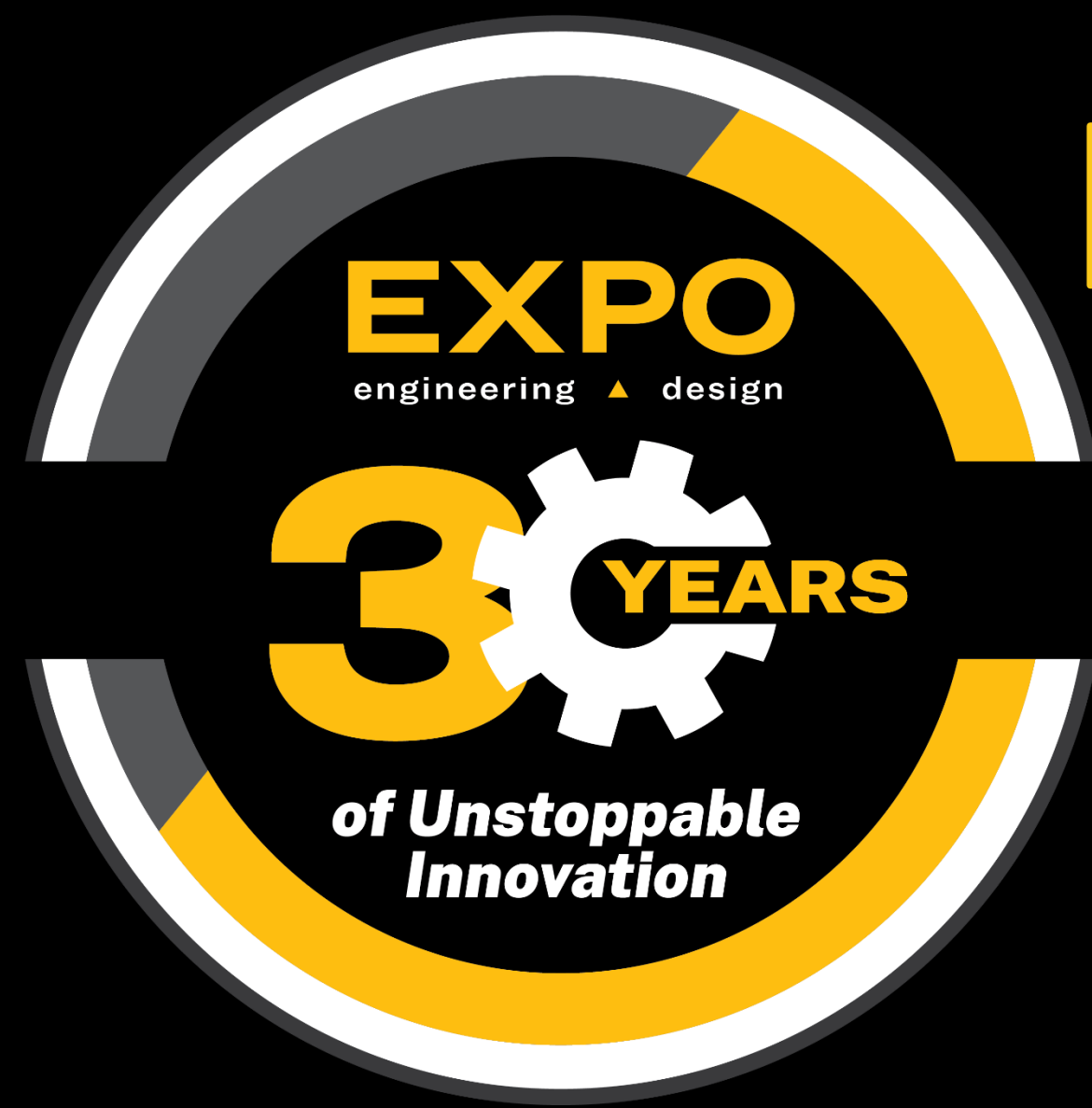
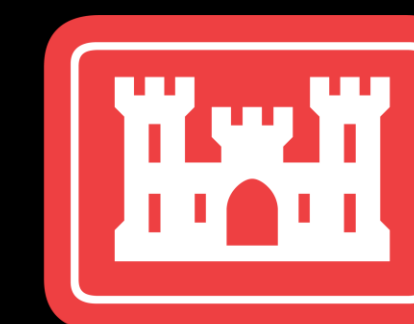




LOWER MONUMENTAL DAM FISH LADDER TEMPERATURE CONTROL SYSTEM



US Army Corps
of Engineers®



University of Idaho
Department of Civil and
Environmental Engineering

Project Team: Lauren Moore, Theodore Ertel, Madelynn Gregoire, Jayr Ayala

Project Sponsors: Jarrod Milligan, S.E., Ryan Laughery, P.E.

BACKGROUND

Anadromous fish are deterred from exiting the Lower Monumental Dam Northern Fish Ladder on the Snake River due to high temperatures and low dissolved oxygen levels.



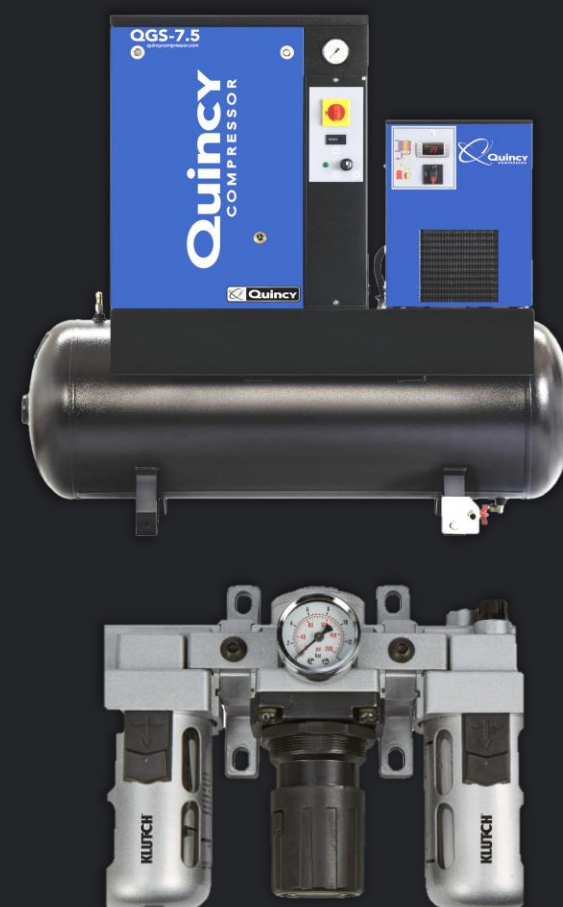
SITE LOCATION

Kahlotus, Washington



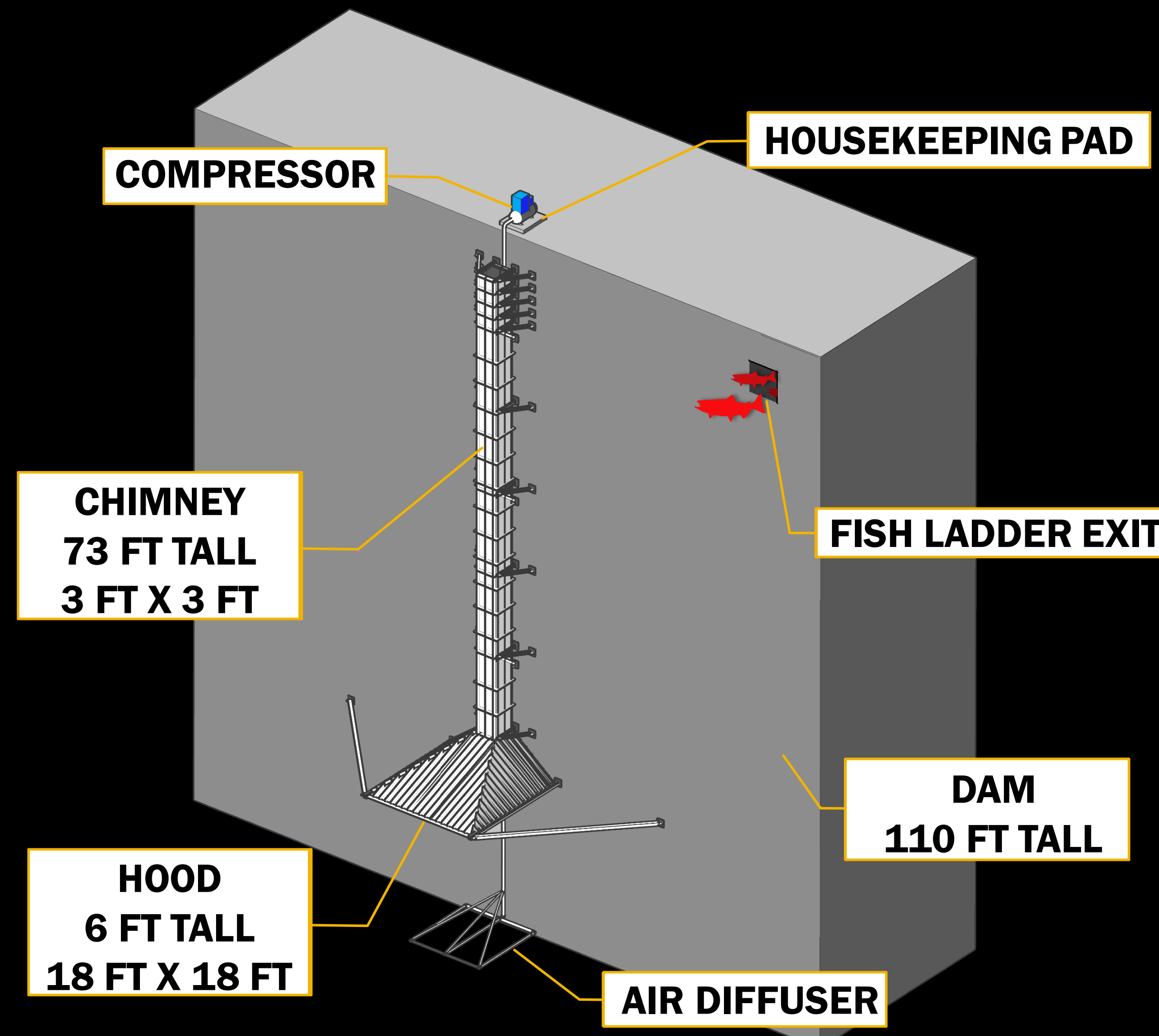
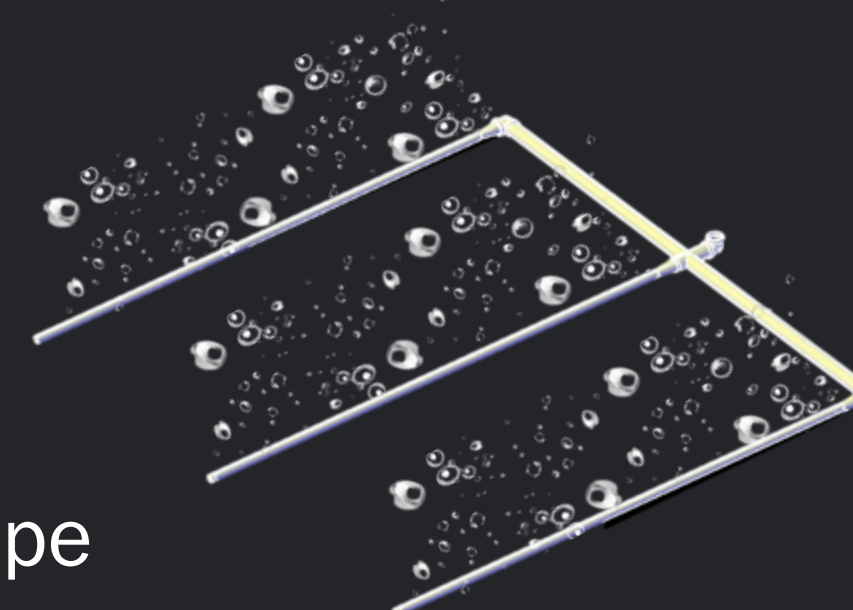
PIPE NETWORK

- 115' long 3" galvanized pipe, ASTM A53 Schedule 40
- Air flow of 22 cfm
- Minimum pressure of 60 psi
- 7.5 HP Quincy Compressor with 60 gallon receiving tank
- Klutch Air Compressor Regulator
- Routing Clamps



AIR DIFFUSER

- Coarse bubble diffuser
- Circulates 37.5 cfs of water
- 11.5' long 1.5" galvanized pipe diffuser
- 12' long 3" diameter feeding pipe
- (20) 0.2" drilled holes per ft of pipe



STRUCTURAL DESIGN CRITERIA

LOAD	DESCRIPTION	TYPE
Dead	Self-Weight	Gravitational
Seismic	Per ASCE 7-16 Chapter 13	Gravitational/Lateral
Fluid	1 ft/s Drag Force 5 ft Pressure Differential	Lateral
Debris*	Per USACE	Lateral

*Special load case that only occurs at the top 8 ft of the structure

- 3,000 psi existing concrete dam
- LRFD load combinations
- Seismic risk category 1, soil class B, and site class B
- System defined as rigid component with limited deformability elements and attachments per ASCE 7-16 Table 13.5.1
- Deflection limit of $L/180$

COST ANALYSIS

ITEM	ESTIMATED COST
Steel Chimney	\$1,900,000.00
Compressor	\$20,000.00
Pipe System	\$30,000.00
Labor and Equipment	\$450,000.00
Estimated Total:	\$2.4 Million

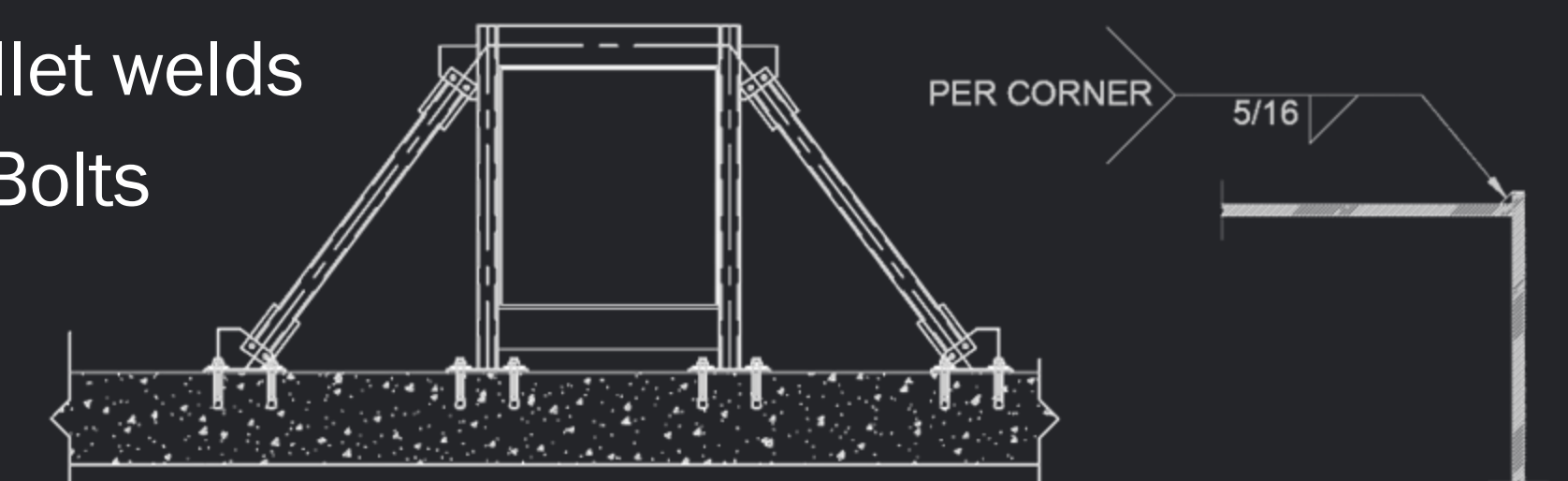
FISH BEHAVIOR

- Fish prefer temperatures around 68°F; our system circulates cooler water from lower depths.
- Bubbles deter fish; our structure minimizes the interactions between the fish and the bubbles.
- Our design also creates a current that entices fish to exit the fish ladder



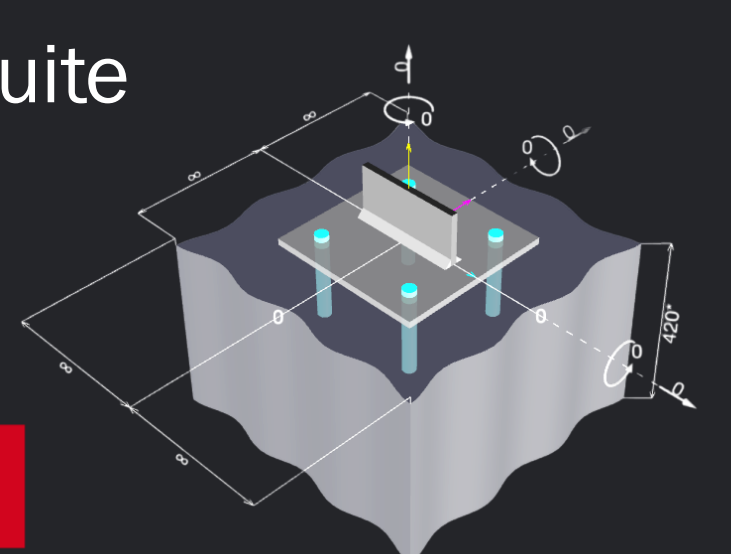
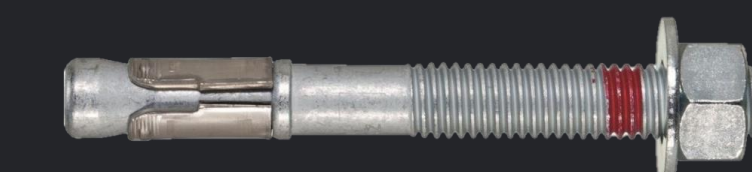
STEEL DESIGN

- Designed per AISC Steel Construction Manual
- $\frac{1}{2}$ " A36 plates walls with 6" ribs and stiffeners to increase rigidity. Protective coatings to resist corrosion
- Galvanized HSS gravitational and lateral braces
- $\frac{5}{16}$ " Fillet welds
- A325 N-Bolts



ANCHORAGE

- Designed in HILTI Profis Engineering Suite
- Chimney: KWIK Bolt TZ2 - SS 304
- Compressor: KH-EZ Concrete Screw



Faculty Advisor: Dr. Richard Nielsen, P.E.

Special Thanks: Dr. Erik Coats, P.E., Dr. Jim Liou, P.E., Dr. Fritz Fiedler, P.E.

2023 Capstone Project

