KONGIGANAK WATER TREATMENT PLANT & WASHETERIA

KONGIGANAK, ALASKA

JUNE 2019

Structural Condition Report

Prepared by:

Prepared for:

VILLAGE SAFE WATER

CONTENTS

REPORT CONTACTS 3

1.0 PURPOSE AND SCOPE 4
- 1.1 BACKGROUND 4
- 1.2 SCOPE 4

2.0 INSPECTION SUMMARY AND REPORT 5
- 2.1 Location 5
- 2.2 Pertinent Codes: 5
- 2.3 Code Evaluation: 5
- 2.3 Topography 6

3.0 STRUCTURAL 6
- 3.1 Introduction 6

4.0 WTP EXISTING CONDITIONS 7
- 4.1 WTP First Floor Framing 7
- 4.2 First Floor Structural Analysis 9
- 4.3 Analysis of the bay holding the large vessel loads from the second floor 9
- 4.4 Second floor framing analysis 10
- 4.5 WTP Pile Loading Review: 11

5.0 STAIRCASE AND LANDING – SECOND FLOOR WEST ENTRANCE 13

6.0 WASHETERIA VIBRATIONAL FAILURE CONDITION 14

7.0 PILING FOR FORMER WATER STORAGE TANK 14

8.0 REPORT LIMITATIONS AND EXCLUSIONS 15

9. APPENDICES 16
- Appendix A – PHOTO LOG 17
- Appendix B – Geotechnical Report 32
- Appendix C – Framing Drawings 33
- Appendix D – Structural Calculations 34
- Appendix E – Pressure Vessel Tank Specifications 35

Appendix F – Vessel Tank Weight Calculations 36
Appendix G – Seismic Design Parameters... 37

REPORT CONTACTS

Project Management	Bristol Engineering Services Company 111 W. 16th Avenue, Third Floor Anchorage, AK 99501-5109	Vanessa Wike, P.E. Senior Civil Engineer Tel: 907-563-0013 Email: Vwike@bristol-companies.com
Structural Engineering	Bristol Engineering Services Company 111 W. 16th Avenue, Third Floor Anchorage, AK 99501-5109	Kraig Hughes, P.E., S.E., P.L.S Senior Structural Engineer Tel: 907-563-0013 Email: khughes@bristol-companies.com
Geotechnical Engineering	Golder Associates, Inc. 2121 Abbott Road, Suite 100 Anchorage, AK 99507	Richard Mitchells, P.E. Principal, Senior Geotechnical Engineer Tel: 907-344-6001 Email: rmitchells@golder.com

1.0 PURPOSE AND SCOPE

1.1 BACKGROUND

The State of Alaska, Department of Environmental Conservation (ADEC), Division of Water through the of Village Safe Water (VSW) program has requested that Bristol Engineering Services Company, LLC (Bristol) to perform a field inspection and evaluation of the existing Kongiganak Water Treatment Plant (WTP), Washeteria building and piling from the former water storage tank location. This was accomplished on June 20th and June 21st of 2019.

1.2 SCOPE

The scope of the work is to investigate the existing building conditions for both the Water Treatment Plant and the Washeteria and the piling conditions at the former water storage tank location. The scope requires determination of load capacity of the existing structure and evaluation as to ability to have additional loading applied in the WTP. There are currently three vertically standing water filtration vessels on the second floor of the WTP and additional water vessels filters are going to be needed. One likely spot for their placement would be the second floor. This inspection was conducted to ascertain the ability of the existing structure to sustain these additional loadings.

Secondly, there is reported vibration failure associated with the use of the washers/dryers in the washeteria. These appliances are located on the bottom floor of this building. This report investigated the as-built conditions of the washeteria and the existing vibration condition.

Finally, the existing wood piling that remain where the former water storage tank existed in the near vicinity of the WTP were to be inspected for possible reuse to support a future structure.

2.0 INSPECTION SUMMARY AND REPORT

2.1 Location

Kongiganak is an unincorporated traditional Yup'ik Eskimo village located approximately 2.5 miles inland to the north from the seacoast Kuskokwim Bay, approximately five miles southwest of the Kuskokwim River and approximately 70 miles southwest of Bethel. Kongiganak is also located within the Yukon Delta National Wildlife Refuge. The community was established on a shallow permafrost bluff along the Kongnignanohk River (Preliminary Engineering Report, Page 1).

The Water Treatment Plant building and the Washeteria Building sites are located in Kogniganak at approximately 59° 57' 34" North Latitude and 162° 53' 21" West Longitude (WGS 84, Google Earth), within the United States Geological Survey Quad Map Kuskokwim Bay, D-3 and more specifically within Township 2 South, Range 79 West, Section 32, Seward Meridian. The buildings are located adjacent to each other on the southeast side of the village, west of the airport.

2.2 Pertinent Codes:

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures
2012 IBC	International Building Code
NCS 2005	National Design Specification for Wood Construction

2.3 Code Evaluation:

From a structural evaluation standpoint, The ASCE 7-10 (Minimum Design Loads for Buildings and Other Structures) indicates the following risk category and load parameters for these buildings:

Risk Category: III Buildings and other structures, the failure of which could pose a substantial risk to human life. Table 1.5-1. Importance Factors listed below are from Table 1.5-2.

Snow Importance:	Is = 1.10
Ice Importance:	Ii = 1.25
Ice Importance-Wind:	Iw = 1.00
Seismic Importance:	Ie = 1.25, Seismic design parameters are provided in Appendix G.

Live Load:	LL = 100 psf No specific category listed in Table 4.1 or IBC Table 1607.1
Dead Load:	DL = Actual (Operational loads for vessels) + Minimal collateral loads
Snow Load:	SL (Pg) = 40 psf (based on Table 7-1, using Bethel's load designation)
Wind Velocity:	160 MPH 3-second gust. ASCE 7-10 Figure 26.5-1B

Calculations are provided in Appendix F – Estimated Existing and Proposed Loads on the Buildings.

2.3 Topography

The site topography is generally flat with slight rolling hills and a gentle slope toward the river that wraps around the town on the south, west and north side of the Village as shown in Figure 1, below:

Figure 1: Village of Kongiganak

3.0 STRUCTURAL

3.1 Introduction

A site investigation was performed on June 20th and June 21, 2019. Bristol's Senior Structural Engineer, Kraig Hughes, PE, SE, PLS, flew to Kongiganak, Alaska in the morning of June 20th via Rav'n Alaska Airways through Bethel. Departure time in Anchorage was approximately 9:30 AM and arrival time in Kongiganak was approximately 2:20 PM. Kraig was accompanied by Richard Mitchells, PE, Senior Geotechnical Engineer, with Golder Associates, Inc. Kongiganak is a village of about 500 people on the Kuskokwim Bay, southwest of the mouth of the Kuskokwim River in Southwest Alaska.

The purpose of the inspection was to evaluate the condition of the existing water treatment plant (WTP), washeteria building and piling on the former water tank location. There are four specific areas of concern:

1) Capacity of the existing floor framing on first and second floor and evaluation of load path to pile foundations.
2) Piling capacity at the Washeteria and WTP.
3) Vibrational failure associated with use of the washers and dryers in the Washeteria.
4) Potential use of the pilings for support of a new structure at the old water storage tank (WST) location.

4.0 WTP EXISTING CONDITIONS

The WTP was constructed in 1978. This building is founded on wood piling installed in permafrost conditions. Reference the technical memorandum from Golder Associates, Inc and dated July 02, 2019 found in Appendix B.

4.1 WTP First Floor Framing

The WTP building is founded on 20 each wood piling as described in the Golder Report. The first floor is founded on top of these piling approximately 4'-0" above the ground surface (varies). The building was built in four 12' 0" long (nominally south to north) sections running approximately 50 feet wide from east to west. There are overhangs on each end and a 14' X 20' – 6" garage on the north side. The exterior building dimensions are approximately 50.15 feet in the nominal east-west direction and 52.29 feet in the north-south direction. The floor joists on the first floor were not visually confirmed, but the total floor thickness was determined to be 8 ¼" deep from top of sheathing on top to bottom of bottom sheathing. The bottom sheathing is ¼" plywood with the top sheathing being 3/4" T&G plywood. It is assumed that the joists are 2 ½"x 7" treated lumber (3" X 8" nominal) at 24" on center. This is based on like joists being used on the second floor, the available depth in the floor cavity and screw patterns in the floor sheathing. This should be confirmed, especially in heavy loaded locations. The joists span between steel channels (C12x25 or C12x20.7) that span between the pilings in the east-west direction. A framing layout is shown in Figure 1. Larger version found in Appendix C.

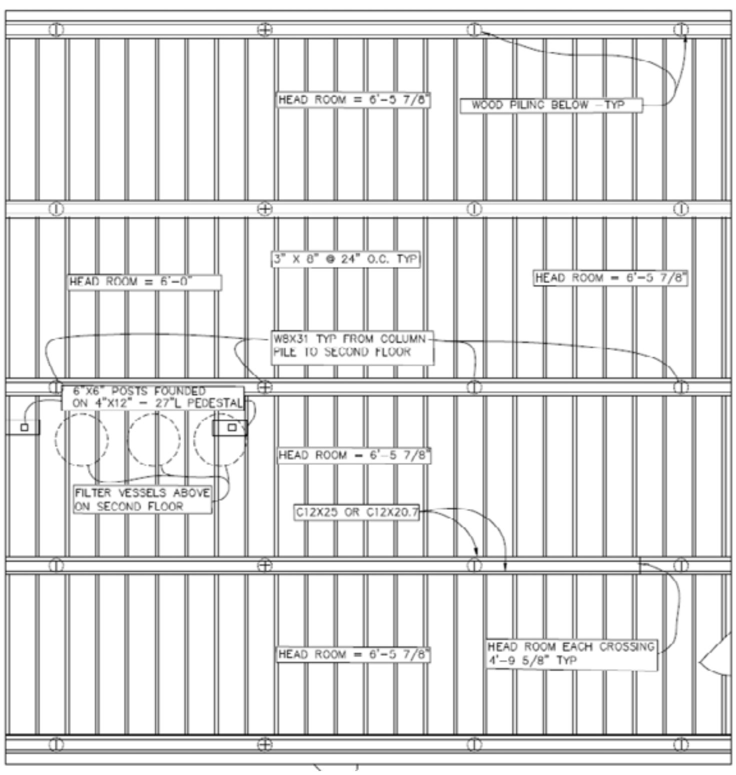


Figure 1. WTP First Floor - Framing plan.

The first floor was heavily loaded with multiple 165 gallon storage tanks, see Figure 2.

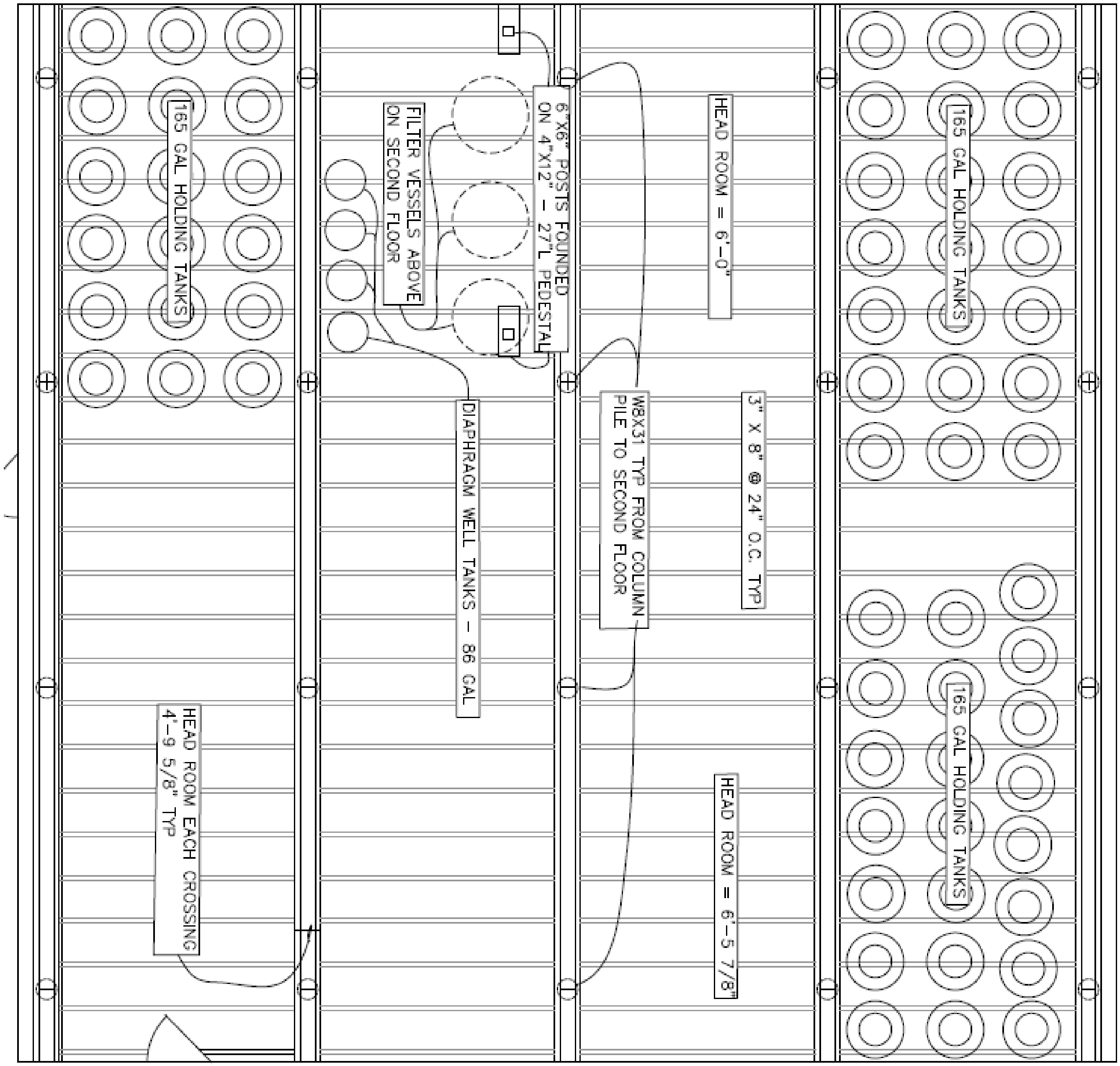


Figure 2. WTP First Floor - Loading.

As is clearly shown, there is excessive loading on the first floor. Each 165 gallon tank can weigh as much as 1,375 pounds. They are reported to never exceed 150 gallons, but that is still 1,250 pounds per tank. The Well-X-Trol WX-252 diaphragm well tanks weigh in the neighborhood of 830 pounds each, see the specification sheet in Appendix E. The vertical vessel tanks on the second floor are estimated to have an operational weight in the neighborhood of 7,500 pounds each when in operation. Their weight is transferred to the first floor through a wooden frame erected directly underneath the tanks and through the walls from the floor joist load path. Considering the support frame underneath the tanks, there are two nominal 6”x6” (5 ½” x 5 ½” actual) treated wood columns (5’-3” high) supporting a 4”x12” (3 ¼” x 11 ¾”) treated wood beam that spans at the top of the columns. The columns are supported at the first floor level on 27” long 4”x12” treated wood footings above the 1” tongue and groove plywood sheathing and wood joists of unknown layout. The span on that beam is approximately 13’ 5 ½” inside the column edges. The frame is diagonally braced with 2”x4”s.

4.2 First Floor Structural Analysis

The ENERCALC Structural calculations for the first floor wooden joists indicate excessive bending moment, shear and deflection for these joists in bays holding the 165 gallon holding tanks. This assumes the joists are 3”x8” at 24” on center. At the time of the inspection, the water in these tanks had all been depleted and was only partially filled by the time of departure, less than 30 gallons each. When the tanks are in a normal operating condition, it is assumed that excessive deflection would be very apparent. The floor condition in these bays must have been modified from the 24” on center spacing, otherwise failure would have been imminent a long time ago. However, even with 12” on center spacing, they still don’t have adequate capacity. If there was failure of this floor, in the bays where the 165 gallon tanks are stored, the failure would likely not be catastrophic for the structure but could cause human harm if anybody was underneath or on the tanks. Depending on time of year, this type of failure could be very inconvenient for the community and would be very harmful under most conditions. For example, having people under the building could be a potentially hazardous situation and immediate cautions should be implemented to eliminated or reduce personnel from working under the building.

Analysis of the steel C channel at each end of the joists indicate adequate sizing and capacity for holding these floor loads.

4.3 Analysis of the bay holding the large vessel loads from the second floor

Assuming the operational total vessels weight is approximately 7,500 pounds each (calculations in Appendix D) and assuming the layout shown on the drawing is accurate, the beam on the support frame is severely overloaded - see photo 22 – 27 & 29. Additionally, the floor joists in this bay, supporting the columns for this frame, are also severely overloaded if they are 3”x8” joists at 24” on center, or even 12” on center. Furthermore, the stress on these components are so much overloaded, that an engineering solution for intermittent support, from the ground, should be strongly considered for immediate implementation. Temporary cribbing could be built up from the ground to the bottom of the floor joists in this vicinity, then the first floor system could be more carefully investigated. It is strongly suggested that the vessels on the second floor be emptied prior to supporting and investigating this area further. An engineered solution should be developed in the near future to perform a careful determination of the floor structural system. Failure of the second floor or first floor in this area could be catastrophic and potentially harmful or fatal to any personnel in the vicinity. Furthermore, it would take the WTP out of service for a significant amount of time and cause significant hardship to the community. The bay directly under the second floor vessels, on the first floor should be warned off to occupancy until a solution can be designed and implemented.

4.4 Second floor framing analysis

The floor joists for the second floor are readily visible from the first floor and vary from bay to bay. Most bays have 2"x12" wood joists spaced at 12" on center and supported on each end by multi-ply timber trusses and or wooden beams at the walkway that are supported by the steel columns directly above each foundation pile. The top floor is sheathed with three layers of plywood consisting of a top 1/2 " layer, then ¾" layer and a bottom layer of ½" plywood.

The area of immediate concern is under the area supporting the three vessels on the second floor. This area is denoted as "bay 2" of the building. The layout of the second floor joists in this vicinity are not consistent, several joists are split and sistered for added support. Again, the second floor framing is inadequate to safely carry the operating load of the vessels above in this bay. Additional framing support under the tanks, leading to ground, should be added immediately. Figure 3 shows the existing condition for framing of west side of Bay 2. Additionally, the tank's support leg pads should all be supported on a channel similar to the center vessel. These tanks should also be adequately anchorage to resist seismic loading considerations. Design for this anchoring is outside of the scope for this report.

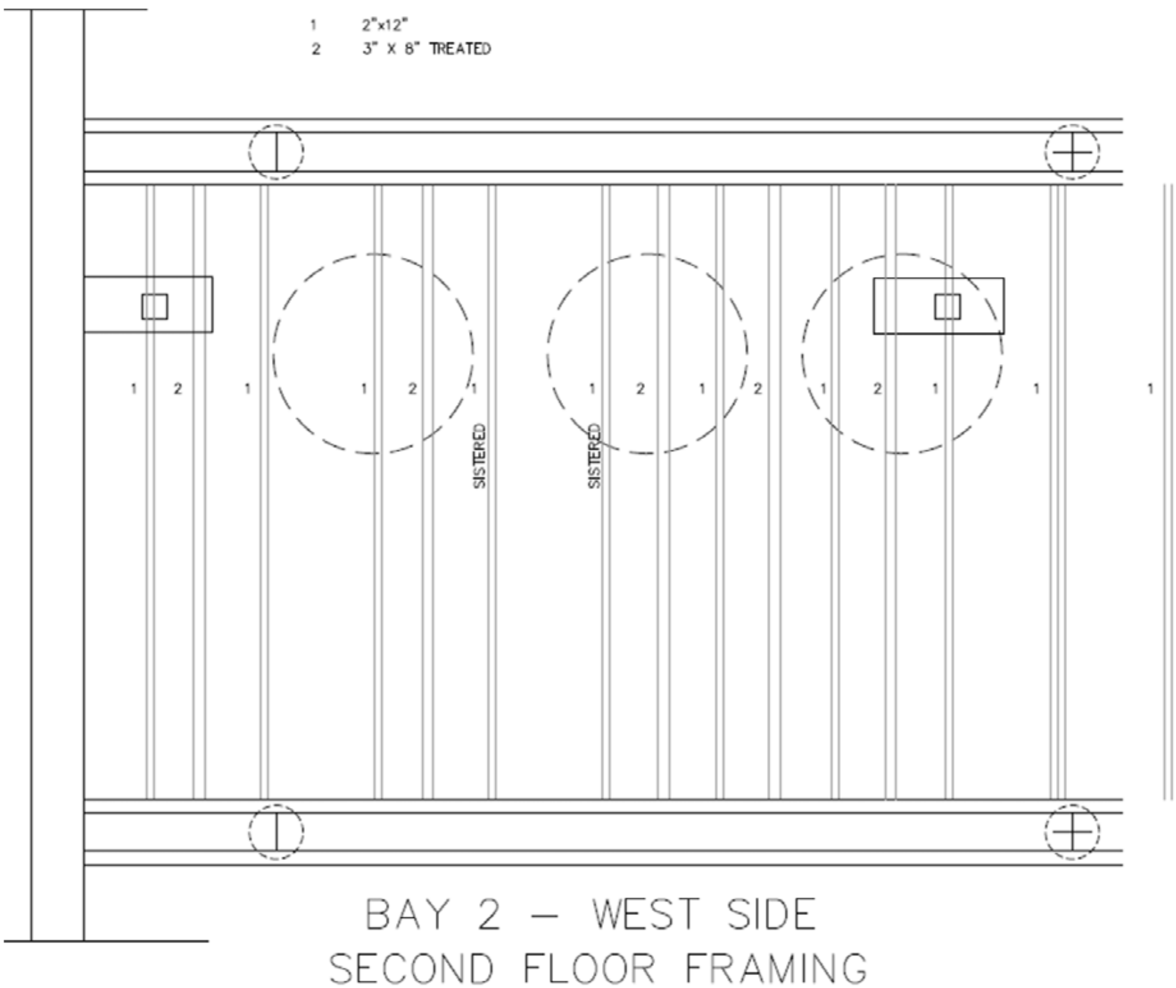


Figure 3. Second Floor Framing Plan West Side of Bay 2

4.5 WTP Pile Loading Review:

There are twenty piles supporting the WTP Building. These piles are shown in figure 4, below.

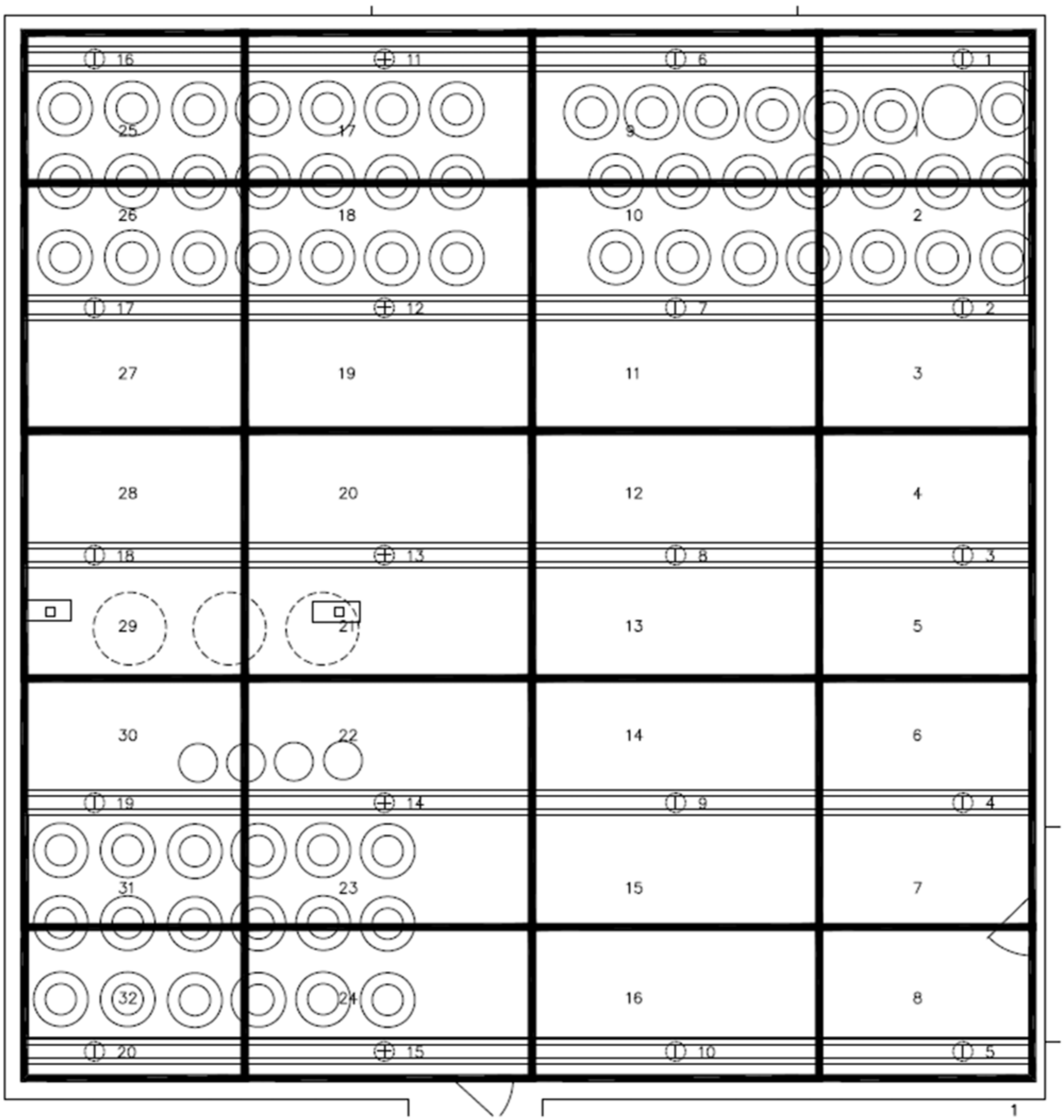


Figure 4. WTP Tributary Areas and Piling Numbers

Using ASCE 7-10 Axial Loading requirements listed above, loads for each pile were determined using the tributary area assigned to each pile. Table 1, shown below, illustrates the area for each pile, the sections that make up that area, the calculated maximum load using IBC load combinations for dead load, live load, and snow load. Lateral loads were not considered in this calculation.

Kongiganak					
Pile	Sections		Area		Pile Load
			SF		Pounds
1	1		74.50		16,763
2	2-3		122.67		27,600
3	4-5		122.67		27,600
4	6-7		123.31		27,745
5	8		74.93		16,859
6	9		100.37		22,583
7	10-11		165.26		37,183
8	12-13		165.26		37,183
9	14-15		166.13		37,378
10	16		100.94		22,713
11	17		100.37		22,583
12	18-19		165.26		37,183
13	20-21		165.26		37,183
14	22-23		166.13		37,378
15	24		100.94		22,713
16	25		76.99		17,323
17	26-27		126.77		28,523
18	28-29		126.77		28,523
19	30-31		127.44		28,673
20	32		77.44		17,423

Table 1. Axial Compressive Loads on WTP Piling

Many of these loads exceed the current estimated <u>ultimate</u> axial compression capacity cited in the geotechnical report as "…. in the range of 25 kips per pile." Ultimate axial compression capacity is the theoretical maximum load that can be supported without failure. Allowable compression capacity is the ultimate capacity divided by a safety factor, as high as 3.0 for piling in this case as shown in figure 5.

Method of Determining Capacity	Loading Condition	Minimum Factor of Safety Compression	Minimum Factor of Safety Tension
Theoretical or empirical prediction to be verified by pile load test	Usual	2.0	2.0
	Unusual	1.5	1.5
	Extreme	1.15	1.15
Theoretical or empirical prediction to be verified by pile driving analyzer as described in Paragraph 5-4a	Usual	2.5	3.0
	Unusual	1.9	2.25
	Extreme	1.4	1.7
Theoretical or empirical prediction not verified by load test	Usual	3.0	3.0
	Unusual	2.25	2.25
	Extreme	1.7	1.7

Figure 5. Piling Safety Factors (Design of Pile Foundations, Gilbert Gedeon, P.E., Course No. G10-001, CED engineering.com, page 4-2)

Failure in this case is likely not catastrophic, but more like differential settlement. There are no signs of differential settlement at this time. Golder indicates that the ultimate axial capacity is that it is based, in part, on a 1-inch creep related settlement over the next 20 years. This also includes an estimate of reasonably anticipated forecast climate impacts to the permafrost over the next 20 years and no additional ground thermal stabilization measures.

5.0 STAIRCASE AND LANDING – SECOND FLOOR WEST ENTRANCE

During the inspection of the WTP facility, it was noted that the staircase and landing on the west side of the building at the second floor had insufficient vertical support. It is recommended that two helical anchors be placed at the outside landing area in line with the vertical posts and support this landing from the ground. The following photo illustrates the existing condition.

Photo of WTP Second Floor West Entrance.

6.0 WASHETERIA VIBRATIONAL FAILURE CONDITION

The village laundry facility was not in operation and water was not available on the first day of the inspection. This was due to the water level in the water storage tank reaching a level that prohibited the pumps from replenishing the water system. This level is reported to be 5 feet of water in the water storage tank. The water was only reestablished in the late that evening. Regardless, Mr. Joseph Mute, Native Village of Kongiganak Tribal Chief, provided background information. Apparently the Laundry Facility had large washers in the past and these washers did produce a large vibrational impact on the building when improperly loaded. However, these washers have all broken down and are no longer in use. Only smaller washers are in use in this facility and this has greatly decreased vibrations. Laundry operations were being performed on the day of our departure and no vibration was felt. See photo 38 & 39 for the laundry area. This issue appears to be moot.

7.0 PILING FOR FORMER WATER STORAGE TANK

The exposed wooden piling that were used from the previous water storage tank were inspected for possible use as support for a new structure. The piling were inspected and appear to be in acceptable condition. There are 88 each piling spaced approximately 5'-6" apart in a matrix that has an approximate circular diameter of 50 feet.

Photo of wooden piling for previous water storage tank.

We concur with the geotechnical report that indicates "the exposed portions of the timber piles at this location appeared to be in decent condition with no significant rot or damage. The exposed tops of the timber piles have experienced weathering and their structural integrity will need to be confirmed."

8.0 REPORT LIMITATIONS AND EXCLUSIONS

The site inspections included only visible areas of the exterior and interior of the buildings. Destructive testing was not conducted during the site inspections. Unseen deficiencies may exist in the walls or in the substructure.

No inspection or condition report can entirely eliminate the uncertainty regarding the presence of physical deficiencies. This report is to be used as a guide completed as art of the due diligence process, and is intended to reduce the potential for unanticipated system failures and/or unexpected costs.

Not include in the scope of work was the implementation of corrective actions. Before any corrective action is made appropriate design, engineering, and permitting documents must be prepared.

9. APPENDICES

Appendix A – PHOTO LOG

Photo Log

June 20-21, 2019

Site Visit

Kongiganak, Alaska

Photo 1 – East side of Washeteria & WTP w/ Previous WST Piling in Forground

Photo 2 – Typical WTP Piling Bracket

Photo 3 – Under WTP. Not Debris

Photo 4 – C Channel at each end of floor joists, first floor WTP

Photo 5 – Typical Header Beam at Walkway and truss layout. First floor WTP

Photo 6 – Header at walkway, first floor WTP. Also showing staircase to second floor

Photo 7 - First Floor WTP, Bay 3. Showing typical truss layout for support of second floor joists.

Photo 8 – Support Column, First Floor. Columns extend vertically at each pile to second floor

Photo 9 – Typical wall truss support for second floor at column.

Photo 10 – Typical Wall Truss at each bay. Trusses run east-west. Also note floor joists for second floor.

Photo 11 – Typical connection detail at truss column connection.

Photo 12 – Typical header beam and truss connecting to column.

Photo 13 – Typical truss connection at column

Photo 14 – Pressure Vessels on First Floor, Bay 2

Photo 15 – Typical Tank Loading in Bay 1 (West side only, Bay 4 both sides).

Photo 16 – 165 Gallon Tank Loading, WTP First Floor

Photo 17 – Typical 165 Gallon Tank Layout

Photo 18 – Typical 165 Gallon Tank Layout, First Floor WTP

Photo 19 – Three Filter Vessels on Second Floor.

Photo 20 – Vertical Supports for Vessels on 2nd floor. Channel is under legs on middle vessel only.

Photo 21 – Vertical Supports for Vessels on 2nd floor. Channel is under legs on middle vessel only.

Photo 22 – Framing under vessels. First Floor, Bay 2, North side.

Photo 23 – Cracks in east column on frame for vessel supports.

Photo 24, Frame for Vessels – west end.

Photo 25, Frame Beam and Second Floor, Floor Joists.

Photo 25 – longitudinal crack on second floor, floor joists – directly under vessels.

Photo 26, Sistered joists in vicinity of vessels above. Note lack of bearing distance.

Photo 27 – Frame under Vesssels. First Floor, Bay 2, North End.

Photo 28 – Typical 2" x 12" Framing. Bay 1, 3, 4. Not Bay 2.

Photo 29 – Frame Column showing cracks

Photo 30 – Typcial hearder connection to column at walkways.

Photo 31 – Typical Sheathing on Second Floor

Photo 32- Raised Ceiling at Vessels on Second Floor. Head Room = 10'-1", Typical Second Floor Head Room = 7'-11"

Photo 33 – Roof Trusses over raised ceiling area. Note trusses – 2x6 top and bottom chords. Tursses Spliced – 3 piece trusses.

Photo 34 - – Roof Trusses over raised ceiling area. Note Blocking and craming.

 Photo 35 - Roof Trusses over raised ceiling area. Note Blocking and craming.	 Photo 36 – Rick Mitchells under WTP taking temperature readings. Note debris.
 Photo 37 – Cribbing, similar to support idea in area under vessels.	 Photo 38 – Washeteria - washers

Photo 39 – Washeteria – Dryers.

Photo 40 – Previous Water Storage Tank, 88 piles.

Photo 41 – Piling

Photo 42 - Piling

Photo 43 – Under Washeteria. Note bent angles

Photo 44 - Under Washeteria. Note bent angles

Photo 45 - Under Washeteria. Note broken angle

Photo 46 – Rick Mitchells

Photo 47 – Multiple ply trusses at each wall section on first floor.

Photo 48 - Multiple ply trusses at each wall section on first floor.

Photo 49 – West side of WTP, Washeteria, WST Piling and new Waster Storage Tank

Photo 50 – Departing flight on 6/21/19.

END OF PHOTOS

Appendix B – Geotechnical Report

GOLDER

TECHNICAL MEMORANDUM

DATE 02 July 2019 19126567

TO Vanessa Wike, PE, Bristol Engineering Services Company

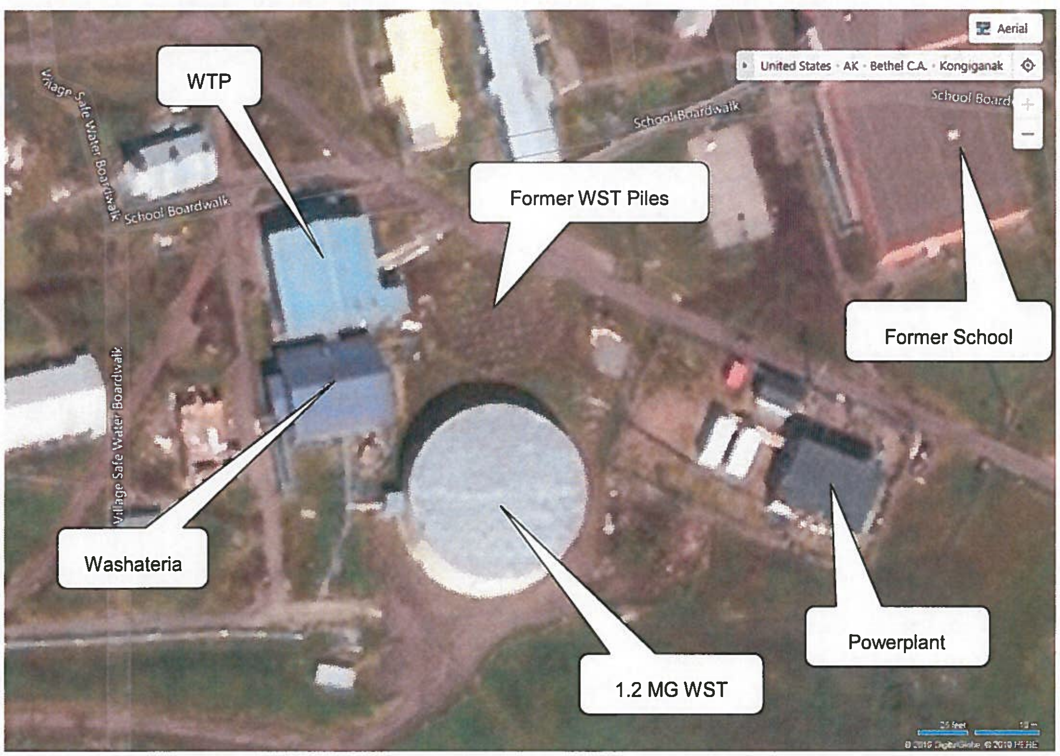
CC Kraig Hughes, SE, PE

FROM Richard Mitchells, PE **EMAIL** rmitchells@golder.com

KONGIGANAK WTP GEOTECHNICAL RECONNAISSANCE FINDINGS

Richard Mitchells and Kraig Hughes travelled to Kongiganak, Alaska June 20-21, 2019 to conduct a brief structural and geotechnical reconnaissance of the existing Water Treatment Plant (WTP) building and adjacent Washateria/Laundromat. The purpose of the reconnaissance was to ascertain the current structural and foundation condition of the facility in light of proposed improvements that may induce additional design loads on the structure. During the WTP reconnaissance, we also conducted visual assessments of the foundations for the adjacent 1.2-MG at-grade Water Storage Tank (WST) and the existing timber piles that supported the now demolished nominal 0.5 MG-WST.

The general locations of the key structures are noted in the following Bing image.



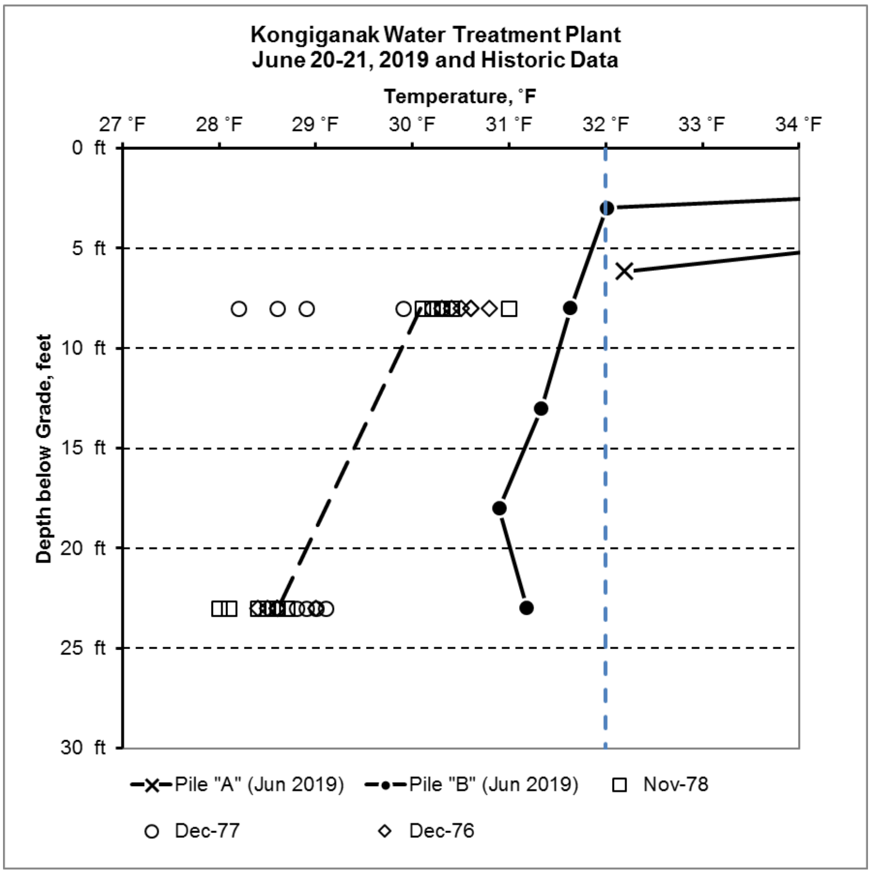
Existing WTP

The existing WTP was constructed in 1978 as a water or wastewater treatment facility. The facility is founded on 20 round timber piles installed using drill and slurry methods. The foundations piles appeared to be treated, at least on their exposed surfaces. The foundation piles are inferred to be adfreeze-type piles. We have assumed the original pile foundation design did not include significant end bearing contribution. Rigid insulation was not observed in the soil underlying the WTP footprint and none was reported with the reviewed as-built data. A summary as-built record of the WTP timber piles is attached for reference.

While there is a considerable amount of building debris under the structure, the exposed portions of the WTP timber piles appeared to be in decent condition with no obvious signs of rot or deterioration. An elevation survey of the pile caps was not conducted during the June 2019 reconnaissance, but no visual indications of excessive pile settlement or heave were noted.

During original installation, a 2-inch diameter ABS standpipe was installed in the borehole annular space adjacent to each timber pile. All but one of these ABS standpipes were either damaged or infilled with material or ice at the time of our June field effort. Ground temperatures were measured in the one accessible ABS standpipe. The location of temperature measured pile is noted on the attached sketch.

Ground temperatures from June 2019 and historic ground temperature data provided with the as-built records are summarized in the following plot. As noted, ground temperatures have warmed significantly since original installation, as expected for this area.



We used the as-built ground temperature data from the late 1970s to derive an estimated ultimate axial capacity at the time of initial installation. The estimated ultimate axial capacity is predicated on a timber pile installed with drill and slurry methods using a non-cohesive mineral soil and potable water slurry and a creep-related settlement of 1-inch over 20 years (approximately year 2000 service life). We also assumed negligible pore water salinity impacts along the piles. We also derived a current estimated ultimate axial capacity for similar conditions based on the June 2019 ground temperature data, ignoring any potential end bearing contribution. For a 22 to 23-foot embedment below existing grade, estimated ultimate axial compression capacity of approximately 65 kips was derived for the initial installation period. The estimated ultimate axial compression capacity is reduced from the initial installation capacities due primarily to ground warming since installation. We estimated current ultimate axial compression capacities in the range of 25 kips per pile.

Additional considerations for current axial capacities include:

- Perimeter piles should be expected to have lower current axial capacities relative to interior piles due to solar gain, runoff water, tundra damage, snow drifts, and albedo impacts along the building perimeter.
- The current facility discharges a considerable amount of water through the floor, particularly along the southeasts corner of the WTP during water pumping. This discharged water is expected to accelerate permafrost degradation in this area.
- The debris under the structure can impede unrestricted air flow under the structure and capture snow drifting. Both may impact colder winter air cooling under and around the structure.
- Climate impacts are expected to continue to further warm the area permafrost and increase the depth of surface thaw. Warming ground will further reduce foundation pile axial capacities and/or increase creep-related settlement rates. Deepening surface thaw will lower the point of fixity along the foundation piles with attendant adverse impacts to lateral capacity and behaviour.

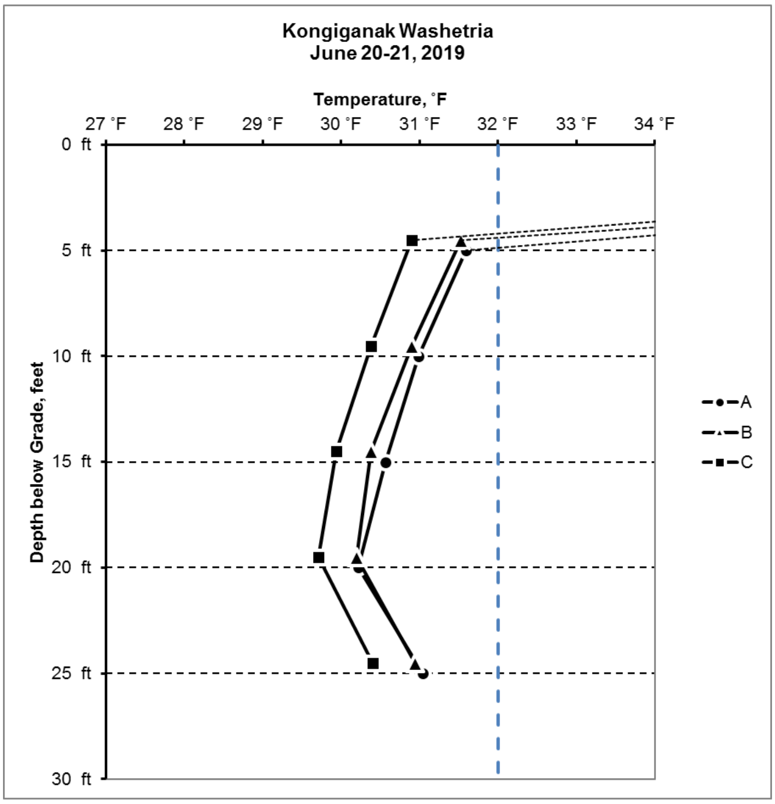
The WTP foundations are considered well beyond their originally intended service life. The current ground temperatures have reduced the estimated axial capacities of these piles. Since only one foundation pile had an accessible ground temperature standpipe, the measured ground temperatures may not accurately reflect ground temperatures along other foundation piles. Select other standpipes that are currently blocked should be opened to determine accurate ground temperatures in other areas of the WTP foundation. We can assist the design team with options for accessing currently blocked ground temperature standpipes.

Assuming the ground temperatures measured on the single standpipe are representative of the site ground thermal states, continued use of the existing WTP foundation pile will almost certainly require geotechnical augmentation for extended use as foundation members under certain loading conditions. Geotechnical augmentation may include installation of rigid insulation and/or use of subgrade cooling around the foundation piles. Redirecting the water discharge through the floor away from the building foundation is also needed.

Existing Washateria

The existing Washateria is founded on 18 each, 6-inch nominal diameter steel Arctic Foundations Inc. (AFI) Thermohelix piles. Pile embedment are estimated to be similar to the WTP foundations, 22 to 23 feet below grade. The foundation piles were installed using drill and slurry methods, assuming a non-cohesive mineral soil and potable water slurry backfill. Rigid insulation was not observed in the soil underlying the structure. Each pile has 2 or 3 steel angle lateral support brackets attached to the structural glulam beam and the base of the pile. Many of the steel lateral supports are damaged, apparently due to frost-related action.

Each foundation pile included a ¾-inch dimeter PVC standpipe assumed installed to the pile embedment depth. Several of the PVC standpipes are damaged or otherwise inaccessible, but an equal number appeared accessible. Of the accessible PVC standpipes, three standpipes along a cross-building transect were accessed for ground temperature measurements, reference the following plot and attached sketch. The Thermohelix piles are apparently cooling the ground around the measured piles within reasonable expectations for their age and assumed as-built conditions.



During our site reconnaissance, local personnel familiar with the facility operations since original construction indicated the Washateria has experienced settlements, reportedly on the order of 8 to 12 inches vertically. There is some evidence supporting differential movements, possibly settlement related, due to select exterior door misalignment. However, widespread evidence of larger differential movements was not visibly supported throughout most of the facility. Also, at the measured ground temperatures referenced above, we would not anticipate foundation differential movements in excess of geotechnical design tolerances, provided the measured ground temperatures reflect the ground thermal regime throughout the entire building footprint.

1.2-MG Water Storage Tank

The current 1.2-MG WST is founded at-grade using 16 AFI Thermoprobes with nominal condenser size of 70 square feet. This WST was installed around 2000 and reliable design and as-built records should be available for the WST. No significant geotechnical issues were observed at the WST. A thermistor reader is located inside the WTP fabricated to provide temperatures for 32 temperature sensors. Temperature measurements for the 32 reader positions are summarized below. We do not have as-built records for the locations of the individual temperature data points, but they are assumed to be located at strategic areas under the WST below a rigid insulation layer installed under and around the WST perimeter.

While temperature data at the Washateria and 12-MG WST indicate the passive subgrade cooling systems are operational, it would be prudent to have AFI conduct a survey of each passive cooling unit to verity their operational status relative to their original basis of design.

Kongiganak 1.2- MG Water Tank
Temperatures (assumed °F)
21-Jun-19

Switch	A	B
1	27.94	27.46
2	28.13	26.96
3	27.76	26.81
4	27.95	27.31
5	28.29	28.37
6	27.42	28.26
7	27.82	28.04
8	28.06	28.06
9	28.42	27.62
10	28.13	28.13
11	27.86	27.42
12	28.04	27.76
13	28.77	28.22
14	29.23	28.40
15	27.76	28.06
16	28.07	28.51

Former WST Foundation Piles

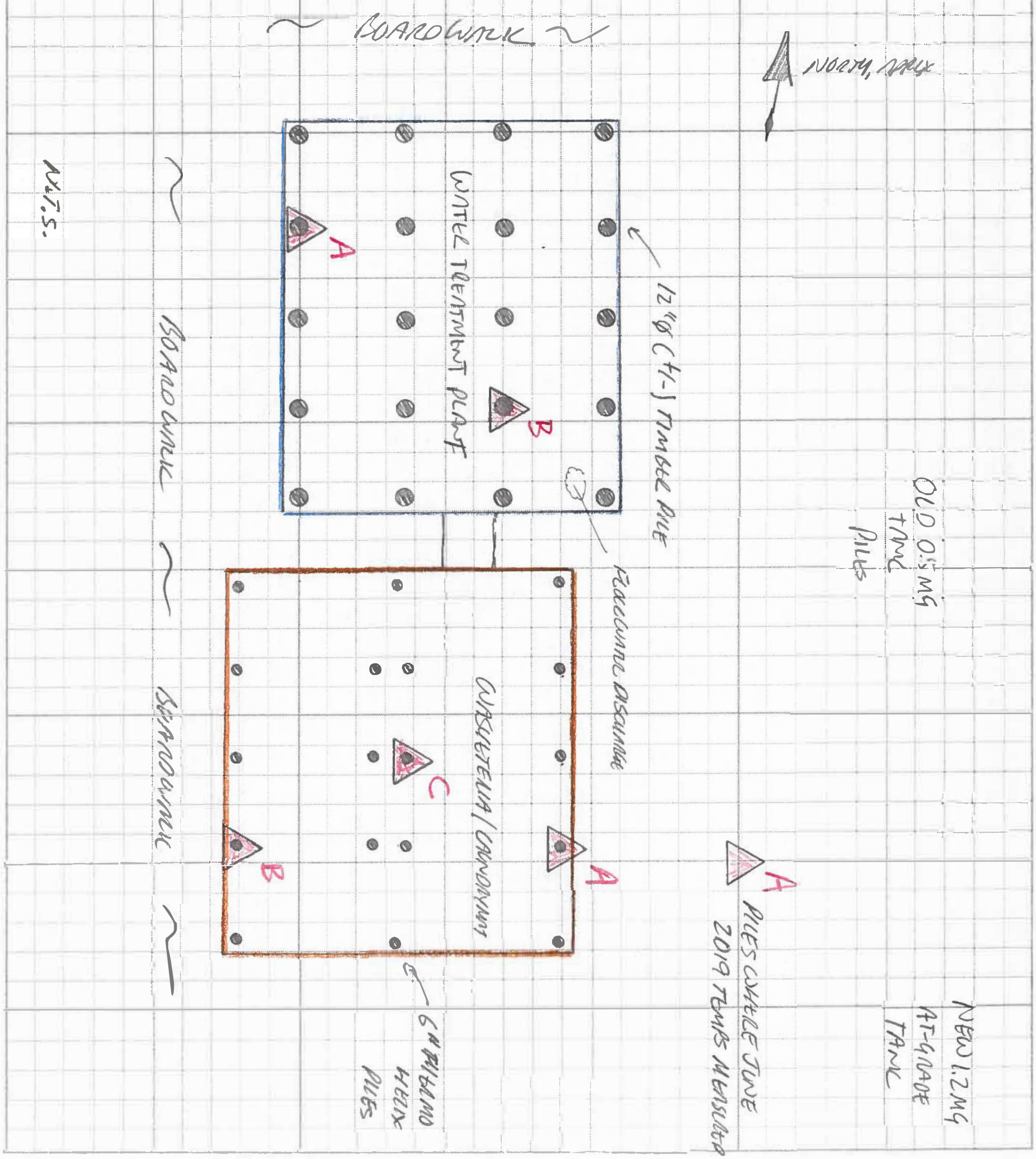
The former WST was founded on 88 timber piles installed on a nominal 5.5-foot rectangular grid. The former WST was demolished concurrent with the 1.2-MG WST project; however, the foundation piles were left in-place. We were unable to locate reliable design or as-built records for these foundation piles. However, it is reasonable to assume they were installed roughly similar to the WTP foundation system. A series of 1-inch diameter PVC standpipes were randomly located throughout the tank foundation footprint. These PVC standpipes were apparently not installed concurrent with original WST pile foundation installation. They may have been installed as part of WST shell post-demolition effort. Only two (2) of the PVC standpipes had caps in place; the remaining PVC standpipes were broken and infilled with soil or ice. The two intact standpipes were both infilled or iced at about 5.5 feet below grade. Reliable ground temperatures were not available from either PVC standpipe.

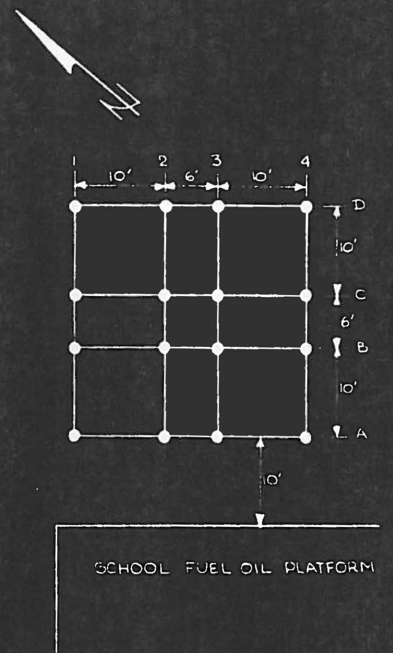
The exposed portions of the timber piles at this location appeared to be in decent condition with no significant rot or damage. The exposed tops of the timber piles have experienced weathering and their structural integrity will need to be confirmed.

If these piles are being considered for new loading, additional geotechnical assessment will be required to estimate their axial and lateral capacities. However, for preliminary considerations, it may be reasonable to assume their current axial capacities could be similar to the WTP foundation piles discussed above, provided both the former WST and WTP foundation piles are of similar design and installation means and methods. Pending the results of a site-specific geotechnical evaluation, reuse of the former WST foundation piles will almost certainly require rigid insulation under and around load bearing piles and possibly subgrade cooling.

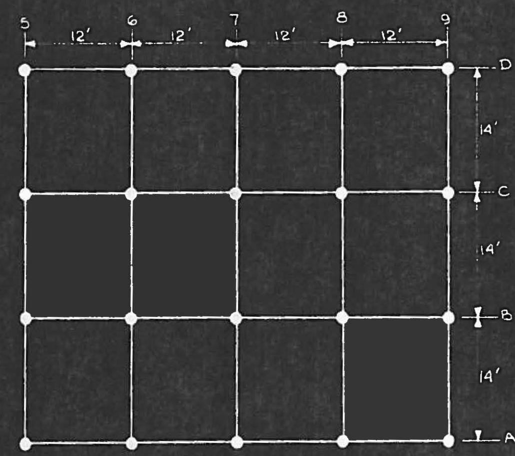
Golder Associates

SUBJECT KONG WTP & WASHETERIA FOUNDATION SCHEMATIC		
Job No. NOT TO SCALE	Made by RAM Reviewed MA	Date 6-24-19 Sheet 1 of 1



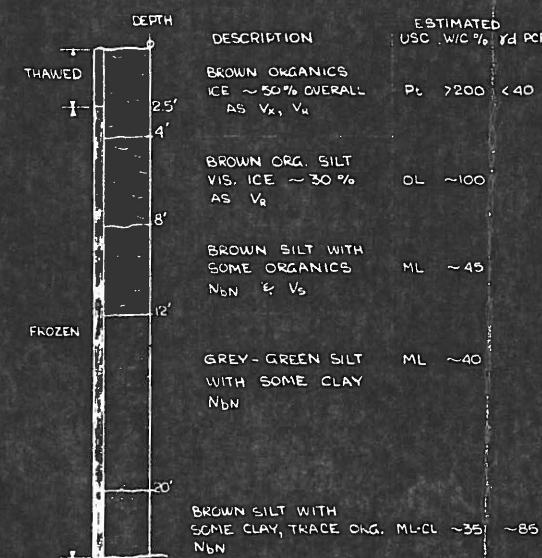


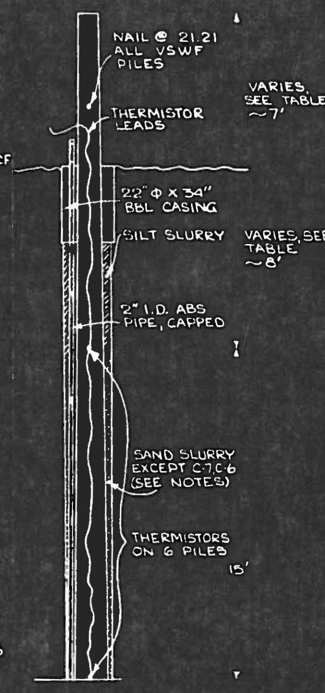
FUEL STORAGE



VSWF SITE

GENERALIZED SOIL PROFILE





TYPICAL VSWF PILE

SCALE: 1" = 4'

PILE	DATE SET	ORIG. LENGTH	ELEV. OF TOP	ELEV. OF GROUND	DIAM. OF TOP	TOTAL EMBED.	SAND BACKFILL
A5	10/14/76		23.7	16.9	11.8"	23.2	
B5	10/28	30'	25.3	17.3	10.7"	22.0	
C5	10/28	30'	25.4	17.4	11.3"	22.0	
D5	10/12	30'	24.5	17.1	11.9"	22.6	
A6	10/13	30'	24.2	17.1	12.1"	22.9	
B6	10/28	30'	25.3	17.5	13.0"	22.3	
C6	10/28	30'	24.0	17.2	11.5"	23.1	
D6	10/12	30'	24.7	17.2	13.4"	22.5	
A7	10/13	30'	23.1	16.5	10.9"	23.4	
B7	10/15	30'	22.8	16.9	10.8"	24.1	
C7	10/28	30'	24.5	16.8	10.7"	22.3	
D7	10/11	30'	25.2	17.9	11.8"	22.7	
A8	10/13	30'	23.7	16.5	10.4"	22.8	
B8	10/15	30'	22.4	16.7	13.5"	24.3	~ 15
C8	10/28	30'	22.9	17.2	12.0"	24.3	~ 15
D8	10/11	30'	25.0	17.6	12.4"	22.6	~ 15
A9	10/12	30'	23.3	16.7	10.7"	23.4	~ 15
B9	10/14	30'	23.6	16.8	11.9"	23.3	~ 15
C9	10/9	30'	23.5	17.2	10.7"	23.7	~ 15
D9	10/28	30'	24.8	17.7	11.5"	23'	~ 15

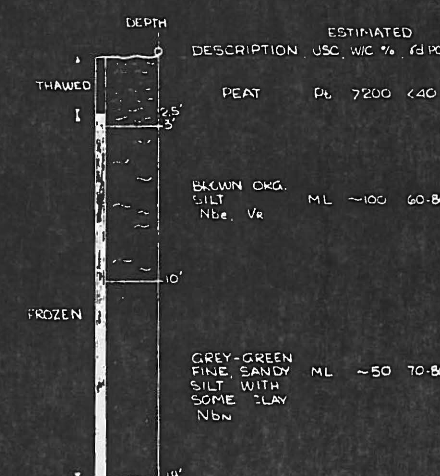
NOTE:

1) PILE C-7 WAS BACKFILLED ENTIRELY WITH A SILT SLURRY.

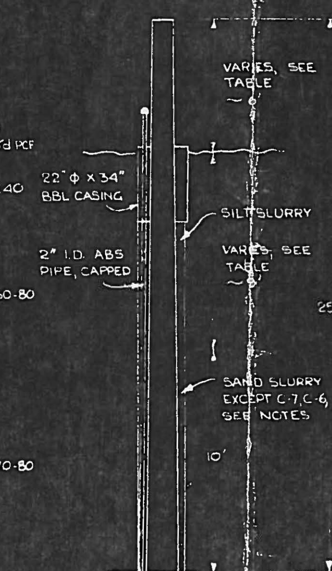
2) PILE C-6 WAS BACKFILLED IN THE LOWER 5 FEET WITH SILT AND THE NEXT 15 FEET WITH SAND AND THE REMAINDER WITH SILT.

3) THE AVERAGE BUTT SIZE FOR VSWF PILES WAS 15.2" WHILE THE AVERAGE TIP IS 10.9".

ELEVATIONS BASED ON ASSUMPTION OF 20.00. AT PLAY DECK ADD 80.0 TO MATCH OTHER ELEVATIONS.



GENERALIZED SOIL PROFILE



TYPICAL FUEL STORAGE PILE

SCALE: 1" = 4'

PILE	DATE SET	ORIG LENGTH	ELEV. OF TOP	ELEV. OF GROUND	DIAM. OF TOP	TOTAL EMBED.	SAND BACKFILL
A-1	10/7/76	25'	16.27	~ 12.0	~ 11.5'	21'	~
B-1	10/6	25'	14.69	~ 12.0	~ 11.5'		
C-1	10/4	25'	15.35	~ 12.0	~ 11.5'		~ 11'
D-1	10/3	25'	16.37	~ 12.0	~ 11.5'	19'	10'
A-2	10/7	25'	16.49	~ 12.0	~ 11.5'		
B-2	10/6	25'	16.08	~ 12.0	~ 11.5'		
C-2	10/5	25'	16.11	~ 12.0	~ 11.5'		
D-2	10/4	25'	15.50	~ 12.0	~ 11.5'		~ 11'
A-3	10/8	25'	16.89	~ 12.0	~ 11.5'		
B-3	10/7	25'	16.91	~ 12.0	~ 11.5'		
C-3	10/5	25'	15.80	~ 12.0	~ 11.5'		~ 11'
D-3	10/4	25'	15.85	~ 12.0	~ 11.5'		
A-4	10/8	25'	16.61	~ 12.0	~ 11.5'		
B-4	10/8	25'	16.05	~ 12.0	~ 11.5'		
C-4	10/8	25'	17.70	~ 12.0	~ 11.5'		
D-4	10/9	25'	16.15	~ 12.0	~ 11.5'		

NOTE:

1) THE AVERAGE BUTT SIZE FOR FUEL DEPOT PILES WAS 15.4" WHILE THE AVERAGE TIP SIZE WAS 11.5"

DAYS AFTER SETTING TEMP °F

PILE	THERMISTOR DEPTH BELOW GROUND	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D 1	0	33.3	33.1	34.2		33.7			31.5	31.9		33.2					
	2	31.8	31.8	31.8		31.7			31.7	31.9		32.0					
	5	32.0	31.9	31.9		31.8			31.8	32.1		32.1					
	8	32.1	32.0	32.0		31.9			31.8	32.1		32.0					
	13	32.0	31.9	31.9		31.6			30.9	30.9		30.7					
	18	32.1	31.9	31.8		31.4			30.1	30.1		29.9					
D 9	8	32.1		32.0	32.2					31.8							31.3
	23	32.1		32.0	32.0					30.7							28.6
D 5	8	33.9				31.7							31.4				
	23	31.9				31.4							28.7				
A 8	8	32.1				31.9							31.7				
	23	31.7				31.8							29.8				
A 5	8				32.4							31.9					
	23				31.8							29.5					
B 7	9																
	24																
C 7	7				31.9												31.0
	22				31.4												28.5

ADDITIONAL READINGS

PILE	THERMISTOR DEPTH BELOW GROUND	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	12/3/76 DATE	2/16/77 DATE	DATE								
D 1	0						32.0																				
	2						31.7																				
	5						31.5																				
	8						31.0																				
	13						30.0																				
	18						29.5																				
D 9	8							30.6								30.2	30.6	28.2									
	23							28.3								28.0	28.6	28.8									
D 5	8			30.6												30.2	30.5	28.9									
	23			28.1												28.0	28.4	28.6									
A 8	8			31.2												30.4	30.8	29.9									
	23			28.9												28.6	29.0	30.1									
A 5	8		30.9												30.1		30.4	28.6									
	23		28.4												28.1		28.6	29.1									
B 7	9	31.9												30.3			30.3	30.3									
	24	31.1												28.7			28.8	29.0									
C 7	7																30.6	30.2									
	22																28.6	28.9									

TEMPERATURE DATA

AS BUILT
OCTOBER 1976

GENERAL NOTES

1) ALL PILES WERE INSTALLED IN HOLES PREDRILLED WITH AN 18" AUGER. DUE TO WOBBLING IN THE HOLE, HOWEVER, THE ACTUAL SIZE OF THE HOLE WAS APPROXIMATELY 20".

2) THE SAND USED TO BACKFILL THE LOWER PORTIONS OF ALL PILES WAS IMPORTED MATERIAL WITH 100% PASSING THE #40 SIEVE AND 20% PASSING THE #200 SIEVE.

3) THE SAND SLURRY WAS AT A WATER CONTENT OF APPROXIMATELY 20% AND VIBRATED IN PLACE WITH A CONCRETE PROBE VIBRATOR.

4) A 2" I.D. ABS PIPE WAS CAST IN PLACE IN EACH HOLE FOR SUBSEQUENT USE EITHER FOR TEMPERATURE MONITORING OR FREEZEBACK.

5) THE UPPER PORTIONS OF EACH PILE WERE BACKFILLED WITH A SATURATED SILT SELECTED FROM THE HOLE CUTTINGS.

6) THERMISTORS USED WERE YELLOW SPRING INSTRUMENT COMPANY #401, GENERAL PURPOSE PROBES. WITHIN A RANGE OF 10°F OF FREEZING, THE RELATIONSHIP BETWEEN RESISTANCE AND TEMPERATURE IS $Y = ae^{-bx}$ WHERE Y IS THE TEMPERATURE IN DEGREES FAHRENHEIT, a IS A CONSTANT EQUAL TO 97.57, b IS A CONSTANT EQUAL TO 1.5157×10^{-4} AND X IS THE THERMISTOR RESISTENCE IN OHMS.

	BY
DESIGNED	J.A.B.
DRAWN	P.J.B.
CHECKED	J.A.B.

NO.	DATE	REVISION	BY
1	4-78	APRIL 1978 REVISED DESIGN	C.E.W.

QUADRA Engineering
Anchorage, Alaska

KONGIGANAK VSW
PILING AS BUILT
KONGIGANAK, ALASKA

DATE: 7 MAY 1977

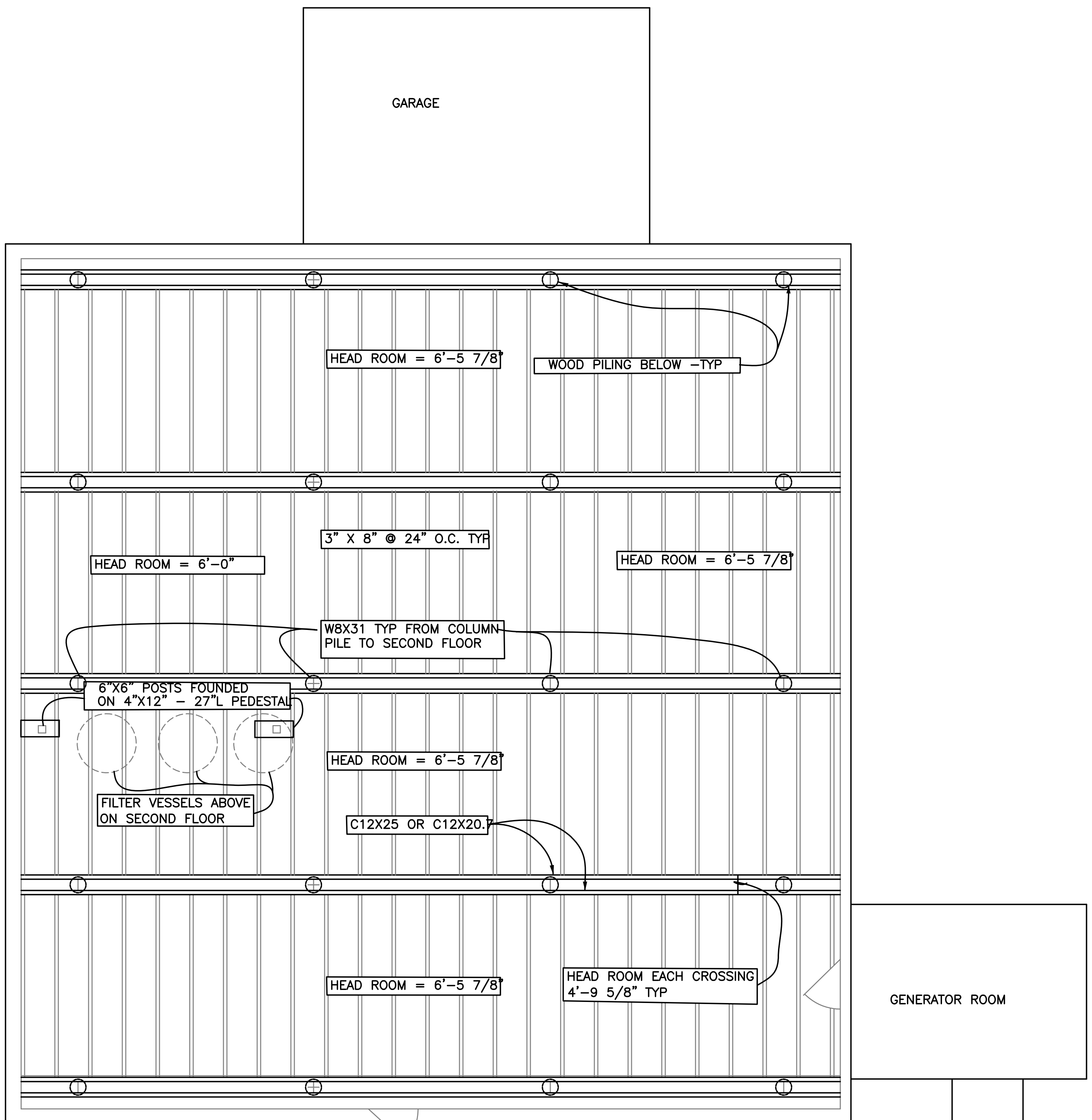
S-1

SHEET 9 OF 24

E574001W-9/22-1

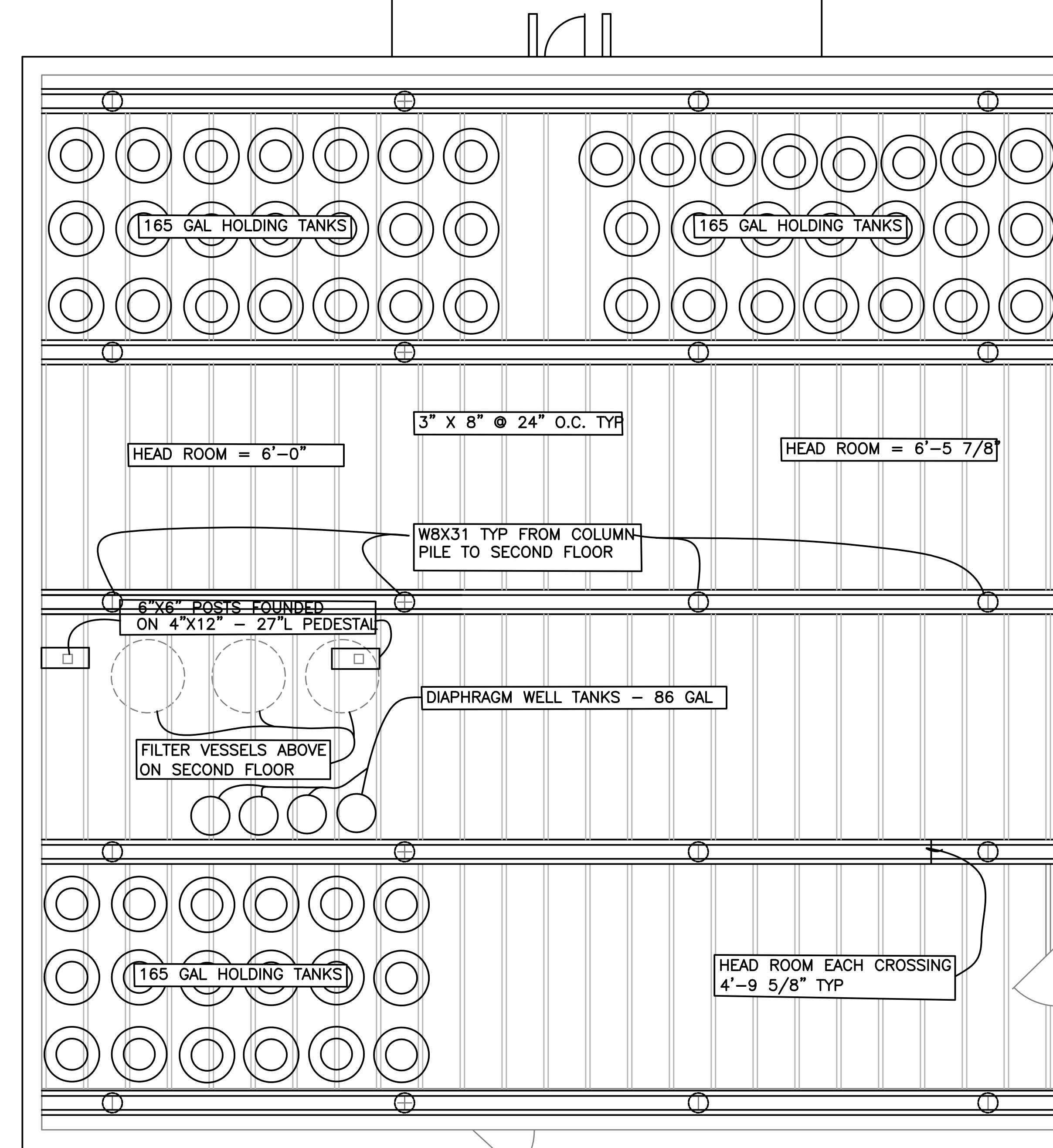
77-16

Appendix C – Framing Drawings



ACCESS TO WASHATERIA

1 S-1 **FIRST FLOOR LAYOUT**
SCALE: 1/4"=1'



ACCESS TO WASHATERIA

2 S-1 **FIRST FLOOR LOADING DIAGRAM**
SCALE: 1/4"=1'

NOT FOR CONSTRUCTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

Project No. 32190078

Bristol
ENGINEERING SEVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

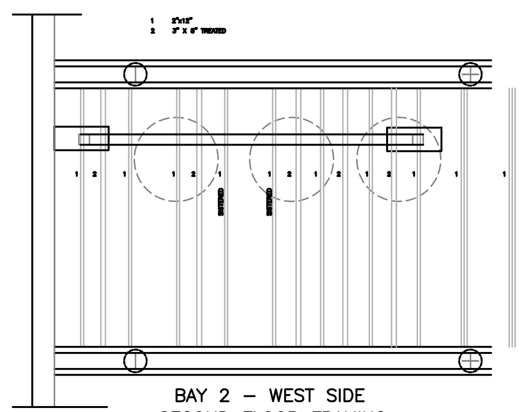
KONGIGANAK WTP
KONGIGANAK, ALASKA
WATER TREATMENT PLANT
TRIP INSPECTION

SHEET NO. **S-1**

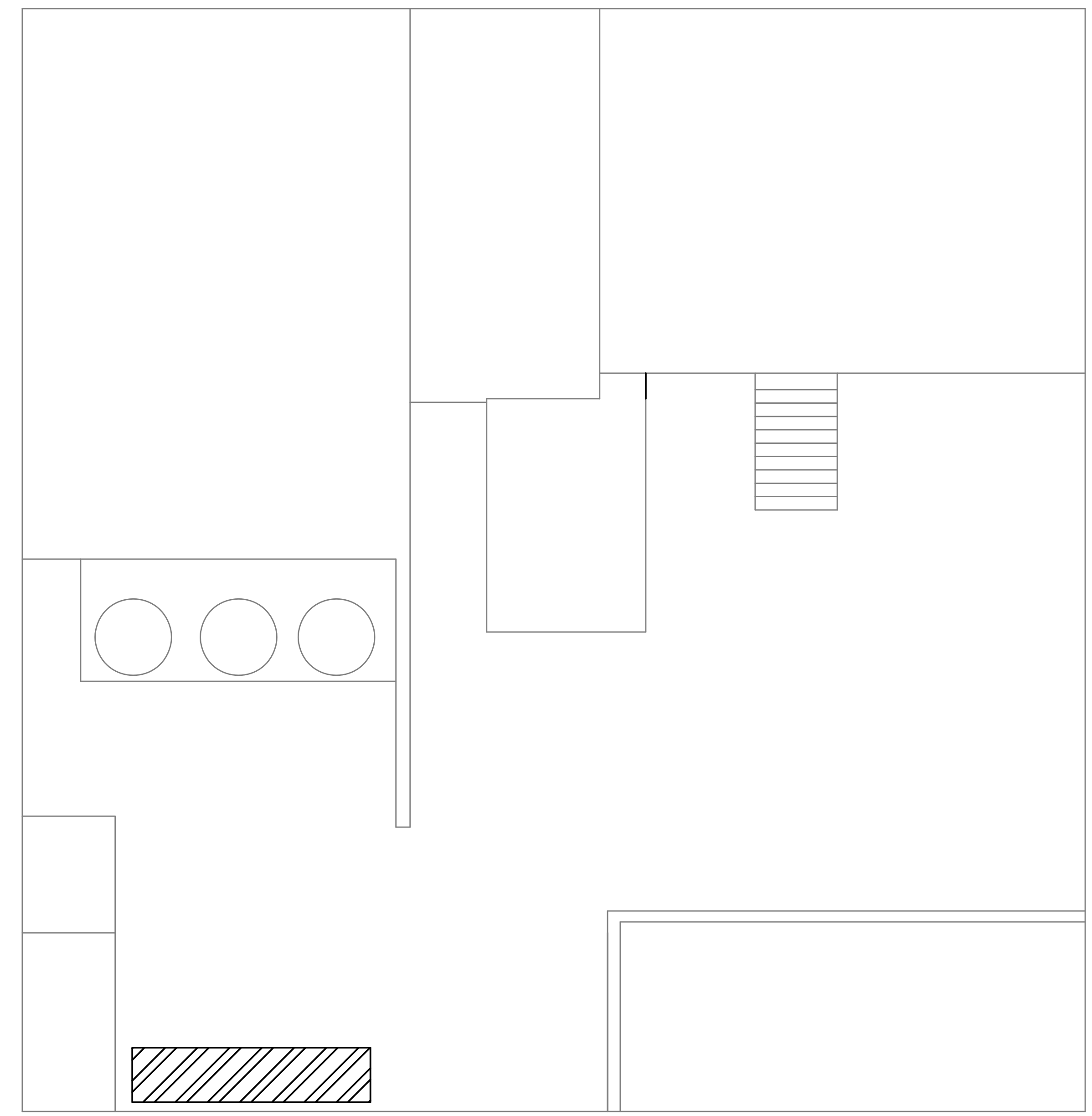
SCALE: NOTED | DESIGNED: N/A | CHECKED: N/A | DRAWN: KRH | DATE: 07/18/19 | SHEET **1** OF **2**

User: KHUGHES Jul 18, 2019 – 4:26pm
Drawing: K:\JOBS\32190078 KONGIGANAK VSW\ACAD-DESIGN\STRUCTURAL\32190078_STRUCTURAL.DWG – Layout: FOUNDATION PLAN
Xrefs: (DIESEL evaluation failed) – Images: None

User: KHUGHES Jul 19, 2019 – 10:59am
Drawing: K:\JOBS\32190078 KONGIGANAK VSW\ACAD-DESIGN\STRUCTURAL\32190078_STRUCTURAL.DWG – Layout: FOUNDATION PLAN (2)
Xrefs: (DIESEL evaluation failed) – Images: None



1 / S–2 **SECOND FLOOR FRAMING**
SCALE: 1/4"=1'



2 / S–2 **SECOND FLOOR LAYOUT**
SCALE: 1/4"=1'

NOT FOR CONSTRUCTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

Project No. 32190078

Bristol
ENGINEERING
SEVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

KONGIGANAK WTP
KONGIGANAK, ALASKA
WATER TREATMENT PLANT
TRIP INSPECTION

SHEET NO.
S-2

SCALE: NOTED | DESIGNED: N/A | CHECKED: N/A | DRAWN: KRH | DATE: 07/18/19 | SHEET **2** OF **2**

Appendix D – Structural Calculations

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 18 JUL 2019, 2:26PM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

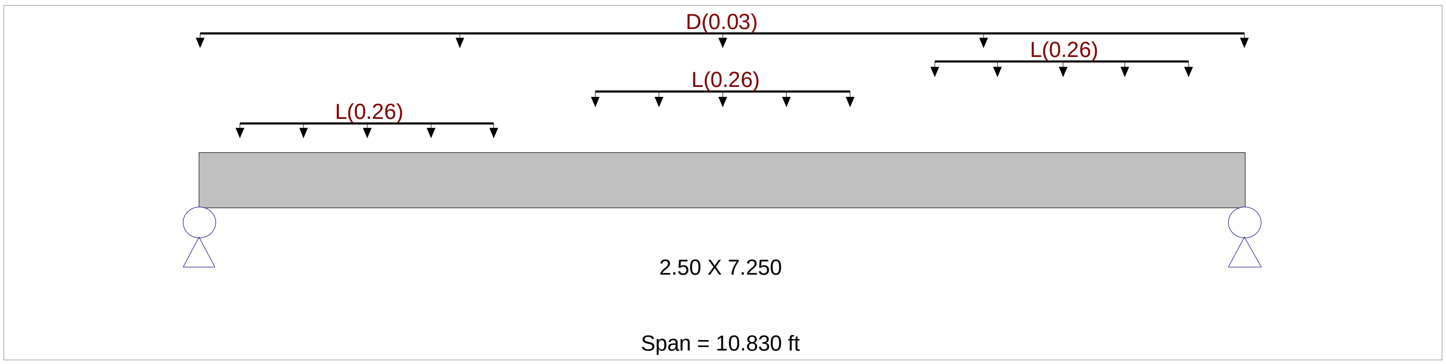
Wood Species :
Wood Grade :

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity
Ebend- xx 1,300.0 ksi
Eminbend - xx 1,300.0 ksi

Density 34.0 pcf
Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.260 k/ft, Extent = 0.430 -->> 3.060 ft, Tributary Width = 1.0 ft, (165 Gallon Tanks)
Uniform Load : L = 0.260 k/ft, Extent = 4.110 -->> 6.740 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : L = 0.260 k/ft, Extent = 7.620 -->> 10.250 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	1.849 : 1	Maximum Shear Stress Ratio	=	1.500 : 1
Section used for this span		**2.50 X 7.250**	Section used for this span		**2.50 X 7.250**
fb : Actual	=	1,848.60 psi	fv : Actual	=	97.49 psi
FB : Allowable	=	1,000.00 psi	Fv : Allowable	=	65.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	5.469 ft	Location of maximum on span	=	10.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.587 in	Ratio =	221 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.691 in	Ratio =	188
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C d	C F/V	C r	C m	C t	C L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 10.830 ft	1	0.275	0.210	1.000	1.000	1.000	1.000	1.000	1.000	0.50	275.37	1000.00	0.17	13.67	65.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.849	1.500	1.000	1.000	1.000	1.000	1.000	1.000	3.37	1,848.60	1000.00	1.18	97.49	65.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 18 JUL 2019, 2:26PM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.6908	5.469		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.220	1.202
D Only	0.186	0.186
L Only	1.035	1.017
D+L	1.220	1.202

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 16 JUL 2019, 9:46AM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species : Douglas Fir - Larch (North)
Wood Grade : No. 1 & Btr

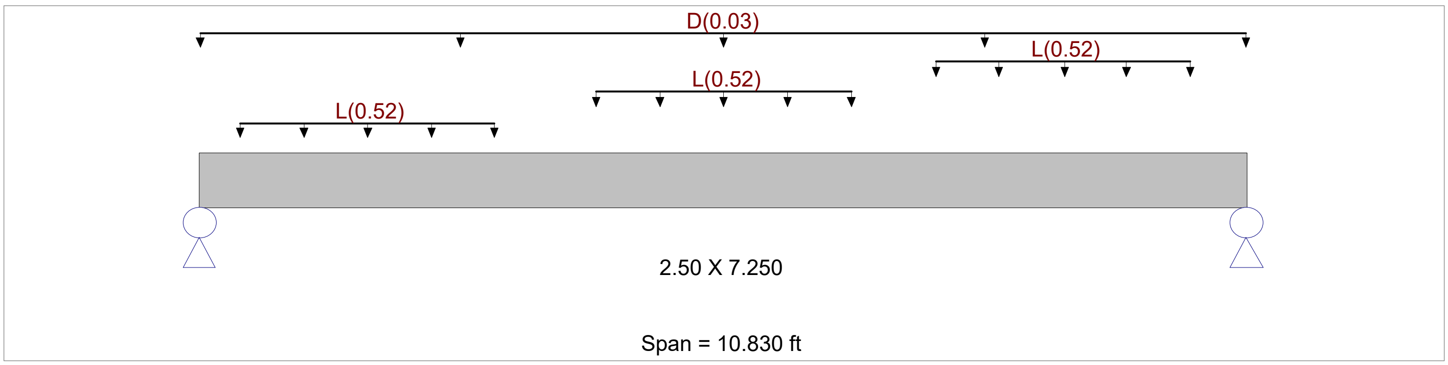
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1150	psi
Fb - Compr	1150	psi
Fc - Prll	1800	psi
Fc - Perp	625	psi
Fv	180	psi
Ft	750	psi

E : Modulus of Elasticity

Ebend- xx	1800	ksi
Eminbend - xx	660	ksi
Density	31.57	pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.520 k/ft, Extent = 0.430 -->> 3.060 ft, Tributary Width = 1.0 ft, (165 Gallon Tanks)
Uniform Load : L = 0.520 k/ft, Extent = 4.110 -->> 6.740 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : L = 0.520 k/ft, Extent = 7.620 -->> 10.250 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	2.973: 1	Maximum Shear Stress Ratio	=	1.007 : 1
Section used for this span		**2.50 X 7.250**	Section used for this span		**2.50 X 7.250**
fb : Actual	=	3,419.40 psi	fv : Actual	=	181.18 psi
FB : Allowable	=	1,150.00 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	5.469 ft	Location of maximum on span	=	10.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.848 in	Ratio =	153	<360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	0.922 in	Ratio =	140	<180
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C d	C F/V	C r	C m	C t	C L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 10.830 ft	1	0.237	0.075	1.000	1.000	1.000	1.000	1.000	1.000	0.50	272.91	1150.00	0.16	13.55	180.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.973	1.007	1.000	1.000	1.000	1.000	1.000	1.000	6.24	3,419.40	1150.00	2.19	181.18	180.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 16 JUL 2019, 9:46AM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.9223	5.469		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.253	2.218
D Only	0.184	0.184
L Only	2.069	2.034
D+L	2.253	2.218

Wood Beam

Description : Frame Beam

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species : Douglas Fir - Larch (North)
Wood Grade : No. 1 & Btr

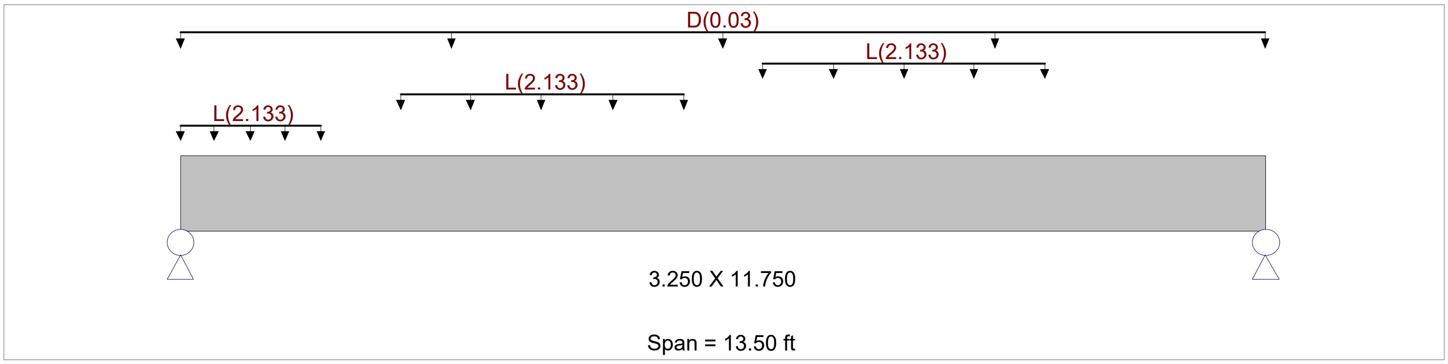
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,150.0	psi
Fb - Compr	1,150.0	psi
Fc - Prll	1,800.0	psi
Fc - Perp	625.0	psi
Fv	180.0	psi
Ft	750.0	psi

E : Modulus of Elasticity

Ebend- xx	1,800.0	ksi
Eminbend - xx	660.0	ksi
Density	31.570	pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 2.133 k/ft, Extent = 0.0 -->> 1.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 2.750 -->> 6.250 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 7.250 -->> 10.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	**3.996** : 1	
Section used for this span		**3.250 X 11.750**	
fb : Actual	=	5,813.48	psi
FB : Allowable	=	1,454.75	psi
Load Combination		+D+L+H	
Location of maximum on span	=	6.143	ft
Span # where maximum occurs	=	Span # 1	

Maximum Shear Stress Ratio	=	**2.000** : 1	
Section used for this span		**3.250 X 11.750**	
fv : Actual	=	359.94	psi
Fv : Allowable	=	180.00	psi
Load Combination		+D+L+H	
Location of maximum on span	=	0.000	ft
Span # where maximum occurs	=	Span # 1	

Maximum Deflection

Max Downward L+Lr+S Deflection	1.479	in	Ratio =	109 <360
Max Upward L+Lr+S Deflection	0.000	in	Ratio =	0 <360
Max Downward Total Deflection	1.516	in	Ratio =	106 <180
Max Upward Total Deflection	0.000	in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.096	0.049	1.000	1.100	1.150	1.000	1.000	1.000	0.87	140.27	1454.75	0.22	8.75	180.00
+D+L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.996	2.000	1.000	1.100	1.150	1.000	1.000	1.000	36.23	5,813.48	1454.75	9.16	359.94	180.00
+D+0.750Lr+0.750L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Frame Beam

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C d	C F/V	C r	C m	C t	C L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
+D+0.750L+0.750S+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	1.5159	6.750		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	11.215	7.966
D Only	0.259	0.259
L Only	10.956	7.707
D+L	11.215	7.966

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 15 JUL 2019, 5:07PM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species :
Wood Grade :

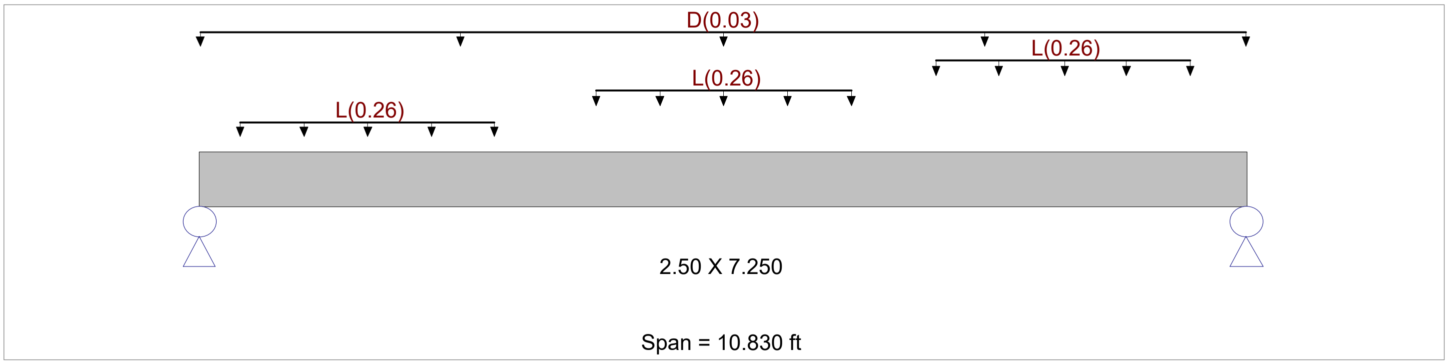
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity

Ebend- xx	1,300.0	ksi
Eminbend - xx	1,300.0	ksi
Density	34.0	pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.260 k/ft, Extent = 0.430 -->> 3.060 ft, Tributary Width = 1.0 ft, (165 Gallon Tanks)
Uniform Load : L = 0.260 k/ft, Extent = 4.110 -->> 6.740 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : L = 0.260 k/ft, Extent = 7.620 -->> 10.250 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	1.849 : 1
Section used for this span		**2.50 X 7.250**
fb : Actual	=	1,848.60 psi
FB : Allowable	=	1,000.00 psi
Load Combination		+D+L+H
Location of maximum on span	=	5.469 ft
Span # where maximum occurs	=	Span # 1

Maximum Shear Stress Ratio	=	1.500 : 1
Section used for this span		**2.50 X 7.250**
fv : Actual	=	97.49 psi
Fv : Allowable	=	65.00 psi
Load Combination		+D+L+H
Location of maximum on span	=	10.234 ft
Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.587 in	Ratio =	221 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.691 in	Ratio =	188
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 10.830 ft	1	0.275	0.210	1.000	1.000	1.000	1.000	1.000	1.000	0.50	275.37	1000.00	0.17	13.67	65.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.849	1.500	1.000	1.000	1.000	1.000	1.000	1.000	3.37	1,848.60	1000.00	1.18	97.49	65.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Wood Beam

Description : First Floor Joists

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C d	C F/V	C r	C m	C t	C L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.6908	5.469		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.220	1.202
D Only	0.186	0.186
L Only	1.035	1.017
D+L	1.220	1.202

Wood Beam

Description : --None--

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species :
Wood Grade :

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity

Ebend- xx	1,300.0	ksi
Eminbend - xx	1,300.0	ksi
Density	34.0	pcf

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0: 1	Maximum Shear Stress Ratio	=	0 : 1
Section used for this span			Section used for this span		
fb : Actual	=	psi	fv : Actual	=	psi
FB : Allowable	=	psi	Fv : Allowable	=	psi
Load Combination			Load Combination		
Location of maximum on span	=	0ft	Location of maximum on span	=	0 ft
Span # where maximum occurs	=	1	Span # where maximum occurs	=	1

Maximum Deflection

Max Downward L+Lr+S Deflection	in	Ratio =	<360
Max Upward L+Lr+S Deflection	in	Ratio =	<360
Max Downward Total Deflection	in	Ratio =	<180
Max Upward Total Deflection	in	Ratio =	<180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2

Steel Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

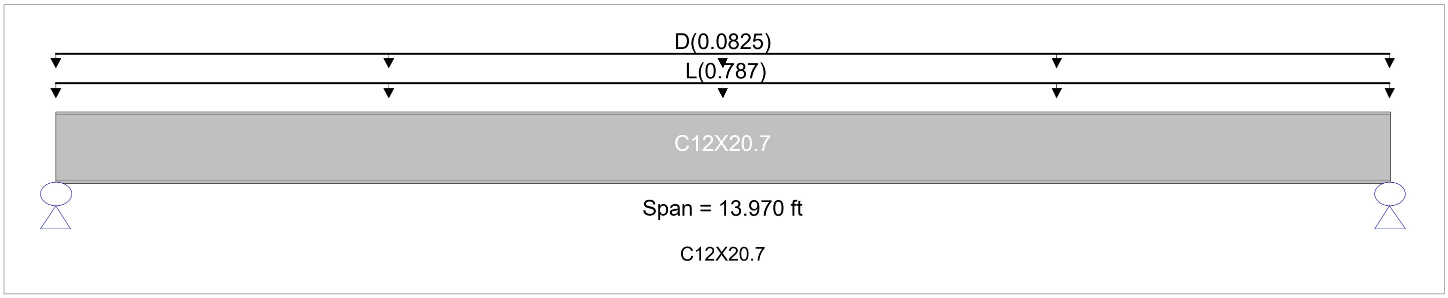
Description : Steel Floor Channel.

Material Properties

Calculations per AISC 360-05, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending
Load Combination 2006 IBC & ASCE 7-05

Fy : Steel Yield : 36.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Uniform Load : L = 0.7870 k/ft, Tributary Width = 1.0 ft, (165 Gallon Tanks - Assume 8 per)
Uniform Load : D = 0.0150 ksf, Tributary Width = 5.50 ft, (Dead Load)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.472** : 1	Maximum Shear Stress Ratio =	**0.142** : 1
Section used for this span	**C12X20.7**	Section used for this span	**C12X20.7**
Mu : Applied	21.717 k-ft	Vu : Applied	6.218 k
Mn / Omega : Allowable	45.988 k-ft	Vn/Omega : Allowable	43.769 k
Load Combination	+D+L+H	Load Combination	+D+L+H
Location of maximum on span	6.985ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.182 in	Ratio =	922
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.206 in	Ratio =	815
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
+D													
Dsgn. L = 13.97 ft	1	0.055	0.016	2.52		2.52	76.80	45.99	1.00	1.00	0.72	73.09	43.77
+D+L+H													
Dsgn. L = 13.97 ft	1	0.472	0.142	21.72		21.72	76.80	45.99	1.00	1.00	6.22	73.09	43.77
+D+0.750Lr+0.750L+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.218	6.218
D Only	0.721	0.721
L Only	5.497	5.497
D+L	6.218	6.218

Wood Column

Description : 6x6 Frame Column

General Information

Calculations per 2005 NDS, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
End Fixities: Top & Bottom Pinned
Overall Column Height: 5.240 ft
(Used for non-slender calculations)
Wood Species: Douglas Fir - Larch (North)
Wood Grade: No. 1 & Btr

Fb - Tension	1150 psi	Fv	180 psi
Fb - Compr	1150 psi	Ft	750 psi
Fc - Prll	1800 psi	Density	31.57 pcf
Fc - Perp	625 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1800	1800	1800 ksi
Minimum	660	660	

Load Combination 2006 IBC & ASCE 7-05

Wood Section Name **6x6**
Wood Grading/Manuf. Graded Lumber
Wood Member Type Sawn

Exact Width	**5.50** in
Exact Depth	**5.50** in
Area	30.250 in^2
Ix	76.255 in^4
Iy	76.255 in^4

Allowable Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compression	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Factor	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No *(non-glb only)*

Brace condition for deflection (buckling) along columns
X-X (width) axis : Unbraced Length for X-X Axis buckling = 5.24 ft, K = 1.0
Y-Y (depth) axis : Fully braced against buckling along Y-Y Axis

Applied Loads

Service loads entered. Load Factors will be applied for calculation

Column self weight included : 34.751 lbs * Dead Load Factor
AXIAL LOADS . . .
From Beam - Vessels: Axial Load at 5.240 ft, D = 0.240, L = 12.440 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.2629** : 1
	Load Combination	+D+L+H
	Governing NDS Formla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are . . .	
	Applied Axial	12.715 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	1,598.54 psi
PASS	Maximum Shear Stress Ratio =	**0.0** : 1
	Load Combination	+D+0.750L+0.750S+0.5250E+H
	Location of max.above base	5.240 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	180.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension
Cf or Cv : Size based factors	1.000	1.000	

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D	0.005682	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+L+H	0.2629	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft

Maximum Reactions - Unfactored

Note: Only non-zero reactions are listed

Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base
D Only		k		k	0.275 k
L Only		k		k	12.440 k
D+L		k		k	12.715 k

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

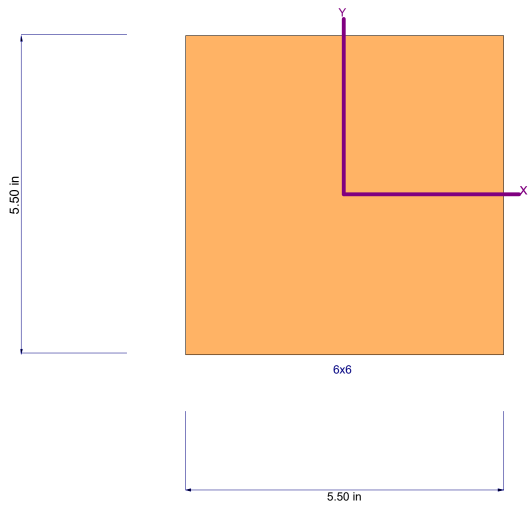
Wood Column

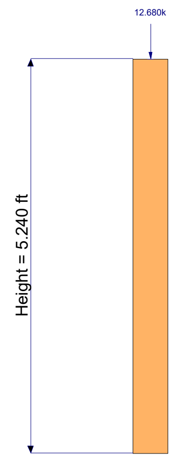
Description : 6x6 Frame Column

Maximum Deflections for Load Combinations - Unfactored Loads

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches





Loads are total entered value. Arrows do not reflect absolute direction.

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 18 JUL 2019, 2:27PM

Steel Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

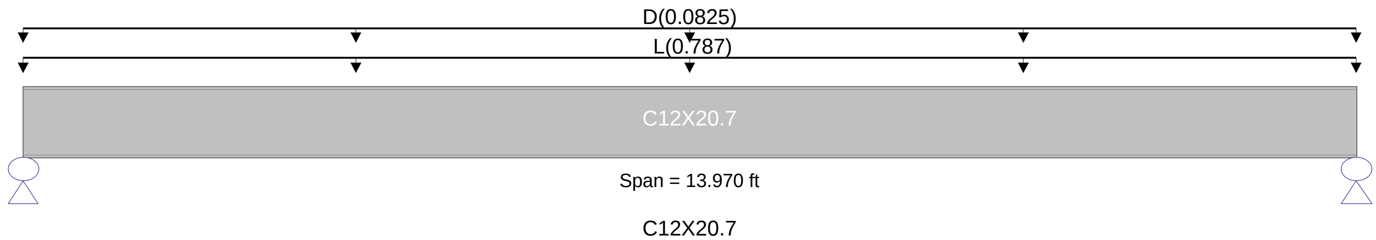
Description : Steel Floor Channel.

Material Properties

Calculations per AISC 360-05, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending
Load Combination 2006 IBC & ASCE 7-05

Fy : Steel Yield : 36.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Uniform Load : L = 0.7870 k/ft, Tributary Width = 1.0 ft, (165 Gallon Tanks - Assume 8 per)
Uniform Load : D = 0.0150 ksf, Tributary Width = 5.50 ft, (Dead Load)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.472** : 1	Maximum Shear Stress Ratio =	**0.142** : 1
Section used for this span	**C12X20.7**	Section used for this span	**C12X20.7**
Mu : Applied	21.717 k-ft	Vu : Applied	6.218 k
Mn / Omega : Allowable	45.988 k-ft	Vn/Omega : Allowable	43.769 k
Load Combination	+D+L+H	Load Combination	+D+L+H
Location of maximum on span	6.985 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.182 in	Ratio =	922
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.206 in	Ratio =	815
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
+D													
Dsgn. L = 13.97 ft	1	0.055	0.016	2.52		2.52	76.80	45.99	1.00	1.00	0.72	73.09	43.77
+D+L+H													
Dsgn. L = 13.97 ft	1	0.472	0.142	21.72		21.72	76.80	45.99	1.00	1.00	6.22	73.09	43.77
+D+0.750Lr+0.750L+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.218	6.218
D Only	0.721	0.721
L Only	5.497	5.497
D+L	6.218	6.218

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Frame Beam

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

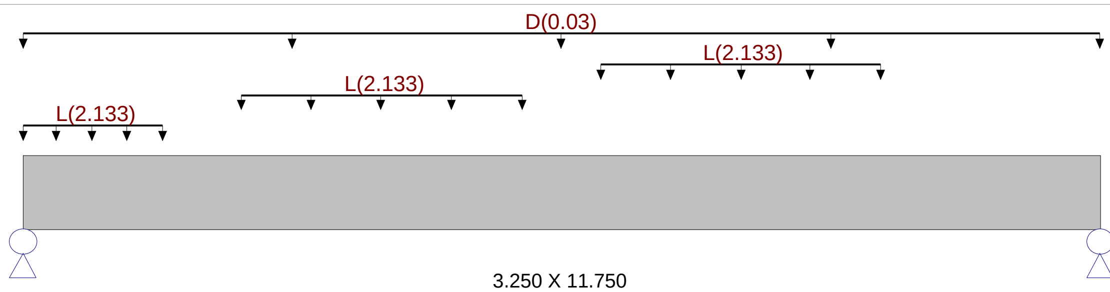
Wood Species : Douglas Fir - Larch (North)
Wood Grade : No. 1 & Btr

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,150.0	psi
Fb - Compr	1,150.0	psi
Fc - Prll	1,800.0	psi
Fc - Perp	625.0	psi
Fv	180.0	psi
Ft	750.0	psi

E : Modulus of Elasticity
Ebend- xx 1,800.0 ksi
Eminbend - xx 660.0 ksi

Density 31.570 pcf
Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 2.133 k/ft, Extent = 0.0 -->> 1.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 2.750 -->> 6.250 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 7.250 -->> 10.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	3.996 : 1	Maximum Shear Stress Ratio	=	2.000 : 1
Section used for this span		**3.250 X 11.750**	Section used for this span		**3.250 X 11.750**
fb : Actual	=	5,813.48 psi	fv : Actual	=	359.94 psi
FB : Allowable	=	1,454.75 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	6.143 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	1.479 in	Ratio =	109 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	1.516 in	Ratio =	106 <180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.096	0.049	1.000	1.100	1.150	1.000	1.000	1.000	0.87	140.27	1454.75	0.22	8.75	180.00
+D+L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.996	2.000	1.000	1.100	1.150	1.000	1.000	1.000	36.23	5,813.48	1454.75	9.16	359.94	180.00
+D+0.750Lr+0.750L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00

Wood Beam

Description : Frame Beam

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C d	C F/V	C r	C m	C t	C L	M	fb	Fb	V	fv	Fv
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	1.5159	6.750		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	11.215	7.966
D Only	0.259	0.259
L Only	10.956	7.707
D+L	11.215	7.966

Wood Column

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : 6x6 Frame Column

General Information

Calculations per 2005 NDS, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
End Fixities Top & Bottom Pinned
Overall Column Height 5.240 ft
(Used for non-slender calculations)
Wood Species Douglas Fir - Larch (North)
Wood Grade No. 1 & Btr

Fb - Tension	1,150.0 psi	Fv	180.0 psi
Fb - Compr	1,150.0 psi	Ft	750.0 psi
Fc - Prll	1,800.0 psi	Density	31.570 pcf
Fc - Perp	625.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,800.0	1,800.0	1,800.0 ksi
Minimum	660.0	660.0	

Load Combination 2006 IBC & ASCE 7-05

Wood Section Name **6x6**
Wood Grading/Manuf. Graded Lumber
Wood Member Type Sawn

Exact Width	**5.50** in
Exact Depth	**5.50** in
Area	30.250 in^2
Ix	76.255 in^4
Iy	76.255 in^4

Allowable Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compression	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Factor	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No *(non-glb only)*

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for X-X Axis buckling = 5.24 ft, K = 1.0
Y-Y (depth) axis : Fully braced against buckling along Y-Y Axis

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 34.751 lbs * Dead Load Factor
AXIAL LOADS . . .
From Beam - Vessels: Axial Load at 5.240 ft, D = 0.240, L = 12.440 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.2629** : 1
	Load Combination	+D+L+H
	Governing NDS Formla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are . . .	
	Applied Axial	12.715 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	1,598.54 psi
PASS	Maximum Shear Stress Ratio =	**0.0** : 1
	Load Combination	+D+0.750L+0.750S+0.5250E+H
	Location of max.above base	5.240 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	180.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension
Cf or Cv : Size based factors	1.000	1.000	

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D	0.005682	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+L+H	0.2629	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft

Maximum Reactions - Unfactored

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base
D Only		k		k	0.275 k
L Only		k		k	12.440 k
D+L		k		k	12.715 k

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 18 JUL 2019, 2:29PM

Wood Column

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

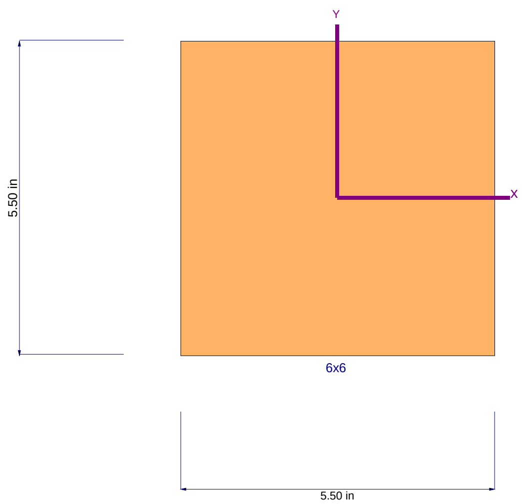
Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

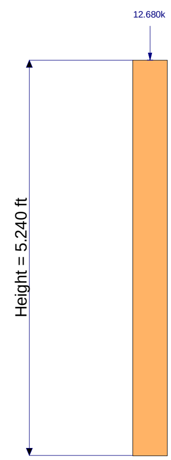
Description : 6x6 Frame Column

Maximum Deflections for Load Combinations - Unfactored Loads

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches





Loads are total entered value. Arrows do not reflect absolute direction.

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Second Floor Framing Check

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

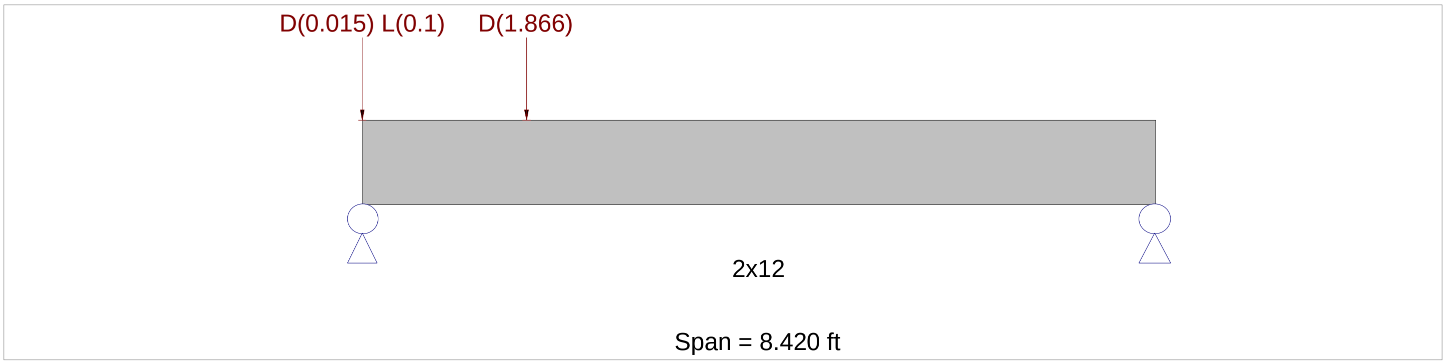
Wood Species :
Wood Grade :

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity

Ebend- xx	1,300.0	ksi
Eminbend - xx	1,300.0	ksi
Density	34.0	pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Point Load : D = 0.0150, L = 0.10 k @ 0.0 ft, (Normal Code Loading)
Point Load : D = 1.866 k @ 1.750 ft

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	0.978 : 1	Maximum Shear Stress Ratio	=	2.021 : 1
Section used for this span		**2x12**	Section used for this span		**2x12**
fb : Actual	=	978.39 psi	fv : Actual	=	131.39 psi
FB : Allowable	=	1,000.00 psi	Fv : Allowable	=	65.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.768 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.105 in	Ratio =	963
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00

Wood Beam

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Second Floor Framing Check

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D Only	1	0.1048	3.705		0.0000	0.000

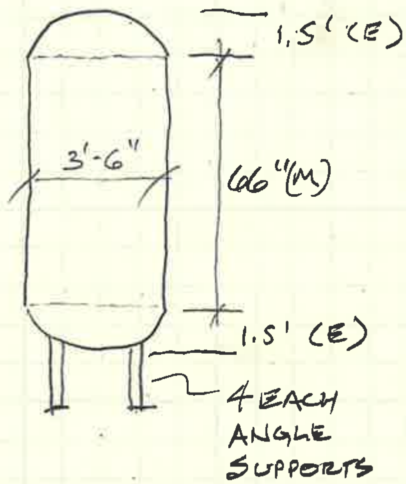
Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.593	0.388
D Only	1.493	0.388
L Only	0.100	0.000
D+L	1.593	0.388

ESTIMATED SECOND FLOOR VESSEL WEIGHT

E = ESTIMATED
M = MEASURED



$V_{TD} = \frac{\pi}{6} \cdot h(3c^2 + h^2)$

$= \frac{\pi}{6} \cdot 1.5(3 \cdot 1.75^2 + 1.5^2)$

$= \frac{\pi}{6} 1.5(3 \cdot 3.06 + 2.25)$

$= \frac{\pi}{6} 1.5(11.44)$

$= 0.52 \cdot 17.16$

$= 8.98$ cf

$A_{MID} = \frac{\pi d^2}{4} = \frac{\pi 3.5'^2}{4} = 9.62$ SF

$V_M = 9.62$ SF $\times 66''/12''/' = 52.92$ CF

$V_{BOT} = \frac{\pi}{6} \cdot 1.5(3 \cdot 1.75^2 + 1.5^2)$

$= 8.98$ CF

$\Sigma V_{OL} = 8.98 + 8.98 + 52.92$ CF

$= 70.88$ CF

ASSUME 1/2 WATER / 1/2 MEDIUM

$= 70.88/2 = 35.44$ CF $\times$ 120 #/CF

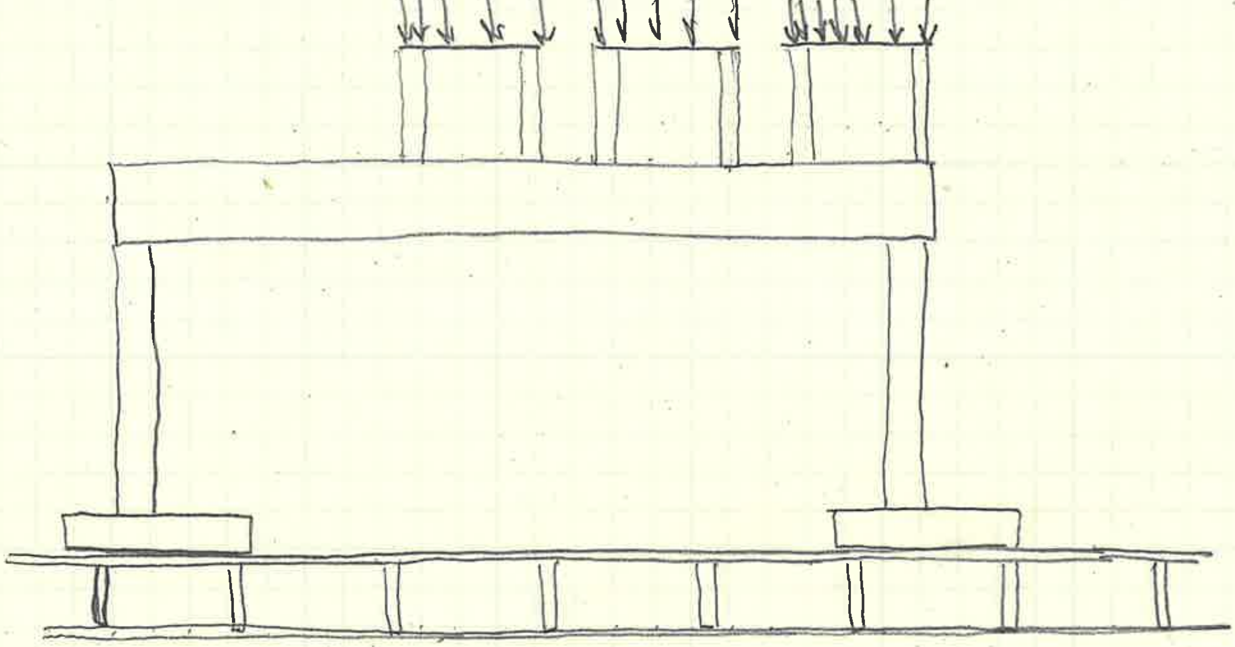
$= 4{,}252.80$ #

$+ \quad 70.88/2 \times 62.4$ #/CF $= 2{,}211$ #

+ DL OF VESSEL ~ 1,000 # +/-

TOTAL LOAD = 4,253 + 2,211 + 1,000 = 7,464 # +/-

VESSEL LOAD ON SUPPORT FRAME BEAM.



7,464#/3.5' = 2,132.64 #/LF ~ LIVE LOAD
(NOT CONSERVATIVE)

PER ENERCALC

MAXIMUM BENDING STRESS RATIO = 3.896:1
MAXIMUM SHEAR STRESS RATIO = 2.00:1
DOWNWARD DEFLECTION = 109 < 360

Appendix E – Pressure Vessel Tank Specifications

AMTROL

WELL-X-TROL®

Diaphragm Well Tanks: WX-100, 200 and 300 Series

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

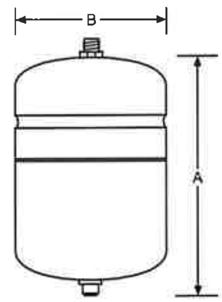
Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.

In-Line Models

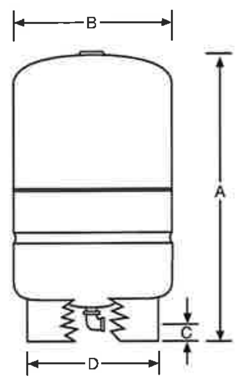
Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-101	2.0	8	0.45	13	330	8	203	¾	5	2
WX-102	4.4	17	0.55	15	381	11	279	¾	9	4
WX-103	7.6	29	0.43	22	559	11	279	¾	15	7
WX-104	10.3	39	1.00	18	457	15	381	1	20	9
WX-200	14.0	53	0.81	22	559	15	381	1	22	10

Available in gray. Use suffix G.



Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-201	14.0	53	0.81	25	635	15	381	1¹⁹⁄₃₂	40	12	304	1	25	11
WX-202	20.0	76	0.57	32	813	15	381	1¹⁹⁄₃₂	40	12	304	1	33	15
WX-202XL	26.0	98	0.44	39	991	15	381	1¹⁹⁄₃₂	40	12	304	1	36	16
WX-203	32.0	121	0.35	47	1194	15	381	1¹⁹⁄₃₂	40	12	304	1	43	20
WX-205	34.0	129	1.00	30	762	22	559	1¹⁵⁄₁₆	49	20½	521	1¼	61	28
WX-250	44.0	167	0.77	36	914	22	559	1¹⁵⁄₁₆	49	20½	521	1¼	69	31
WX-251	62.0	235	0.55	47	1194	22	559	1¹⁵⁄₁₆	49	20½	521	1¼	92	42
WX-255	81.0	306	0.41	57	1448	22	559	1¹⁵⁄₁₆	49	20½	521	1¼	103	47
WX-252*	86.0	326	0.39	62	1575	22	559	1¹⁵⁄₁₆	49	20½	521	1¼	114	52
WX-302	86.0	326	0.54	47	1194	26	660	2¹⁄₁₆	52	20½	521	1¼	123	56
WX-350	119.0	450	0.39	62	1575	26	660	2¹⁄₁₆	52	20½	521	1¼	166	75



*WX-252: Maximum Working Pressure: 100 PSIG. Available in Blue only. Available in Tan and Gray. Use suffix T or G.

All dimensions and weights are approximate.

Job Name ______________________

Engineer ______________________

Contractor ______________________

P.O. No. ______________________

Sales Rep. ______________________

Model No. ______________________

Notes ______________________

CERTIFIED TO NSF/ANSI 61

MADE IN USA

LOW-LEAD

ANTIMICROBIAL PROTECTION

TURBULATOR

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

WELL-X-TROL®

Diaphragm Well Tanks: WX-100, 200 and 300 Series with DuraBase®

AMTROL

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

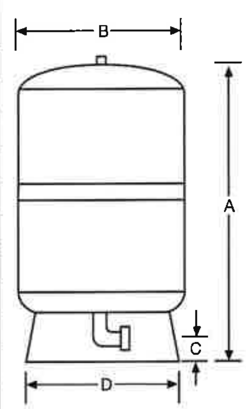
Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.
- DuraBase stand is rugged and will never corrode. Patent Pending.

Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-201D	14.0	53	0.81	25	635	15	381	1 11/16	43	15⅝	391	1	25	11
WX-202D	20.0	76	.057	32	813	15	381	1 11/16	43	15⅝	391	1	33	15
WX-202XLD	26.0	98	0.44	39	991	15	381	1 11/16	43	15⅝	391	1	36	16
WX-203D	32.0	121	0.35	47	1194	15	381	1 11/16	43	15⅝	391	1	43	20
WX-205D	34.0	129	1.00	30	762	22	559	2	51	22	559	1¼	61	28
WX-250D	44.0	167	0.77	36	914	22	559	2	51	22	559	1¼	69	31
WX-251D	62.0	235	0.55	47	1194	22	559	2	51	22	559	1¼	92	42
WX-255D	81.0	306	0.41	57	1448	22	559	2	51	22	559	1¼	103	47
WX-302D	86.0	326	0.54	47	1194	26	660	2	51	22	559	1¼	123	56
WX-350D	119.0	450	0.39	62	1575	26	660	2	51	22	559	1¼	166	75



Available in Tan and Gray. Use suffix T or G.

All dimensions and weights are approximate.

Job Name ____________________ Notes ____________________

Engineer ____________________ ____________________

Contractor ____________________ ____________________

P.O. No. ____________________ ____________________

Sales Rep. ____________________ ____________________

Model No. ____________________ ____________________

NSF CERTIFIED TO NSF/ANSI 61

MADE IN USA

LOW-LEAD IAPMO R&T

ANTIMICROBIAL PROTECTION™

TURBULATOR

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

AMTROL

WELL-X-TROL®

Diaphragm Well Tanks: Underground, Wall Hung and Pump Stand Series

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

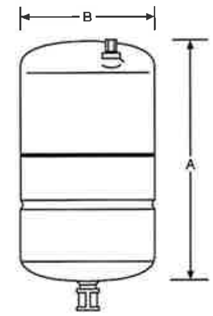
Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

Application

• Controls pump cycling in residential well water systems.

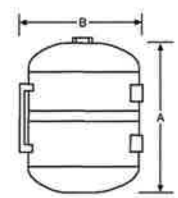
Undergound Models (BLACK)

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-200UG	14	53	0.81	23	584	15	381	1	22	10
WX-202UG	20	76	0.57	30	762	15	381	1	30	14
WX-250UG	44	167	0.77	33	838	22	559	1¼	60	27
WX-251UG	62	235	0.55	44	1118	22	559	1¼	83	38



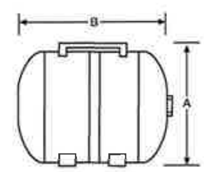
Wall Hung Model for VFD Systems

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-102VFD	4.4	17	0.55	15	381	12	305	¾	13	6



Pump Stand Models

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Width		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-102PS	4.4	17	0.55	12	305	15	381	¾	13	6
WX-105PS	5.3	20	0.80	12	305	18	457	¾	15	7
WX-110PS	7.4	28	0.56	12	305	23	584	¾	18	8
WX-200PS	14.0	53	0.81	16	406	22	559	1	29	13
WX-202PS	20.0	76	0.57	16	406	30	762	1	35	16
WX-202H	20.0	76	0.57	16	406	30	762	1	33	15



All dimensions and weights are approximate.

Job Name ____________________ Notes ____________________

Engineer ____________________ ____________________

Contractor ____________________ ____________________

P.O. No. ____________________ ____________________

Sales Rep. ____________________ ____________________

Model No. ____________________ ____________________

CERTIFIED TO NSF/ANSI 61

LOW-LEAD

MADE IN USA

ANTIMICROBIAL PROTECTION

TURBULATOR

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

WELL-X-TROL®

AMTROL®

Diaphragm Well Tanks: WX-200PA and WX-300PA Series with PRO ACCESS®

150 PSIG Working Pressure

Construction

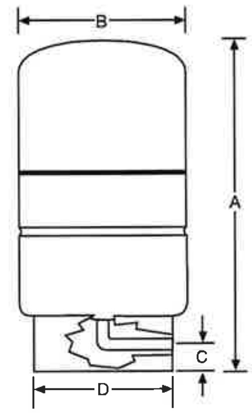
Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel NPTF
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.
- PRO ACCESS provides piped to stand convenience for faster installation.



Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTF)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-202PA	20.0	76	0.57	32	813	15	381	1 19/32	40	12	304	1	33	15
WX-202XLPA	26.0	98	0.44	39	991	15	381	1 19/32	40	12	304	1	36	16
WX-203PA	32.0	121	0.35	47	1194	15	381	1 19/32	40	12	304	1	43	20
WX-205PA	34.0	129	1.00	30	762	22	559	1 15/16	49	12	304	1¼	61	28
WX-250PA	44.0	167	0.77	36	914	22	559	1 15/16	49	20½	521	1¼	69	31
WX-251PA	62.0	235	0.55	47	1194	22	559	1 15/16	49	20½	521	1¼	92	42
WX-255PA	81.0	306	0.41	57	1448	22	559	1 15/16	49	20½	521	1¼	103	47
WX-302PA	86.0	326	0.54	47	1194	26	660	2 1/16	52	20½	521	1¼	123	56
WX-350PA	119.0	450	0.39	62	1575	26	660	2 1/16	52	20½	521	1¼	166	75

Available in Tan and Gray. Use suffix T or G.

All dimensions and weights are approximate.

Job Name ____________________ Notes ____________________

Engineer ____________________ ____________________

Contractor ____________________ ____________________

P.O. No. ____________________ ____________________

Sales Rep. ____________________ ____________________

Model No. ____________________ ____________________

NSF CERTIFIED TO NSF/ANSI 61

ISO 9001:2008 REGISTERED

MADE IN USA

LOW-LEAD IAPMO R&T

ANTIMICROBIAL PROTECTION

TURBULATOR

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

Appendix F – Vessel Tank Weight Calculations

Kongiganak

Pile	Sections	Area SF	Pile Load Pounds
1	1	74.50	16,763
2	2-3	122.67	27,600
3	4-5	122.67	27,600
4	6-7	123.31	27,745
5	8	74.93	16,859
6	9	100.37	22,583
7	10-11	165.26	37,183
8	12-13	165.26	37,183
9	14-15	166.13	37,378
10	16	100.94	22,713
11	17	100.37	22,583
12	18-19	165.26	37,183
13	20-21	165.26	37,183
14	22-23	166.13	37,378
15	24	100.94	22,713
16	25	76.99	17,323
17	26-27	126.77	28,523
18	28-29	126.77	28,523
19	30-31	127.44	28,673
20	32	77.44	17,423
			37,378

IBC ASD Load Combinations

INPUT

DEAD LOAD	D	=	45
LIVE LOAD	L	=	200
ROOF LL	Lr	=	20
EARTH LOAD	H	=	
FLUID LOAD	F	=	
SNOW LOAD	S	=	40
SEISMIC LOAD	E	=	
WIND LOAD	W	=	-
THERMAL	T	=	
RAIN LOAD	R	=	

Bristol
ENGINEERING SERVICES CORPORATION

IBC - ASD - LOAD COMBINATIONS.XSLS
PW: Kraig2015

1605.3.1 Basic Load Combinations

MAX = 225

16-8	D	45
16-9	D + H + F + T	45
16-10	D + H + F + Lr	65
	D + H + F + SL	85
	D + H + F + R	45
16-13	D + H + F + .75 (W) + 0.75 (L) + 0.75 (Lr)	210
	D + H + F + .75 (W) + 0.75 (L) + 0.75 (S)	225
	D + H + F + .75 (W) + 0.75 (L) + 0.75 (R)	195
	D + H + F + .75 (0.7 E) + 0.75 (L) + 0.75 (Lr)	210
	D + H + F + .75 (0.7 E) + 0.75 (L) + 0.75 (S)	225
	D + H + F + .75 (0.7 E) + 0.75 (L) + 0.75 (R)	195
16-14	0.6D + W + H	27
16-15	0.6D + 0.7E + H	27

1605.3.2 Alternative Basic Load Combinations

MAX = 285

16-16	D + L + Lr	265
	D + L + S	285
	D + L + R	245
16-17	D + L + (ωW)	245
16-18	D + L + (ωW) + S/2	265
16-19	D + L + S + ωW/2	245
16-20	D + L + S + E/1.4	285
16-21	0.9D + E/1.4	45

Appendix G – Seismic Design Parameters

OSHPD

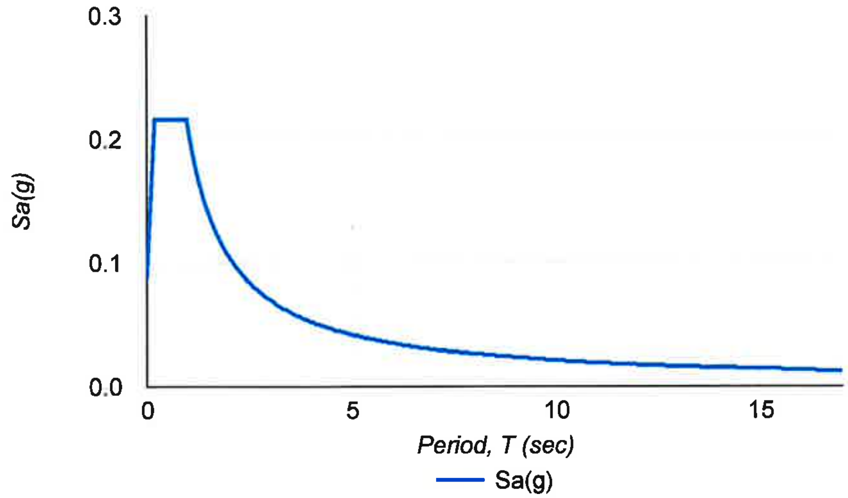
Latitude, Longitude: 59.959630556, -162.888272222

Date	6/19/2019, 4:25:47 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

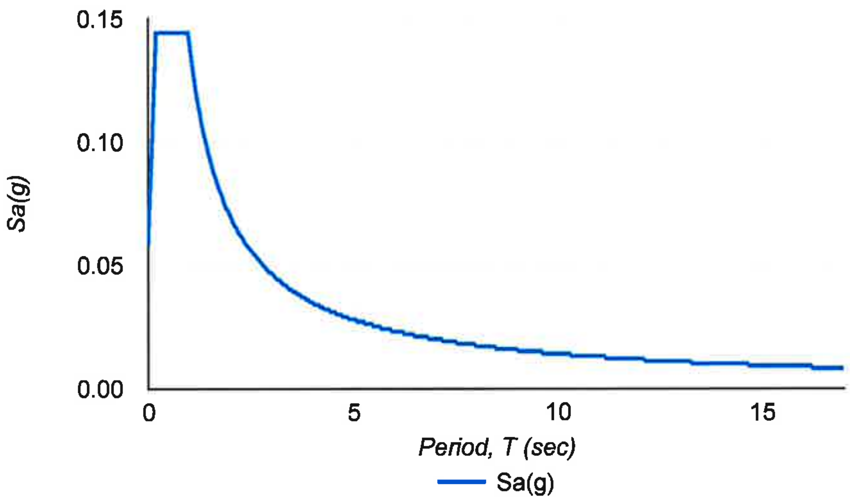
Type	Value	Description
S_S	0.135	MCE_R ground motion. (for 0.2 second period)
S_1	0.087	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.216	Site-modified spectral acceleration value
S_{M1}	0.209	Site-modified spectral acceleration value
S_{DS}	0.144	Numeric seismic design value at 0.2 second SA
S_{D1}	0.14	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	C	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.052	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.084	Site modified peak ground acceleration
T_L	16	Long-period transition period in seconds
SsRT	0.135	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.133	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.087	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.088	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	1.02	Mapped value of the risk coefficient at short periods
C_{R1}	0.992	Mapped value of the risk coefficient at a period of 1 s

MCER Response Spectrum



Design Response Spectrum

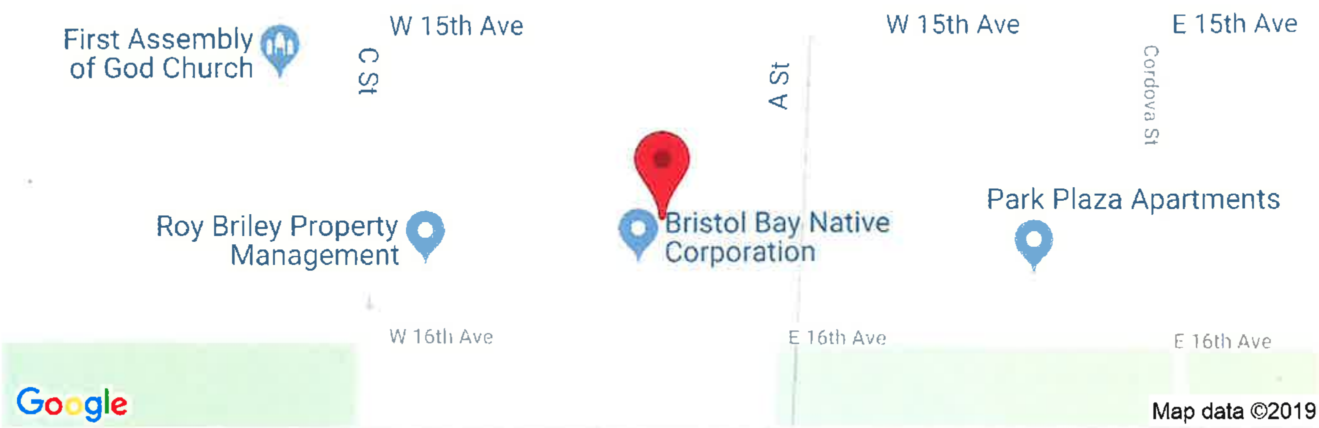


DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC /OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this webstie.

OSHPD

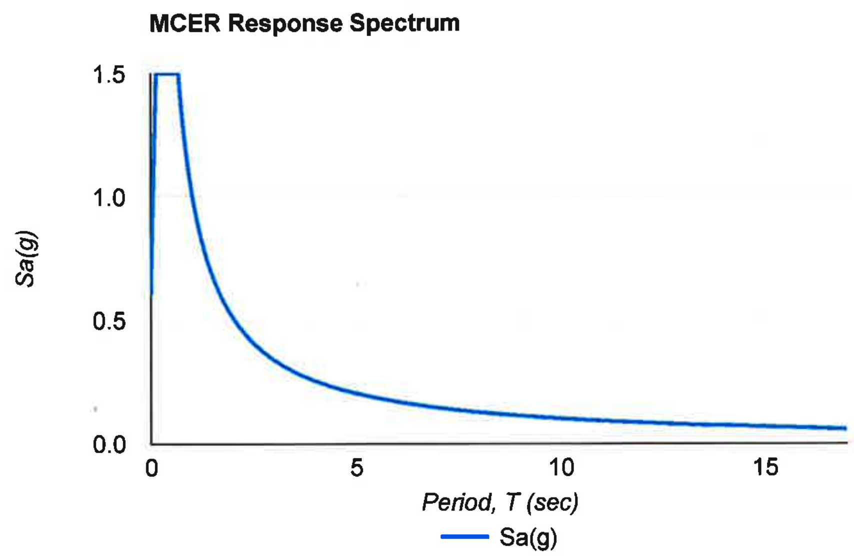
Latitude, Longitude: 61.206730556, -149.88432222

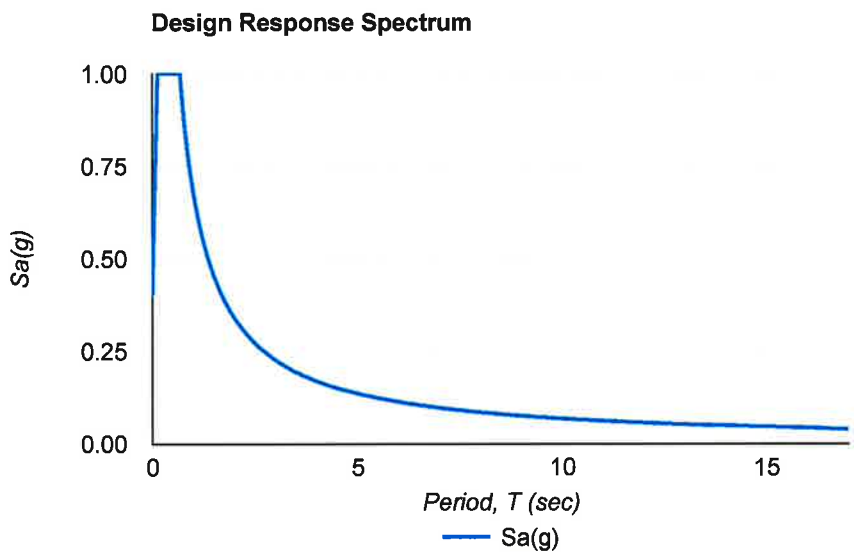


Date	6/19/2019, 4:30:57 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	**Value**	**Description**
S_S	1.5	MCE_R ground motion. (for 0.2 second period)
S_1	0.677	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.5	Site-modified spectral acceleration value
S_{M1}	1.015	Site-modified spectral acceleration value
S_{DS}	1	Numeric seismic design value at 0.2 second SA
S_{D1}	0.677	Numeric seismic design value at 1.0 second SA

Type	**Value**	**Description**
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.5	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.5	Site modified peak ground acceleration
T_L	16	Long-period transition period in seconds
SsRT	1.894	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.703	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.832	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.801	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.677	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	1.113	Mapped value of the risk coefficient at short periods
C_{R1}	1.038	Mapped value of the risk coefficient at a period of 1 s





DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC /OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this webstie.