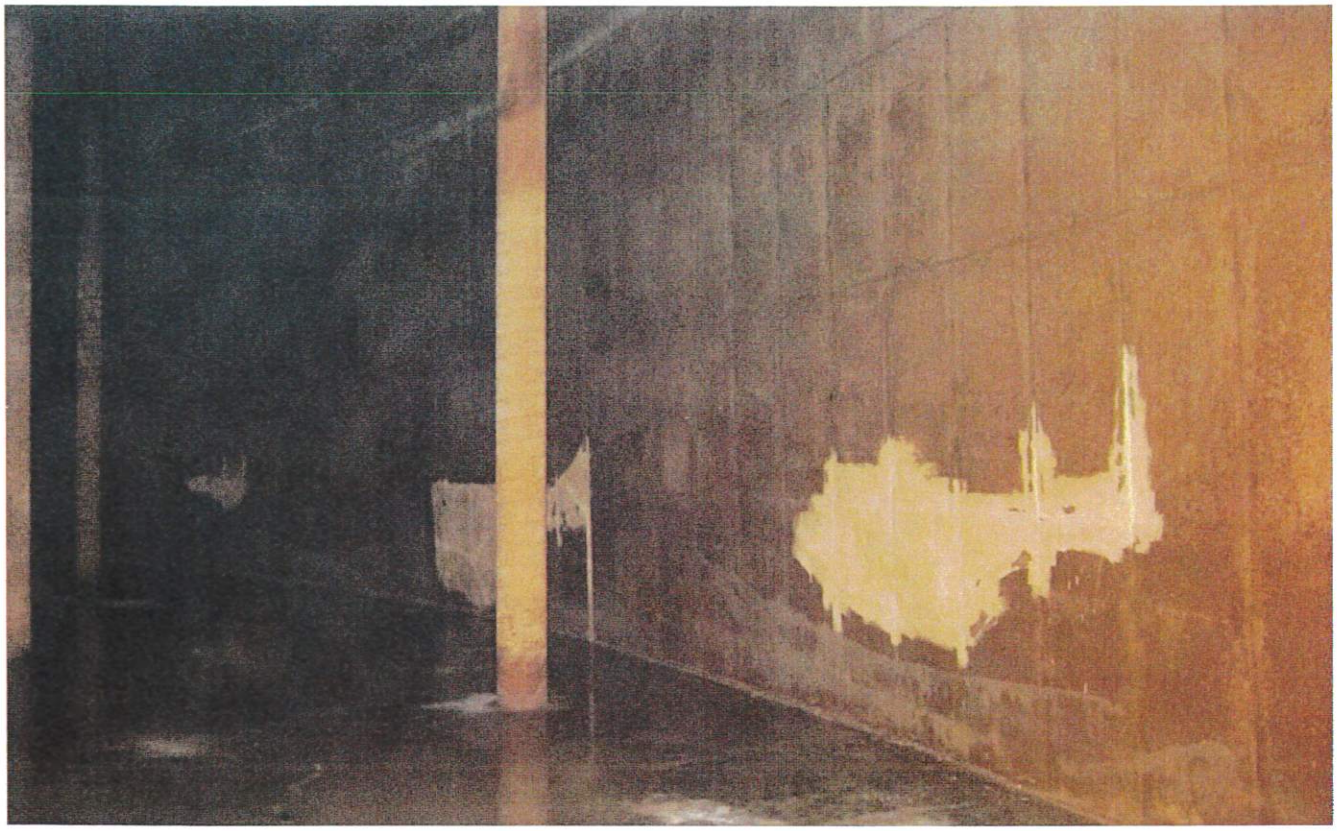
62. Interior shell.

63. Interior shell.

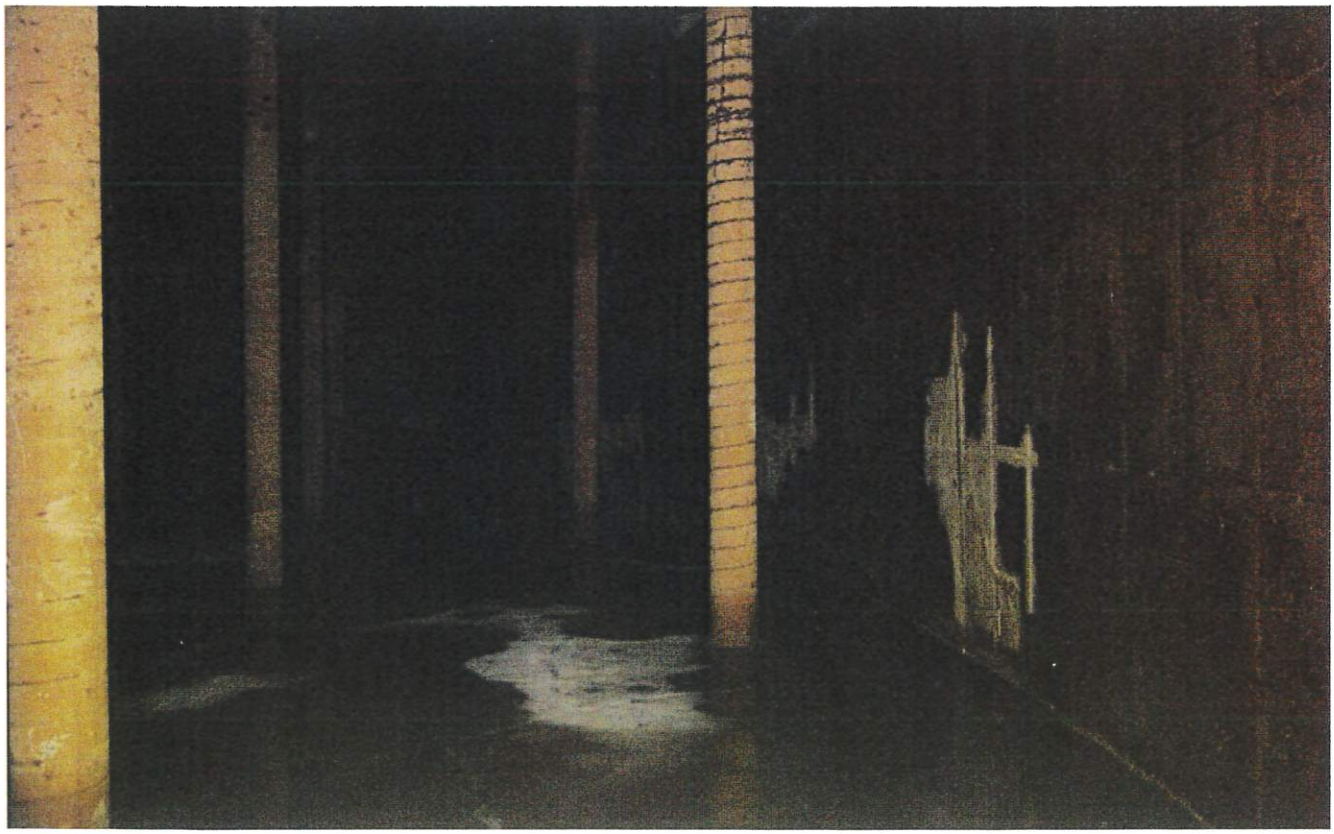
64. Interior shell.

65. Interior shell.

66. Interior shell and columns.



67. Interior shell, floor, and columns.



68. Interior shell, floor, and columns.

69. Interior floor and columns. Note cracking in floor.

70. Interior floor and column.

71. Interior floor and column.

72. Interior floor.

73. Interior floor.

74. Interior floor.

75. Interior floor.

76. Interior floor.

77. Abandoned tray located in tank.

78. Inlet pipe in floor of tank.

79. Outlet pipe in floor of tank.

80. Overflow/drain pipe in floor of tank.