PENNSTATE

Borland Laboratory Renovation

Dustin Faust - Construction Management

PENNSTATE **Borland Laboratory Renovation**

Presentation Outline

- Project Background
- Project Overview
- Industry Research:
  - AIA 2030 Challenge and It's Significance in Renovations
- Breadth #1:
  - Redesign of Domestic Water System
- Breadth #2:
  - Redesign of HVAC System
- Conclusions
- Acknowledgments

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Project Background

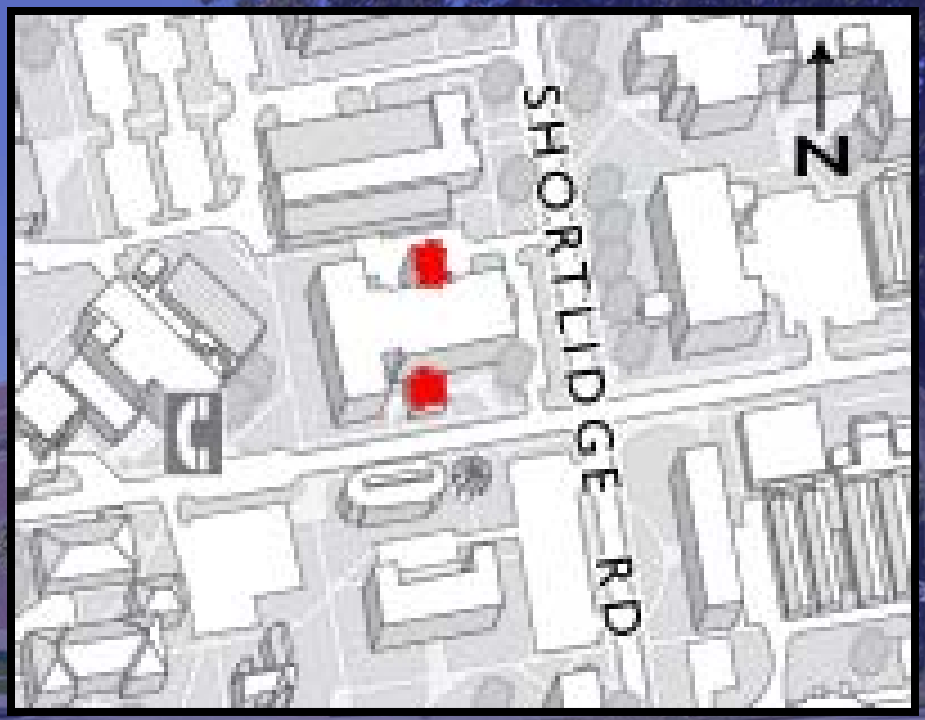
Originally Built: 1932

Housed Penn State Creamery for Over 73 Years

2 Renovations in 1960-1961

- Raw Milk Receiving Room (North Side)
- Sales Room (South Side)

Being Renovated to Original Footprint



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Project Information

Location: Corner of Curtain Rd. and Shortlidge Rd.

Function: Art History, E-Learning, and Integral Arts

General Contractor: Leonard S. Fiore

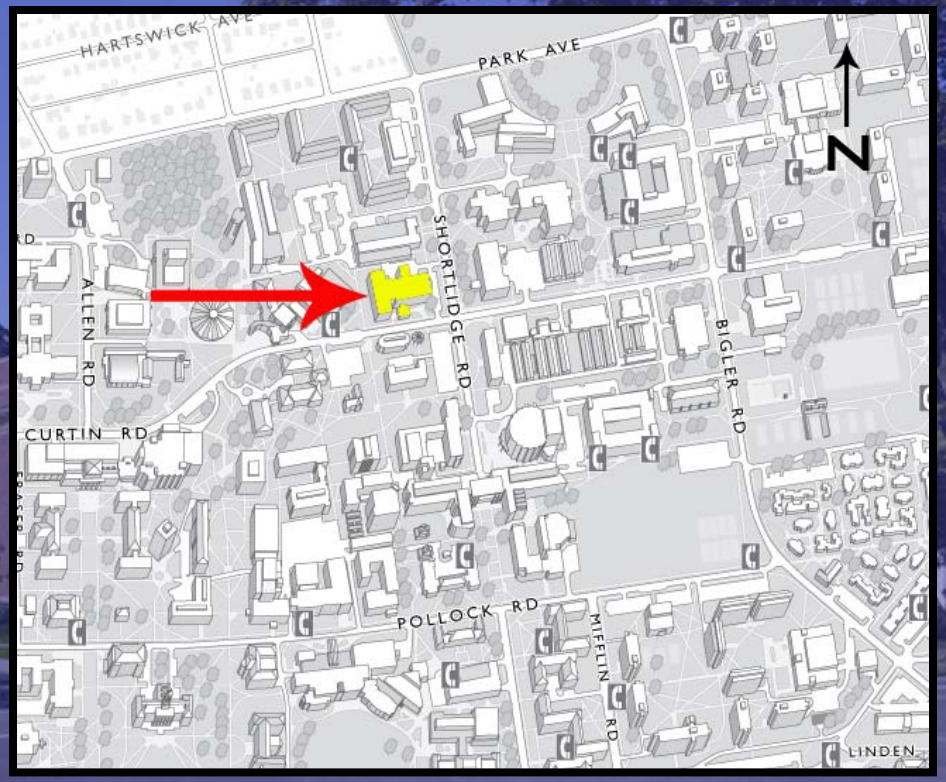
Building Size: 76,000 Ft²

Building Cost:

- Construction Costs: $11,800,000
  - $150.33 / Ft²
- Project Costs: $15,000,000
  - $197.40 / Ft²

Construction Schedule: Dec. 1st, 2006 – April 23rd, 2008

LEED: Certified



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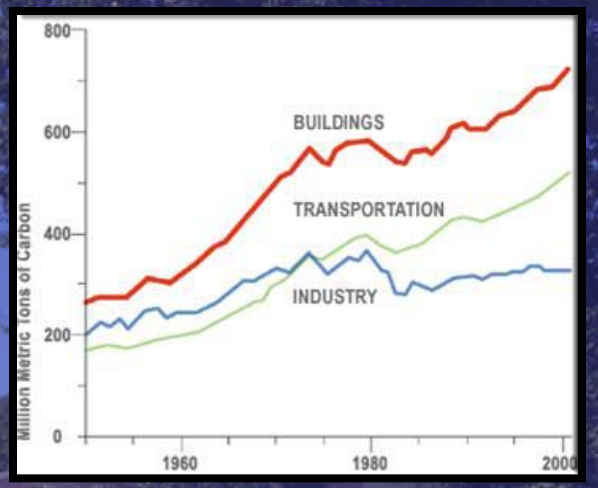
AIA 2030 Challenge:

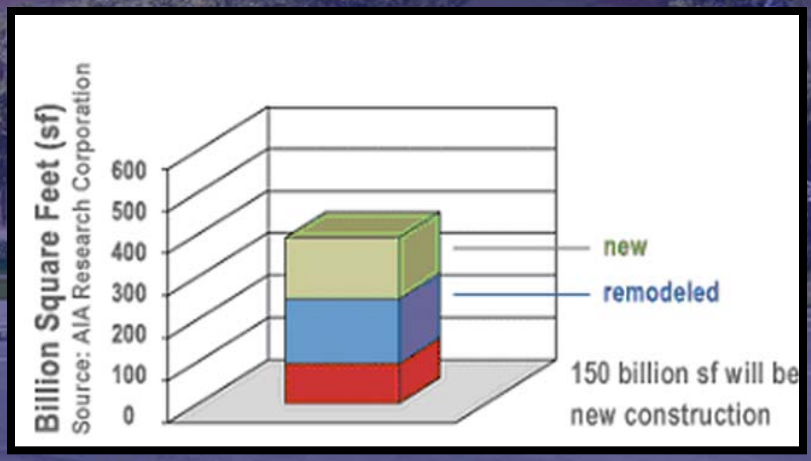
Problem Statement

American Institute of Architects – (AIA)
- Formed in 1857 by 13 architects
- Acts as the voice of the architecture profession

2030 Challenge – Challenges all A/E to stabilize and reduce the amount of Greenhouse Gas Emissions produced by the Building Industry

- Construction Industry's Effect on the Environment
- How Building Renovations Make an Effect
- Overview of AIA 2030 Goals
  - 60% by 2010
  - 70% by 2015
  - 80% by 2020
  - 90% by 2025
  - Carbon Natural by 2030





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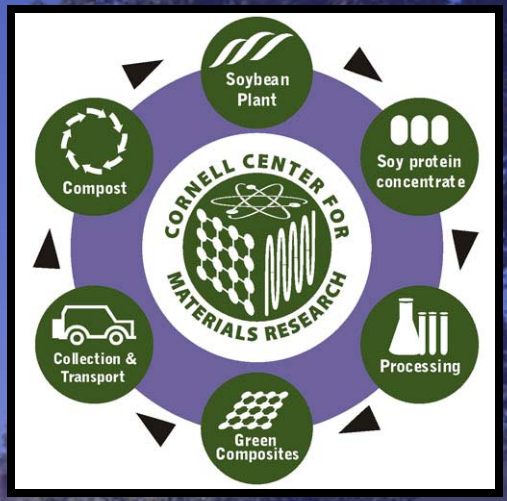
AIA 2030 Challenge: Solutions

- Development of New Materials
  - High performance glazing, More efficient and recycled insulation, New HVAC systems such as Geo-Thermal
- Education of the Problem
  - Require classes in the Architecture and AE curriculums
  - Penn State setting an example
- Development of Green Energy
  - Solar hot water, Hydro, Wind, Geo-exchange, Hydrogen fuel cells



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AIA 2030 Challenge: Conclusions

- Survey Results – Architecture Faculty at PSU
  - No one heard about the AIA 2030 Challenge
  - All agree PSU should put a carbon neutral plan into effect
  - All feel that the goals set by the 2030 challenge are achievable
- Technology Vs. Education
  - Survey shows that not many people know about this challenge
  - We have the technology in materials and energy sources, however they are not being used.
- Resolution #50
  - Passed by mayors of Albuquerque, Seattle, Chicago, and Miami
  - All new construction and renovations follow codes set by AIA 2030 Challenge and the U.S. Department of Energy

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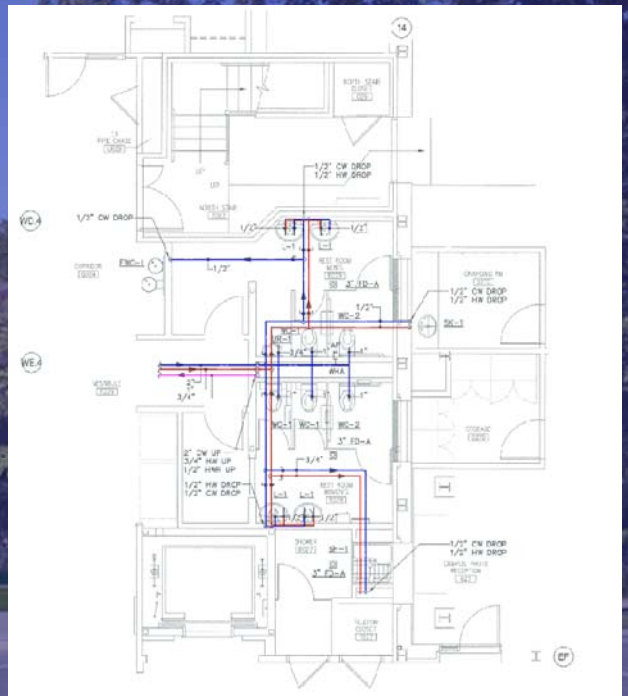
Domestic Water Piping System

Overview and Problems with the Design

- Sweated Copper Tubing Design
  - Rigid Type L Copper
- Valve Placement
  - Valves placed in ceiling plenum
  - Hard to find in emergency
- Price of Copper – no markup
  - 1” copper tubing - $4.23 / LFt
  - 1” PEX tubing - $1.35 / LFt



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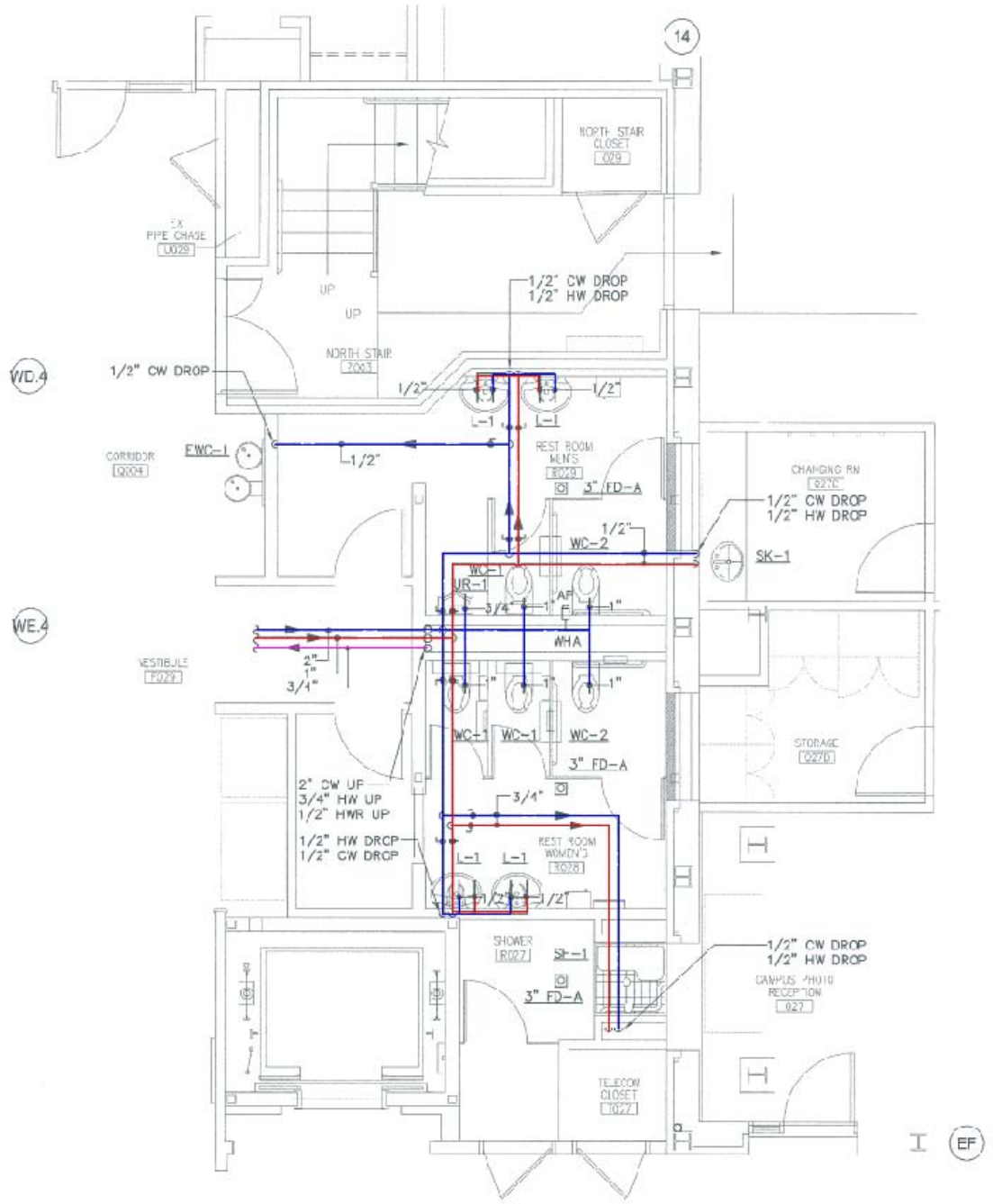

4 GROUND FLOOR REST ROOM PARTIAL PLAN-DOMESTIC WATER

P302 SCALE 1/4"=1'-0"

Copper Piping System Estimate

Includes only materials with no mark-up
- Supplied by APR Supply Co.

Copper Piping System		
Copper Pipe Total Cost		$17,122.70
Copper Fittings Total Cost		$3,839.57
Total Cost		**$20,962.27**

Detailed Estimate and Take-off Found in Thesis Report

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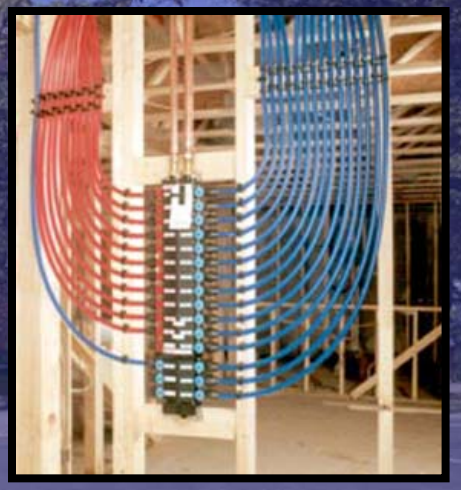
Solution

PEX Tubing System

PEX - **Cross-Linked Polyethylene Tubing**

Advantages of PEX Tubing:

- Much cheaper compared to copper
- Due to flexibility, much easier to handle and install
- Can be recycled
- Manifold system
- Heavily tested
- Easily connected fittings



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PEX System Estimate

PEX and Copper Combination
- PEX sizes 1” – ½”
- Copper sizes 3” – 1 ½”

Includes only materials with no mark-up
- Supplied by APR Supply Co.

PEX Piping System		
PEX & Copper Pipe Total Cost		$10,866.84
PEX & Copper Fittings Total Cost		$1,426.84
Total Cost		**$12,293.71**

Detailed Estimate and Take-off Located in Thesis Report

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Conclusions

Cost and Schedule Effects

- Includes only materials with no mark-up
  - Supplied by APR Supply Co.

Copper Piping System		
Copper Pipe Total Cost		$17,122.70
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Total Cost		**$20,962.27**

PEX Piping System		
PEX & Copper Pipe Total Cost		$10,866.84
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Savings of 96 man hours by using PEX Piping System
- Estimated by: Schuylkill Sales Co.

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Geo-Thermal HVAC System

Overview and Problems with Design

- Following with the AIA 2030 Challenge
  - A Geo-Thermal Heat Pump system has been designed for this renovation
- LEED Rating
  - 33 points required for silver rating
- 4 Trane AHUs
  - Low Pressure Steam
  - Chilled Water

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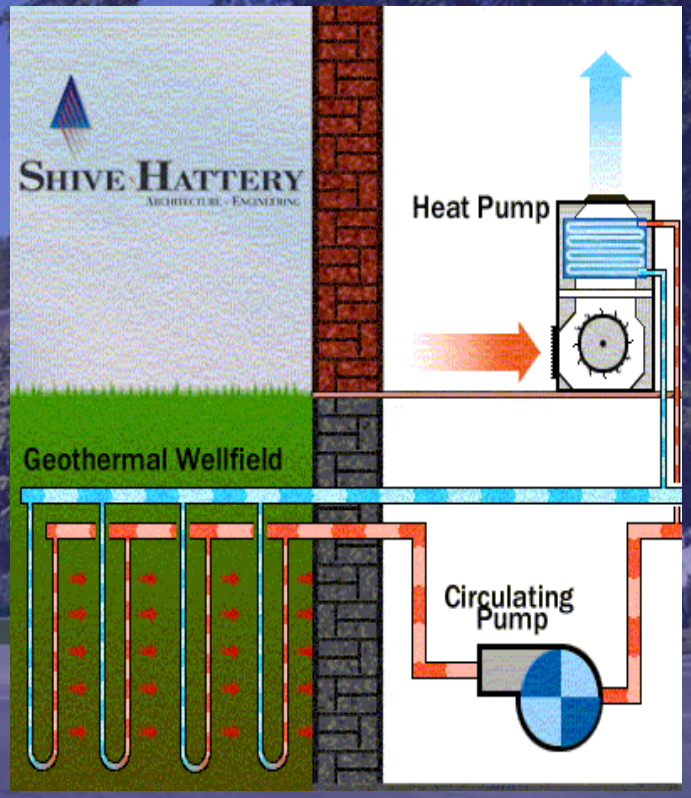
Solution

Geo-Thermal HVAC System

Underground earth and water stay at a stable temperature of 55ºF at a depth of 10 ft. or more.

This energy is captured and stored by the liquid in the piped during the heating and cooling seasons



Advantages of a Geo-Thermal HVAC System

- Very Durable Piping
  - Uses polyethylene piping
  - Life cycle of 30 – 50 years
- Heating and Cooling Cost Savings
  - 25 – 40 percent
- Earth Friendly System
  - All tubing and liquids are earth friendly

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Geo-Thermal System

Estimate

4 – 25 ton units.....$99,600

2 – 15 ton units.....$33,400

- According to CostWorks 2005

Drilling of Wells, Piping, and Fittings

$7.00 / Ft. x 32,500 Ft.....$227,500

- Supplied by H&M Well Drilling

Total Cost.....$360,500

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Conclusions

Rule of thumb 200-250 ft of tubing per ton
- Supplied by APR Supply Co.

4 Trane Units = 130 Tons

130 Tons x 250 ft/ton
= 32,500 ft or 6.16 Miles

Not feasible for this building
- Due to a lack of undeveloped green space near the project

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Final Conclusions

AIA 2030 Challenge

- Penn State and other universities need to set an example and implement a carbon neutral plan.
- Resolution #50 by the conference of mayors is a step in the right direction, however more cities need to agree to the plan

Breadth #1 – Domestic Water Re-Design – PEX Tubing System

- A PEX tubing system will result in a great cost savings and minimal schedule savings.
- The manifold system makes it easier to service.
- All valves are located at the manifold resulting in less time searching for a valve during an emergency
- I recommend this system for the Borland Laboratory Renovation, and for future use in the commercial building industry

Breadth #2 – HVAC System Re-Design – Geo-Thermal Heat Pump System

- A combination of the extensive amount of piping and the well drilling cost leads to a total cost of $360,500
- Due to the vast amount of underground piping needed for this system to run efficiently, this system is unfeasible do to a lack of undeveloped green space at the project site
- I do not recommend the use of a Geo-Thermal heat pump system on this project due to the above reasons.

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Acknowledgments

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- Dan Breon – Penn State Office of the Physical Plant
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