



Campbell STRUCTURAL

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January 28, 2022

James Davey, PE
James Davey & Associates
1025 W 24th St.
Yuma, AZ 85364

Re: City of Somerton 1.0M Gallon Water Tank – Structural Review

Dear Jim:

Per your request we have prepared this report based on our field observations at the City of Somerton 1,200,000-gallon steel tank, located at 348 N. Somerton Ave. This tank is the southern most of the two existing steel water tanks. The installation date of this tank occurred between 1977 and 1979 according to the water tank construction drawings. The structural observation of the existing tank condition was performed upon request due to previously observed deterioration and corrosion of the tank. A copy of the *Ferguson, Morris & Simpson, Inc.* construction drawings dated May 1977 were provided for review in addition to a report dated November 7, 2015, prepared by *Pittsburg Tank & Tower Maintenance Co.* Site observations revealed significant deterioration at various tank structural components that require replacement and/or strengthening.

Description of Tank

The ground-supported flat-bottom, welded steel tank has nominal dimensions of 74'-0" $\varnothing$ x 32'-0" shell height. The tank name plate is missing from the tank.

The tank roof consists of steel roof plates—with lap seam edges—supported on a total of 36 equally spaced C shape steel rafters on the outer periphery of the roof and 18 C shape steel rafters interior of the roof. Six steel W wide flange beams support the outer and interior C rafters at $\approx$ 20 ft. from the center column. The 18 interior rafters span from the center of tank column to the wide flange beams and the 36 outer rafters span from the wide flange beams to the inside face of the steel shell. The six wide flange beams are supported by six round pipe columns.

The total height of the tank shell is 32'-0", and it is fabricated with four-8'-0" tall courses of steel plate. All shell plate joints are butt welded joints.

TANK SHELL PLATE SIZE

Course #	Height above Floor	Thickness Measurements
1	0'-0" – 8'-0"	0.535"
2	8'-0" – 16'-0"	0.425"
3	16'-0" – 24'-0"	0.283"
4	24'-0" – 32'-0"	0.288"

The 6" $\varnothing$ center support pipe column is supported on a 32" square baseplate over the steel floor plate. The six 6" $\varnothing$ support pipe columns located 20 ft. from the center column also bear on a 32" square baseplate of the steel floor plate.

The floor plate is a lap seam steel plate.

Ferguson, Morris & Simpson, Inc. construction drawings indicate the tank is supported on a reinforced cast-in-place concrete ring wall, compacted granular base course. The tank is an unanchored tank; the tank to ring wall has no positive anchorage.



Location Plan from Google Maps

The American Water Works Association (AWWA) AWWA D100-11 classifies water tanks into Seismic Use Groups (SUG) for the purposes of seismic design and requirements. SUG requirements, particularly requirements pertaining to freeboard, are recommended to be addressed during the tank strengthening and repairs. Freeboard is defined as the distance from the maximum operating level to the lowest level of the roof framing. This will involve, as a minimum, lowering the tank overflow lip in combination with adding to the top shell course height.

Observations

On December 1, 2021, a site visit was performed by Robert L. Campbell, P.E., S.E. and Emmanuel Jimenez of *Robert L. Campbell Structural Engineer, P.C. (RCSE)* in preparation of this report. Chris, Project Manager and a number of employees from *Superior Tank Solutions (STS)* were also present during the site observations. Field measurements were obtained during a non-destructive visual observation of the cleaned and drained tank. STS was on site and provided the confined space entry safety watch in addition to assistance with moving the scaffolding located inside the tank.

Note, a significant area of the tank was off limits to access due to safety issues regarding the failed roof purlins. Our observations were limited to roughly one-half of the tank area.

- Tank Roof and Columns:
 - The observed corrosion on the steel roof plate, steel channel rafters and wide flange beams has progressed to the extent of causing failure of the roof structure. In several locations, the steel channel rafters have failed and are dangling from one end, flanges on all channel rafters and wide flange beams are corroded to the point of delamination.
 - The steel channel to perimeter tank shell connection is corroded beyond structural serviceability and the perimeter steel angle at the top of the tank shell is delaminated due to the corrosion.
 - The steel bearing plate at the top of columns, which supports the wide flange beams, is corroded with delamination.
 - Similar to the outer steel shell, the interior pipe columns are corroded at the normal operating water elevation.
 - Modification of the overflow elevation to provide a positive freeboard space is recommended.
- Tank Shell:
 - Approximately 27" down from the top of the upper shell course, which coincides with the normal operating water elevation, the steel shell is deteriorated from a 0.25" thick plate to 0.143" thick and in one observed location the corrosion extends through the entire plate thickness. This upper section of the tank shell will require replacement.
- Tank Floor:
 - Blisters in the tank floor plate coating were observed with some surface corrosion on the steel shell. The depth of this corrosion appears to be fairly superficial but shall be verified after the floor plate coating is removed and the steel is cleaned.
- Tank Foundation:
 - The cast-in-place ring foundation appears to be in relatively good condition at the areas observed. For the most part, the ring foundation is covered by a layer of asphalt and soil. The presence of this asphalt layer is creating a trap for moisture and an invitation for corrosion along the bottom perimeter of the tank.
 - Epoxy injection is recommended where the concrete is cracked to eliminate moisture and salts from penetrating the cracks causing corrosion and further cracking.

- The concrete retaining walls around the overflow and drain box are corroded beyond epoxy repair and replacement of this upper portion of concrete is recommended.

Results of Field Observations (Recommendations)

The following minimum structural repairs and strengthening to the tank are recommended based on the field observations:

1. The roof structure shall be replaced in its entirety. This includes roof plate, rafters and beams.
2. The steel pipe columns, base plates and top of column plates shall be replaced.
3. The shell plate at the top of the tank shall be cut at approximately 36" below the top course. Final confirmation of 36" shall be determined after the tank coating and steel surface is cleaned. New shell plate shall be welded to the existing cut plate. Replacing the 36" of removed plate with 48" tall plate will help with providing additional free board.
4. The floor plate shall be cleaned and inspected for significant corrosion.
5. The asphalt covering the base of the steel tank shall be removed and positive water drainage shall be provided away from the tank shell.
6. Cracks in the foundation concrete ring wall shall be filled with pressure injected epoxy.
7. Replace the damaged concrete retaining walls at the overflow & drain box.
8. Various non-structural deficiencies shall be repaired and addressed. The non-structural deficiencies are not included in the scope of this structural report. Reference is made to the report prepared by STS.

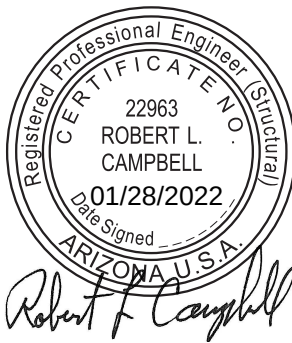
Conclusions

In summary, it is our opinion the existing corrosion and failed structural members has rendered the tank unusable. It is our recommendation this tank either be repaired as noted in the recommendations or replaced.

Appendix A contains photographs showing the typical damage, failures and overall tank.

The opinions and comments in this report are based on visual observations and measurements. OSHA, architectural, mechanical, electrical and plumbing conditions are not included in this report and no warranty expressed or implied as to the condition of the structure is intended. This report is limited to the previously identified scope.

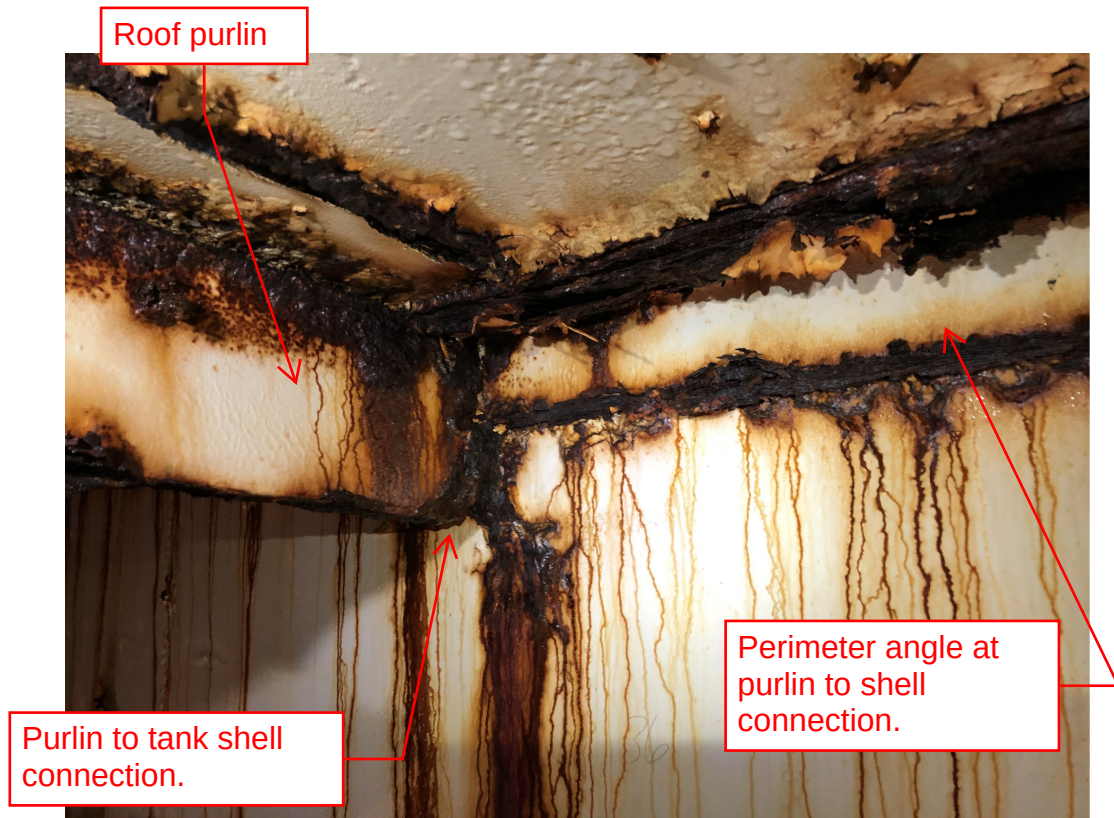
Sincerely,



Robert L. Campbell, P.E., S.E.

APPENDIX A
PHOTOGRAPHS



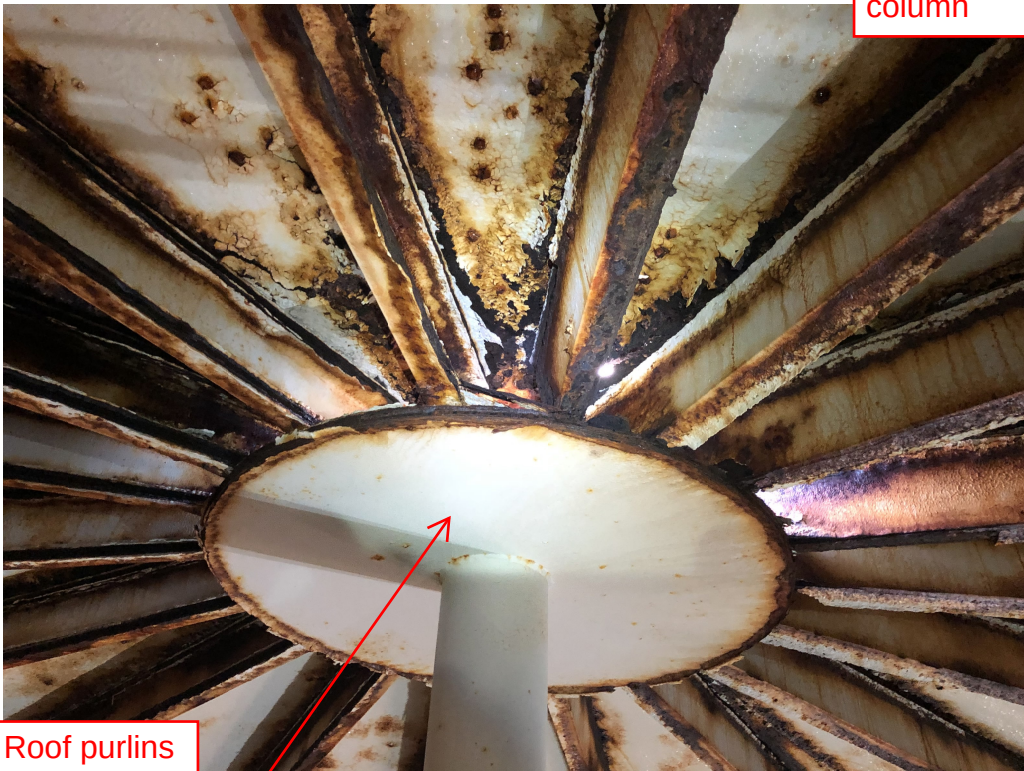




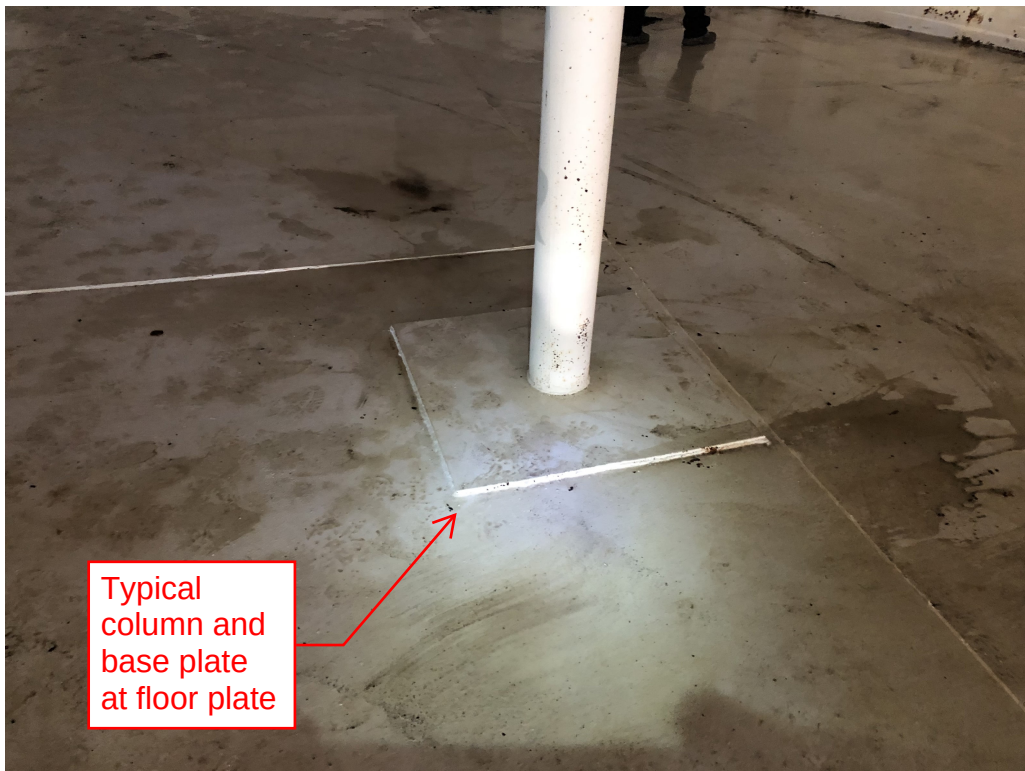


Roof purlin
connection
to steel
beam

Roof beam
to top of
steel pipe
column



Roof purlins
connection
to center
column





SAMPLE ADDENDUM

CITY OF SOMERTON

REPAIR OF 1,000,000 GALLON STEEL WATER STORAGE TANK

BID No. 2022-01

C.I.P. No. 2022-01

Date: _____, 20__

From: Samuel Palacios – Public Works Director

Subject: Addendum No.1

Note: Each vendor must acknowledge receipt of this addenda and return with the bid.

Clarification: See attached pages

Samuel Palacios – Public Works Director

Company Name: _____

Contact Person: _____ Signature: _____

Address: _____

City, State, Zip: _____

Telephone Number: _____

E-mail Address: _____