Should a Deferred Maintenance Project Stop at Deferred Maintenance?

Jon Ziegler II, PE
LEED AP, GGP
Senior Mechanical Engineer/Analyst
jziegler@glhn.com
A better understanding of Deferred Maintenance (DM) and the needs it engenders

What a successful DM project truly entails

Ways to incorporate efficiency improvements when they are not the focus

Understand one pathway to success through example

Case Study
What we mean by Deferred Maintenance (DM)
What DM typically does and doesn’t involve
DM & energy efficiency improvements
Case Study: University of Arizona, Building 90
  History
  Project Timeline
  Marketing the Need
  The Project
  The Results
In the absence of renewal and funding, buildings from the 1950’s and 1960’s are becoming high risk.

- History of lower maintenance funds
- MEP well beyond projected life

DM doesn’t end with this wave of buildings; construction from more recent decades will soon become the focus.
THE HEART OF DEFERRED MAINTENANCE

IN FRONT OF THE WALLS
23%

BEHIND THE WALLS
77%

Roofing - 25 yr
Exterior - 30 yr
Elevators - 25 yr
Fire sprinklers - 40 yr
Fire alarm - 25 yr
Built in equip - 25 yr
Interior finishes - 15 yr
Painting - 15 yr

HVAC controls - 20 yr
HVAC equipment - 30 yr
HVAC distribution - 50 yr
Electrical equipment - 25 yr
Electrical distribution - 50 yr
Plumbing fixtures - 30 yr
Plumbing piping - 50 yr
THE HEART OF DEFERRED MAINTENANCE

- Cracked concrete floors
- Antiquated cold rooms
- Envelope leakage
- Asbestos abatement
- Deteriorated insulation
- Duct leakage
- Aging MEP equipment
- Poor MEP control
- Dirty ductwork
- Erratic ACH/pressures
- Interior duct lining
- Aging Distribution Gear
- Site drainage issues
- Piping dead legs
- Piping leaks
WHAT MAY NOT BE ADDRESS

- Antiquated casework
- Antiquated programming
- Inefficient lighting
- If not original installation
- Aesthetic concerns
- Outdated lab equipment
- Certain Efficiency Upgrades
  - Not typically a focus of DM
WHAT ABOUT ENERGY EFFICIENCY?

In Scope: Equipment Replacements
   (Low to no extra cost)
   ◦ HVAC controls replacements
     ◦ Pneumatic to digital
     ◦ Standard, modern sequences
     ◦ Trending/fine-tuning
     ◦ Controls that actually work
   ◦ Improved fan/motor technologies
   ◦ Variable speed drives now more economical
   ◦ Lower air change rates?
   ◦ LED lighting?
   ◦ Other electrical gear
     ◦ Minor, probably only 1-2% equip. eff. increase

Energy Efficiency Projects
   (Separate funding source?)
   ◦ Energy recovery
     ◦ Careful of equipment locations, cost can escalate
   ◦ Introduce mixed air systems
     ◦ Economizers
   ◦ CAV to VAV
     ◦ Automated exhaust valves
   ◦ Lighting Controls
   ◦ LED lighting?
Case Study: University of Arizona Bldg. 90 Renewal
BLDG. 90 AT A GLANCE

Background:
Built in 1967
5 stories, 60,000 GSF
Originally Pharmacy
Then Veterinary Sciences
Then Microbiology
Now Animal and Comparative Biomedical Science

Occupancy:
Office
Classroom
Wet Lab
Lab Support
Vivarium

Issues:
Mold
Asbestos
Ventilation
Piping
Power
Lighting
TIMELINE

- 1995 -2015  Mounting Occupant Concerns and FM Costs
- 2016 Q2  Facility Condition Assessment
- 2016 Q4  Marketing
- 2017 Q1  Funding Approvals
- 2017 Q1  Release RFQ
- 2017 Q2  Select DB
- 2018 Q2-Q3  Design
- 2018 Q3-Q4  Abatement and Demolition
- 2018 Q3-Q4  Contractor Scope
- 2018 Q3- 19Q1  FM Scope
- 2019 Q1  Occupy
MARKETING: PRODUCTIVITY

RISK AND PRODUCTIVITY IN THE ABSENCE OF DEFERRED MAINTENANCE

YEAR

PRODUCTIVITY

RISK

CONTROL

RECRUITMENT

RETENTION

PRODUCTIVITY

CULTURE

HEALTH

DISRUPTION

RELIABILITY
Building needs
Asbestos Fire Proofing
HVAC Replacement
Electrical Replacement
Fire Alarm
Fire Sprinkler

Occupant Needs
Reprogramming
Casework,
Interior Finishes
A SERIES OF DECISIONS

- Renovate existing structure V. Fully demolish/rebuild
- Complete gut-to-shell V. Selectively salvage
- Vacate occupants V. Phase construction around them
- Current Standards: Adopt V. Adapt
- Limit to Deferred Maintenance V. Additional betterments
  - Reprogram
  - New Casework
  - Lighting upgrades
  - New millwork & FHs
  - Paint, doors, & flooring
<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>OA Intake</th>
<th>VAV Fan</th>
<th>Stage 1 Heat Recovery</th>
<th>Stage 2A Heat Recovery</th>
<th>Stage 2B Heat Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>Hour</td>
<td>T-DB</td>
<td>ω</td>
<td>Airflow</td>
<td>Savings</td>
</tr>
<tr>
<td>1/1</td>
<td>1</td>
<td>45.0</td>
<td>36.9</td>
<td>42,000</td>
<td>24.3</td>
</tr>
</tbody>
</table>

### Preheat Coil
- T-DBin: 44.96°F
- ωin: 36.92 gr/lb
- T-DBout: 44.96°F
- Sensible: 0 BTUH
- Latent: 0 BTUH
- Added dP: 0.00 in WC

### Stage 2A Heat Recovery
- T-DBin: 44.96°F
- ωin: 36.92 gr/lb
- T-DBout: 44.96°F
- Sensible: 0 BTUH
- Latent: 0 BTUH
- Added dP: 0.00 in WC

### Cooling Coil
- T-DBin: 44.96°F
- ωin: 36.92 gr/lb
- Sensible: 0 BTUH

### Reheat Coil
- T-DBin: 44.96°F
- ωin: 36.92 gr/lb
- T-DBout: 44.96°F
- Sensible: 0 BTUH
System Selections & Energy Analyses

**BASIC:** CAV without Energy Recovery

**ALL OPTIONS:** VAV with 2 Stages of Energy Recovery
Near complete replacement of HVAC, Electric Power and Plumbing addresses Deferred maintenance

Reconfiguration of certain spaces enables improvements to laboratory usage

Replacement of casework, fume hoods, and lighting provides occupant benefits
BEFORE & AFTER: ABOVE CEILING
Deferred Maintenance Item
BEFORE & AFTER: ABOVE CEILING
Deferred Maintenance Item

- New Ductwork
- New Terminal Boxes
- New Digital Controls
- New air terminals
- New waste system
- New Laboratory Piping
- New Electrical Feeder
- New Panelboards
- New Lighting
Replace 50 year old dual deck air handlers

Shipping splits to fit through building openings
Assemble in place
Air leakage test
BEFORE & AFTER: BELOW CEILINGS
Non-Deferred Maintenance Item

Failing ceilings
Poor lighting
Cracked flooring
Moldy wooden cabinets

Actual Occupancy Utilization At 50%
BEFORE & AFTER: BELOW CEILINGS
Non-Deferred Maintenance Item

New Finishes
New Lighting
New Flooring
New Casework

Actual Occupancy
Utilization near 100%
Update controls/sequences
- Upgraded utility metering
- Lower air change rates
- Improved fan/motor efficiencies
- Reduced horsepower
- Reduced duct leakage
- Reduced fume hood density
- New low flow fume hoods (FM)
- LED lighting (FM)
- Fault detection (FM)

THE INS & OUTS OF ENERGY EFFICIENCY
THE INS & OUTS OF ENERGY EFFICIENCY

OUT

- Energy recovery
- VAV (exhaust prohibitive)
- Envelope U-value
- Return air in Office/Admin spaces
  - 10% of largest AHU
Energy Efficiency: Early Results

Caveats

- Removed 2/29/16 from set
- 2018 no data (in construction)
- Electrical doesn't restart until 7/25/19
- Still fine tuning building controls
- EUI calculated using building meters

Comparative Analyses

Building Occupancy

Before: ≈50 - 60%

After: >90%

<table>
<thead>
<tr>
<th>Year</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inclusive</td>
<td>Exclusive</td>
<td>MBH</td>
<td>MBH</td>
<td>MBH</td>
<td>MBH</td>
<td>MBH</td>
</tr>
<tr>
<td>May 01 0:00 to June 01 0:00</td>
<td>1,648</td>
<td>1,792</td>
<td>2,246</td>
<td>0</td>
<td>570</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 01 0:00 to July 01 0:00</td>
<td>1,939</td>
<td>2,225</td>
<td>2,217</td>
<td>0</td>
<td>1,024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 01 0:00 to August 01 0:00</td>
<td>1,864</td>
<td>2,000</td>
<td>3,052</td>
<td>0</td>
<td>2,334</td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 01 0:00 to September 01 0:00</td>
<td>2,730</td>
<td>1,923</td>
<td>3,599</td>
<td>0</td>
<td>2,772</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 01 0:00 to October 01 0:00</td>
<td>1,806</td>
<td>1,419</td>
<td>2,973</td>
<td>0</td>
<td>2,592</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>9,987</td>
<td>9,358</td>
<td>14,088</td>
<td>0</td>
<td>9,291</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Year EUI Notes

2015 323.3
2016 300.6
2017 326.0
2018 0.0 Construction
2019 283.4 Rough Projection, Still Early
Vacate building and gut has advantages over extensive phasing and selective salvage.

Reprogramming and betterment are as essential to success as behind-the-walls renewal.

Clear demarcation and accountability of Contractor scope.

Clear project scope with all users.

Search for efficiency improvement funding source.
Thank you,
Jon Ziegler II, PE
LEED AP, GGP
Senior Mechanical Engineer/Analyst
jziegler@glhn.com