



Checklist for Maintainability:

**An Owner's Perspective for
Design and Construction**

Jack Colby, Asst. Vice Chancellor for
Facilities Operations

Allen Boyette, PE, CEFP, Director,
Building Maintenance and Operations

David Hatch, PE, CEFP, Director, Repair
and Renovation Services

What is Maintainability?



Facility Maintainability is the practice of **integrating operations and maintenance experience** into the project planning, design and construction process to achieve ease, accuracy, safety and economy of maintenance task through the life of the facility.

What Is Maintainability?

- Durable and long lasting
- Cost effective, TCO
- Flexibility
- Renewable
- Replaceable
- “Bad” experience produces “Good” results
- Build It As If It Was Your Money. It Is!



Why Maintainability Matters

- **Operations Funding** - down 40% over 10 years
- **Maintenance staffing** = 50% of industry standards > 75,000 gsf.
- **Housekeeping Staffing** - >37,000 gsf
- **SCO FCAP** = DM&CR backlog of \$5.4 billion
- **Extended Equipment Lifespans**
- **Low Capital Reinvestment**
- **State Projects Are Different!**

Sustainability

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

- More Sustainable = More Maintainable
- Proper selections of building material
- Are materials recyclable after use?
- Are the materials locally sourced?
- Are we designing for disassembly/ replacement over lifespan?

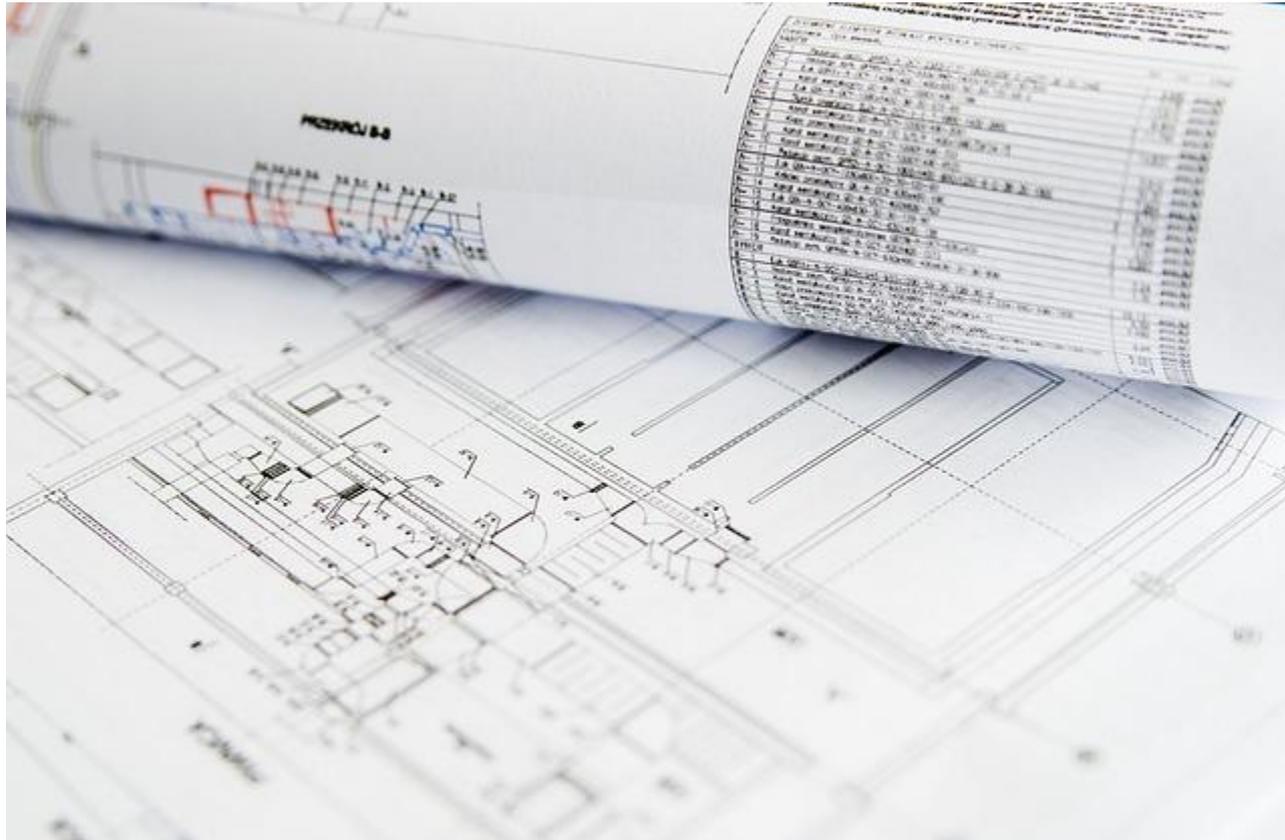


Why Sustainability Is Important

- Energy costs continue to escalate
- 75% of a building's total cost is the operating cost over its lifespan
- State buildings will not be torn down in 30 years
- Systems will be replaced 3 times during the building's life
- Healthy environments



Maintainability Starts With Design





Have I Reviewed the Owner's Design Standards?

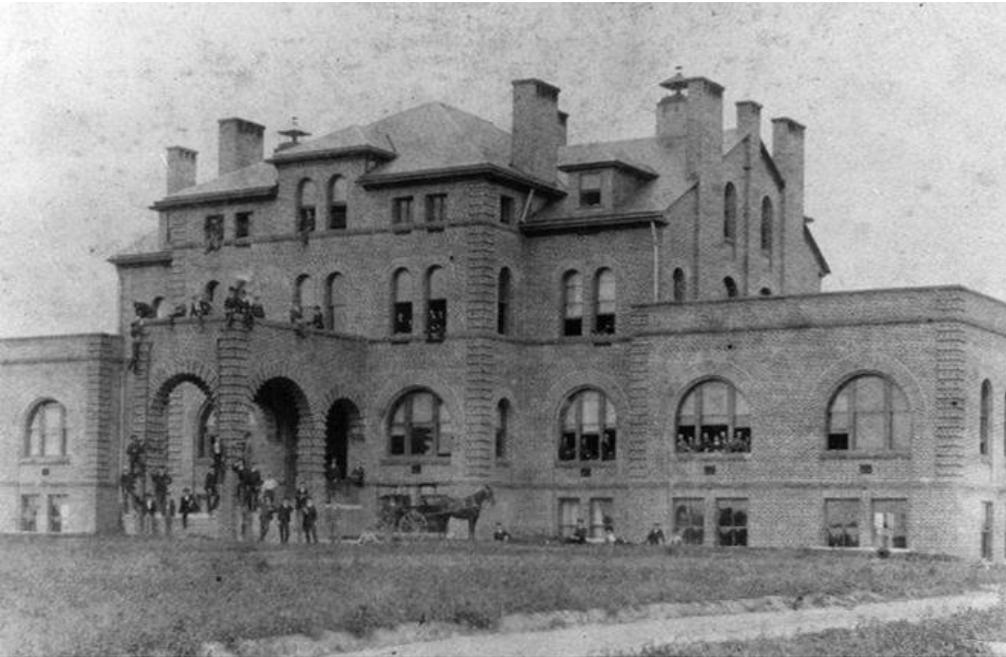


No, seriously, read them AND use them.

DESIGNING FOR MAINTAINABILITY



What are the Owner's Expectations?



100-year shell, 30-year interior



Has Cradle to Grave Life Cycle Approach Been Incorporated Into Design?

Pre-Building

- Manufacture, package, shipping

Building

- Construction, **Operations**

Post-building

- Disposal, recycle, reuse



DESIGNING FOR MAINTAINABILITY

What Do You See?

- **Mechanical Contractor**
 - Excellent workmanship
- **Design Engineer**
 - Beauty – I am the greatest designer ever!!!
- **Maintenance Manager**
 - Space to access equipment
 - Room to replace equipment
 - Clearly identify systems
 - Determine issues at a glance
- **Architect**
 - Wasted Space - I could have improved the Net to GSF Ratio



DESIGNING FOR MAINTAINABILITY



Is it accessible for maintenance and operations staff?



If we can't get to it, we can't maintain it.

DESIGNING FOR MAINTAINABILITY



Is it accessible for maintenance and operations staff?



If we can't get to it, we can't maintain it.

DESIGNING FOR MAINTAINABILITY



Is it accessible for maintenance and operations staff?



Fume Hood exhaust fans - Primary life safety devices!



Is it accessible for maintenance and operations staff?



Why do you think it took so long to correct the too hot issue and repair the leak.

DESIGNING FOR MAINTAINABILITY



Is it accessible for maintenance and operations staff?



Would you go in here?

DESIGNING FOR MAINTAINABILITY

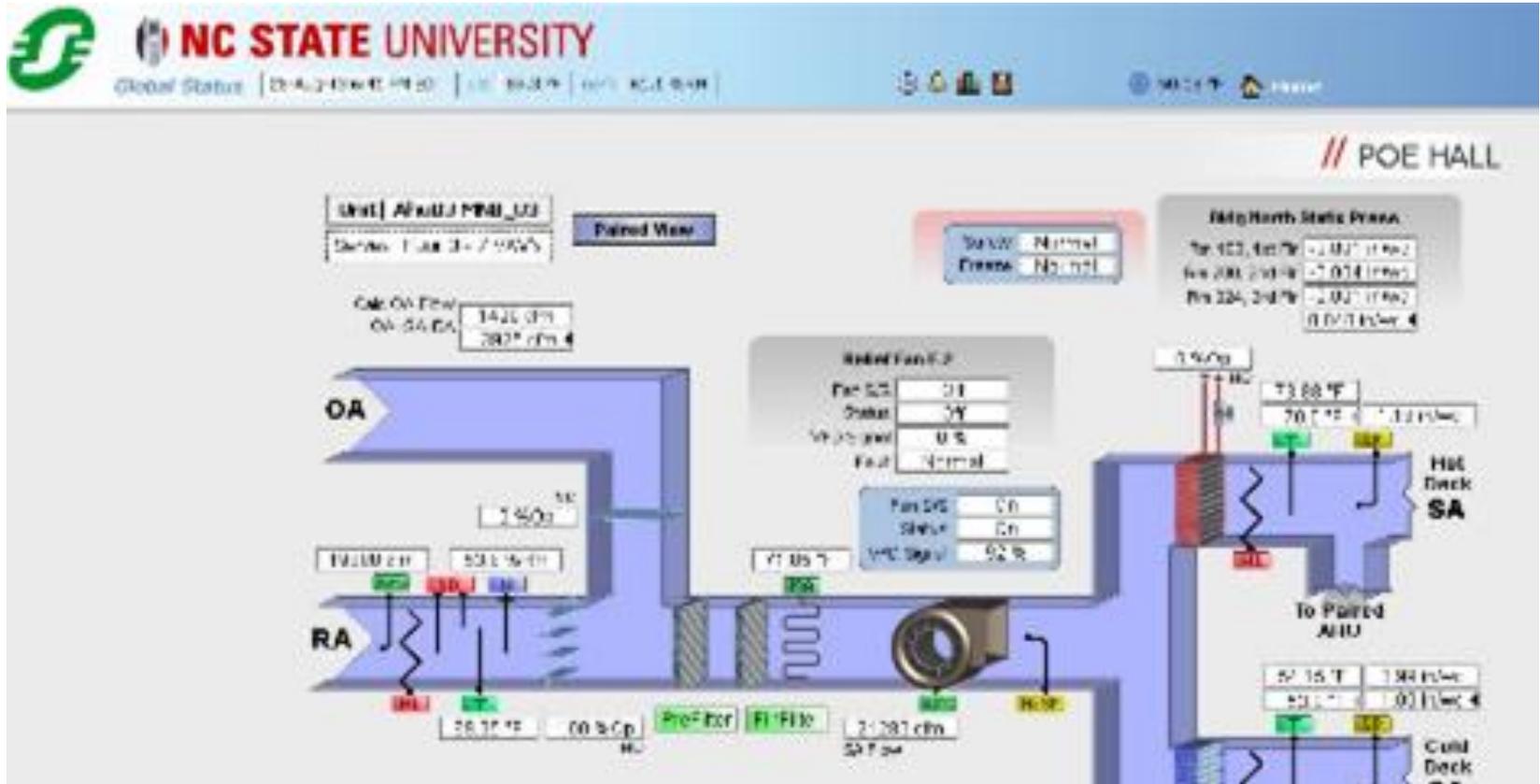


Does the layout enable accessibility?

- Additional items required to make system fully functional
 - Valves, electrical junction boxes and radius bends, pipe flanges, pipe & duct insulation, I-Beam support thickness, condensate drains
- Block, Single line, or dimensioned detail
 - What is needed to convey the requirement?
 - What does the designer need to do to ensure it fits with adequate access?

DESIGNING FOR MAINTAINABILITY

✓ Is this compatible with existing systems?



High-tech building systems

DESIGNING FOR MAINTAINABILITY



Does the design include unnecessary gadgetry?



Use it on another client's project.

DESIGNING FOR MAINTAINABILITY

Is the design versatile?

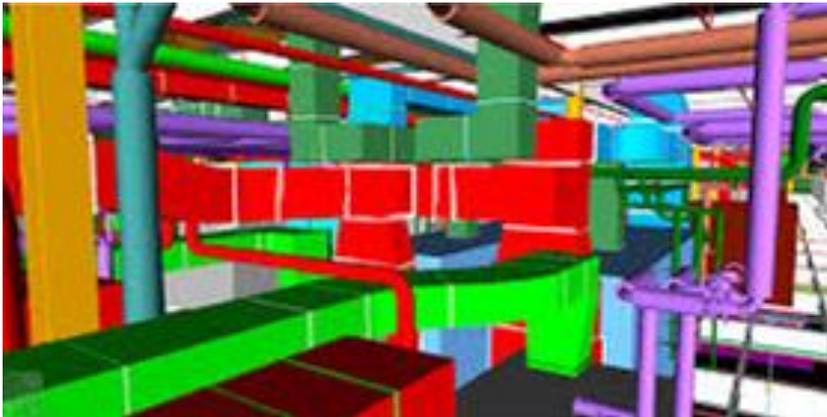


Who knows how the building
will be repurposed in 50 years?

DESIGNING FOR MAINTAINABILITY



How do I help the contractor visualize the design?



Provide a 3D model.

DESIGNING FOR MAINTAINABILITY

Other Tips for Owners and Designers

- Show areas to remain clear on drawings
 - Coil pull, items in ceiling, aisles, etc.
- Avoid underground duct and ‘pits’
- ‘Walk through’ (on paper) the Maintenance Tasks that must be performed – Include operations staff early in the process
- Discuss how equipment will be replaced
- Detail worst/tightest conditions

DESIGNING FOR MAINTAINABILITY

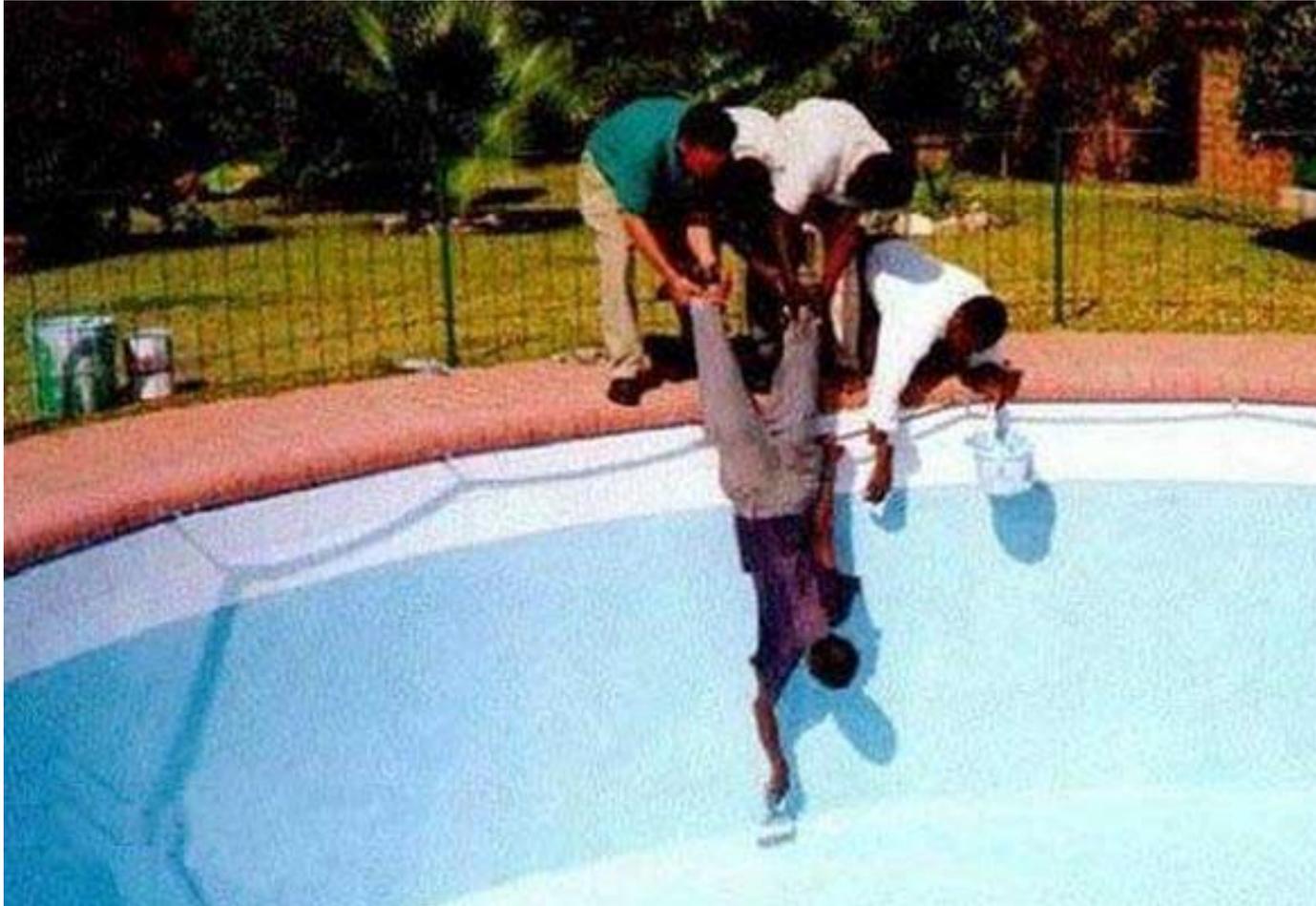


Is the design simple and straightforward?



If designer can't understand how it works,
don't expect the maintenance staff to.

Construction with Maintainability in Mind



BUILDING FOR MAINTAINABILITY



Have I asked, 'Does This Make Sense?'





BUILDING FOR MAINTAINABILITY

Have I asked, 'Does This Make Sense?'



North entry door is equipped with an automatic opener, although it is otherwise inaccessible.



BUILDING FOR MAINTAINABILITY

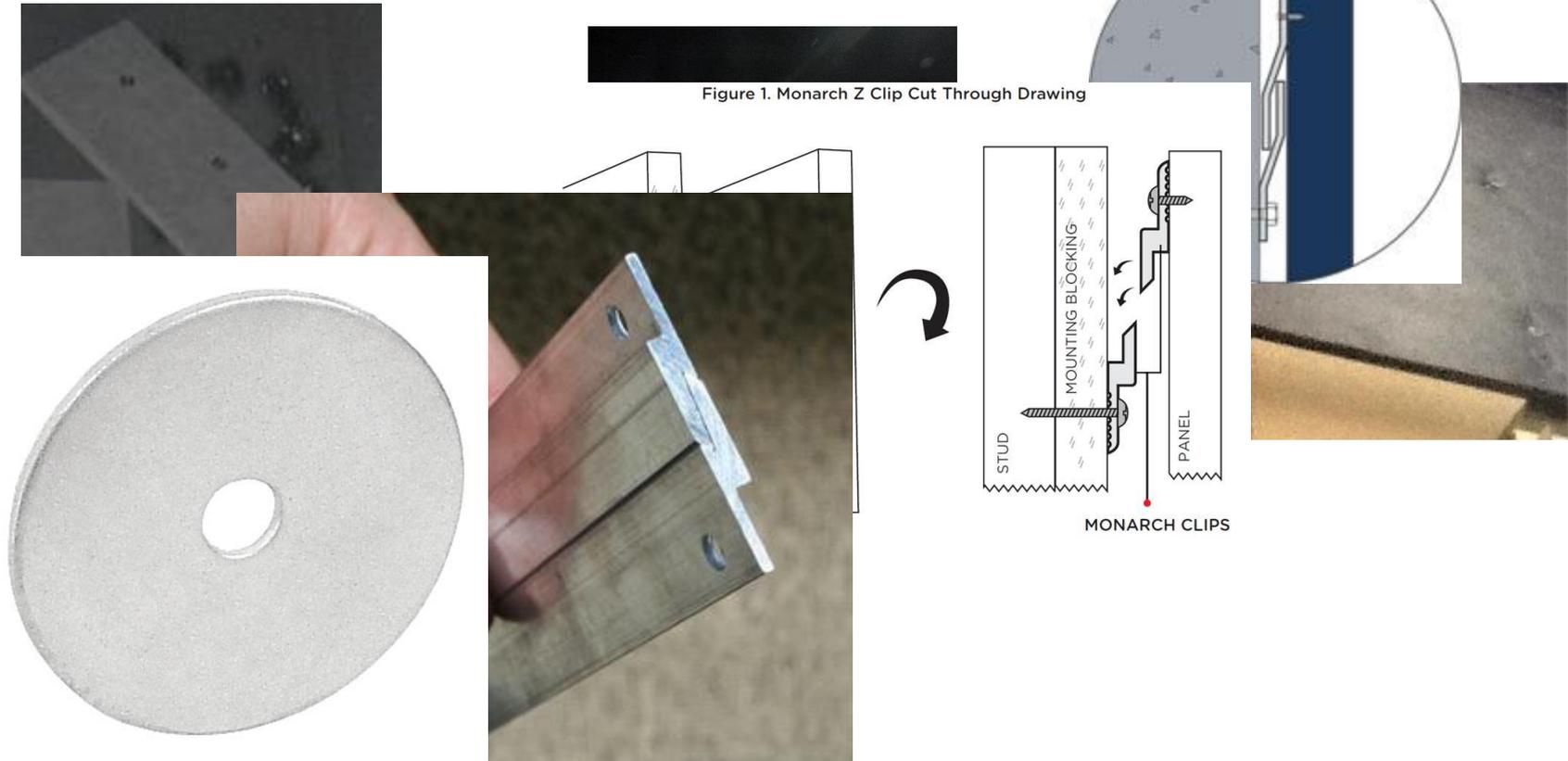
Did We Get the Basics Right?



Have the installers been trained?

BUILDING FOR MAINTAINABILITY

Did We Get the Basics Right?



Are the details on the manufacturer's data sheets?



BUILDING FOR MAINTAINABILITY

Did We Get the Basics Right?

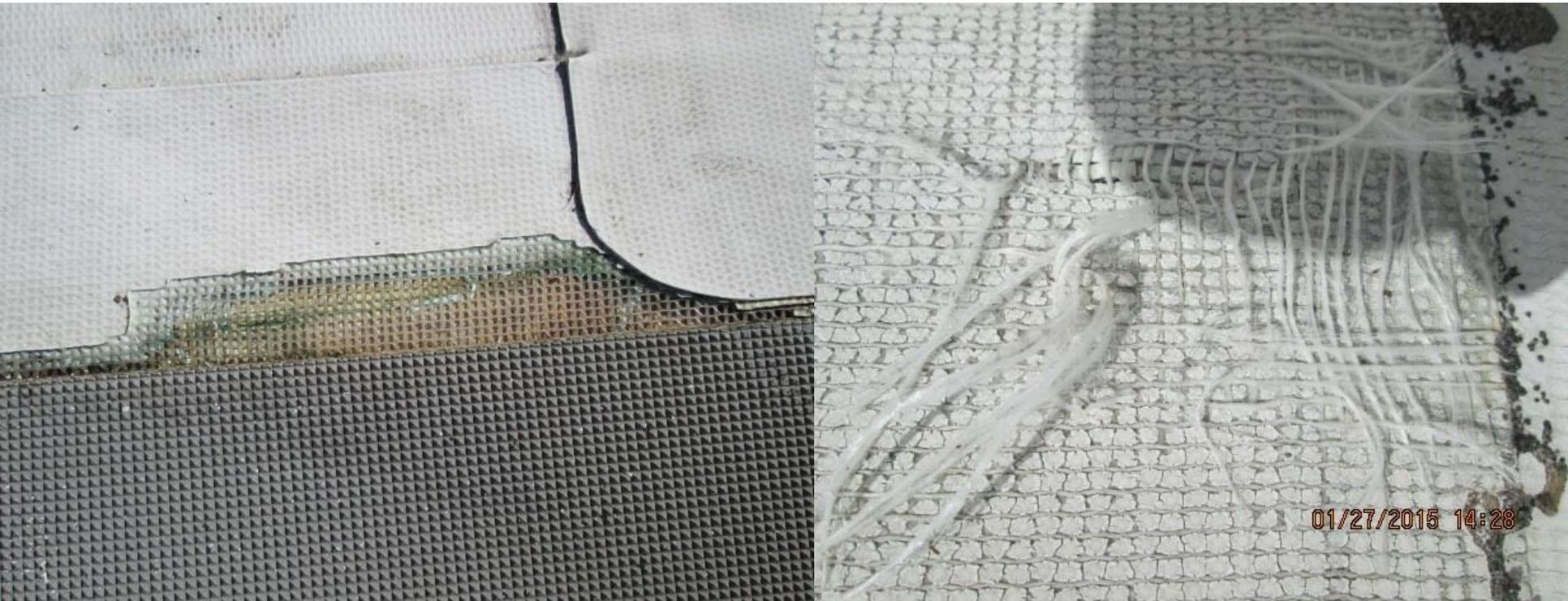


Fix it now or fix it later.

BUILDING FOR MAINTAINABILITY



Is the Building Material Proven and Durable?

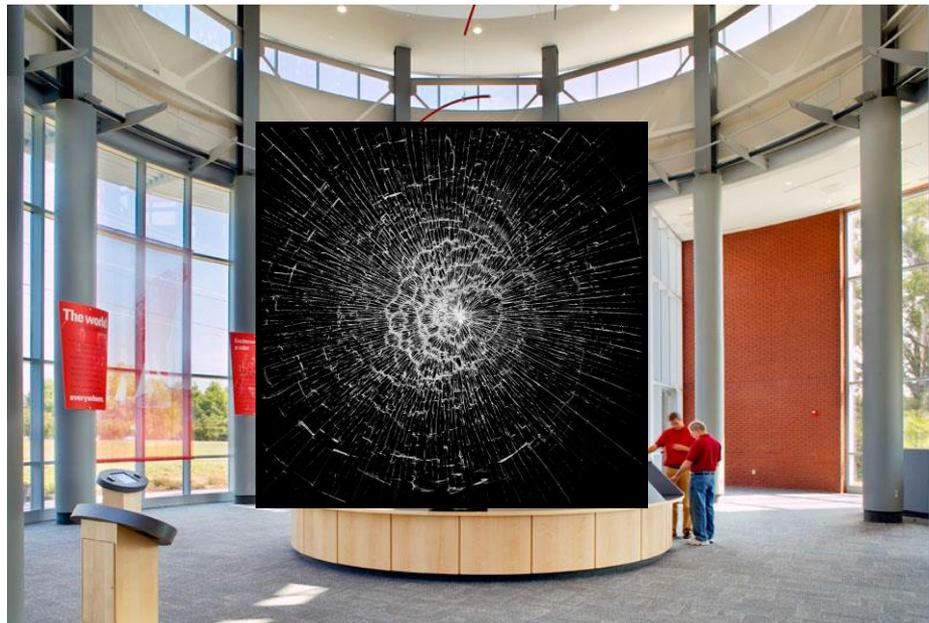


So much for this roofing membrane
lasting through its 2020 warranty

BUILDING FOR MAINTAINABILITY



Have Proprietary Materials Been Avoided?

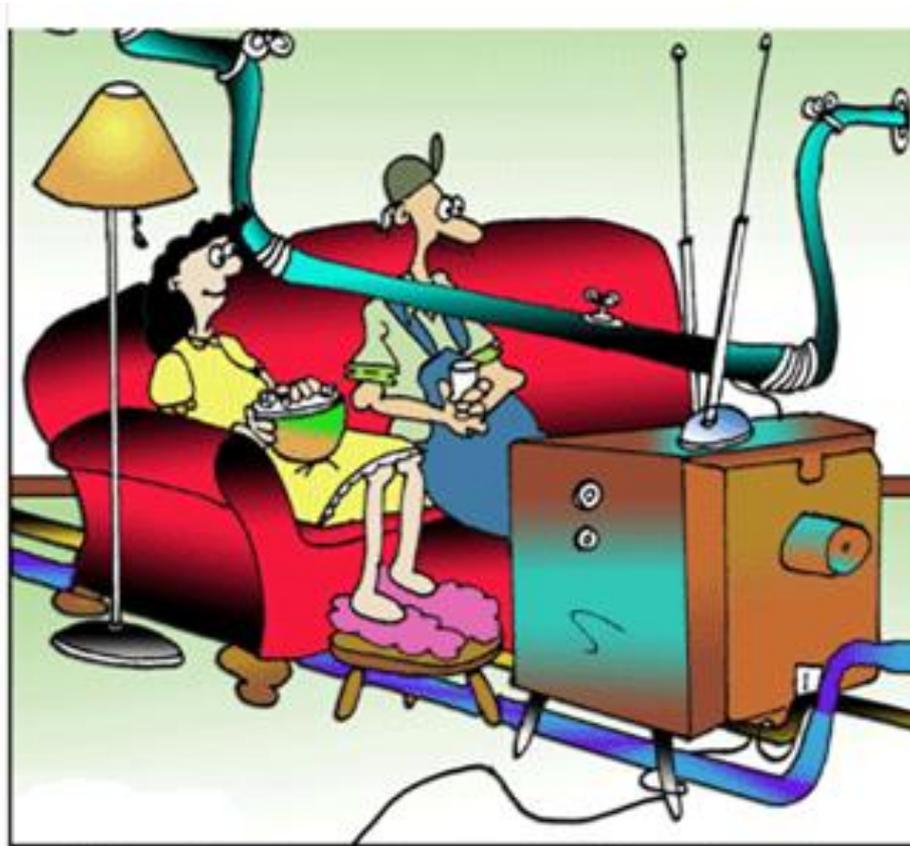


Remember, it has to last us 30 years.

BUILDING FOR MAINTAINABILITY



Have We Followed the Plans?



Why it's a bad idea to decide on location changes of duct work late in a building project.

✓ Have We Coordinated Overhead Piping & Ductwork?



Coordination drawings are better than ductwork mods



BUILDING FOR MAINTAINABILITY

Have Important Areas Been Inspected?



Horizontal Kitchen Exhaust

BUILDING FOR MAINTAINABILITY



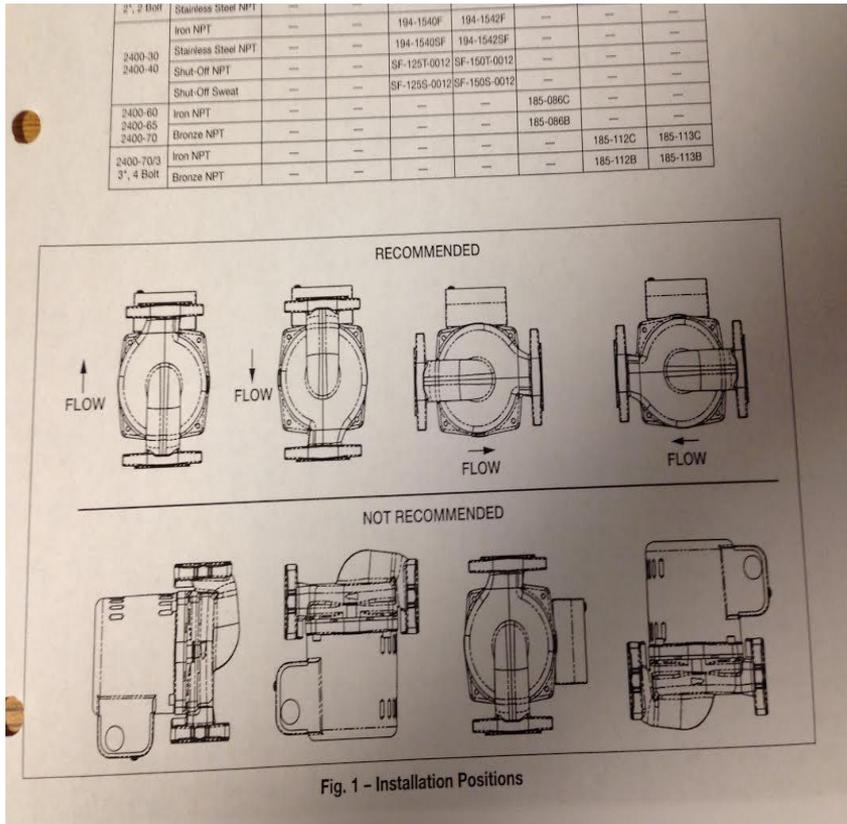
Have We Followed the Plans?



If the design says install 1.5 HP pump, please don't install a ½ HP pump.



Have We Followed the Manufacturer's Specification?



Pump motor orientation

BUILDING FOR MAINTAINABILITY



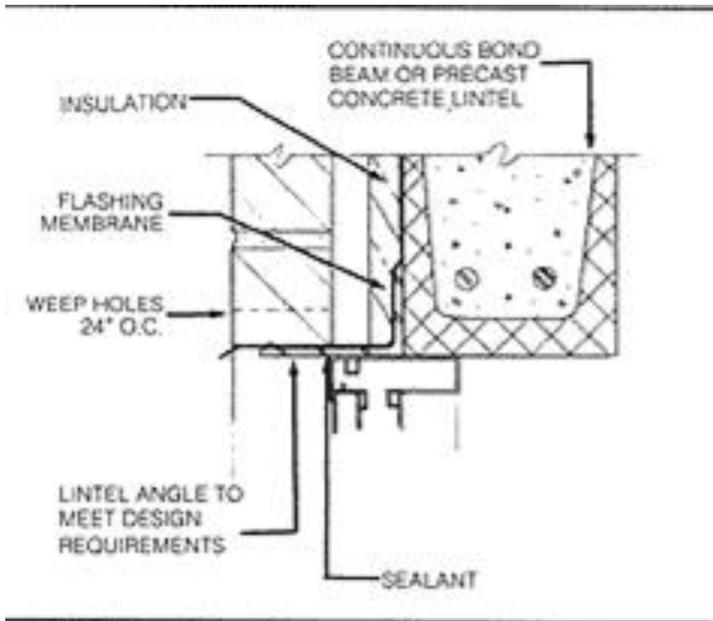
Have We Followed the Manufacturer's Specification?



300 HP Motor w/ roller bearings. Ball bearings were specified.

BUILDING FOR MAINTAINABILITY

Do Submittals Meet the Specification?

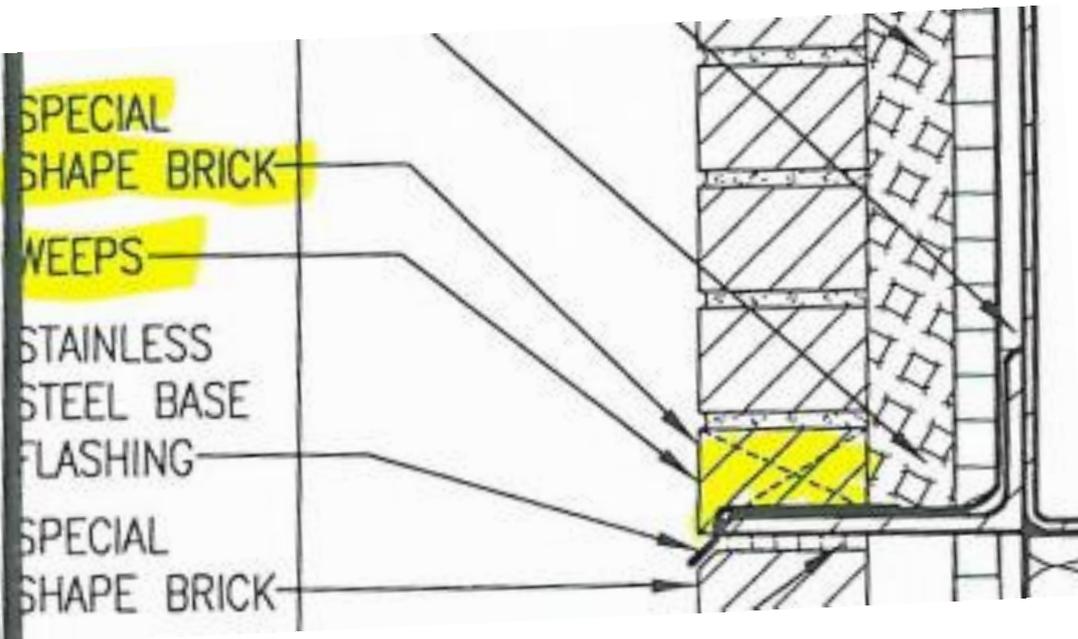


Two Piece Flashing Substitution

BUILDING FOR MAINTAINABILITY



Have We Followed the Plans?



Site fabricated brick falls away from building due to freezing



BUILDING FOR MAINTAINABILITY

Did We Get the Basics Right?



Flashing Details

BUILDING FOR MAINTAINABILITY

Skids Are Easy For Designers



Not for maintenance staff.

BUILDING FOR MAINTAINABILITY



Have you talked with those who will be operating and maintaining the building?



They need a seat at the table.



**What Have We
Learned?**

Major Takeaways

- Know and Understand the Owner's Standards
- Ask What the Owner wants; don't Assume that you know
- Take Life Cycle Cost Decisions seriously -- in all parts of the design, not just systems
- Design for flexibility of use and renewal over the life of the building
- Are you designing for access and efficient maintenance?
- Are you training construction trades on expectations?
- What will future maintenance staff say about your design? Your construction?

Discussion