Sustainable Growth without the Price Tag

business as usual

The Original Campus Plan, 1892
Main Quadrangle

• The Main Quadrangles are the heart of the Campus, a physical and intellectual center.

• The Main Quads were conceived as a planned system of quadrangles formed by limestone buildings in the Collegiate Gothic style.

• The 35 buildings of the Quad collectively total almost 1.7 million SF and were built over an 80-year period (1890 – 1970) as program and finances dictated.

About the Quad
The Campus Today – Beyond the Quad

The Problem Statement

1. The Quad contains 40% of the University’s deferred maintenance.
2. The Quad is the symbolic and academic heart of the campus.
3. The need for quality academic and student life program space is growing.
4. How to plan for its renovation and sustainable use for the next 100 years.
Prior Engagements

BSC Energy Master Plan

Resource Availability: Increasing demand for diminishing resources

- Back-casting or long-range planning
- Science Based Decisions
- Documentation
- Preventive Maintenance
- Radiant ceilings - warm and cool

Sustainability
- Maintainability
- Simple systems and Life Cycle View
- Renewable energy used at "found" temperatures

Return to Physics
- Importance of radiant forces
- Passive envelope
- Displacement ventilation
- Humidity control
- Separate the HV with AC
- Liquids are 10x more efficient to transfer energy than air

Fundamentals of Human Comfort
- Superior environments improve productivity
- Natural Lighting
- No returned air (capture energy yes)
- ASHRAE definition of comfort not acceptable

Not Business as Usual Thinking

The Natural Step
- Back-casting or long-range planning
- Science Based Decisions
- Documentation
- Preventive Maintenance
- Radiant ceilings - warm and cool

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Q.C.R. Embraces ALL Facilities Services Strategic Themes

To become a national model for effectiveness...

ENGAGED
FS COLLABORATION
Our Challenge

1. Improve the quality of the environment.
2. Efficiency: Recover non-program space to convert to program space.
3. Minimize disruption to programs during planning, design, and construction.
4. Extend the useful lives of the existing buildings by 50-100 years.
5. Do the above *without* increasing energy or maintenance costs
   - Net Delta Zero

And, perhaps most importantly...

Our Challenge – an integrated approach
Our Team

The key to success was a multi-disciplined team.

Our Approach

<table>
<thead>
<tr>
<th>The Challenge</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Improve the quality of the existing program space.</td>
<td>SUCCESS =</td>
</tr>
<tr>
<td>2. Recover non-program space to convert to program space</td>
<td>1. Excellent Indoor Environment</td>
</tr>
<tr>
<td>3. Extend the useful lives of the existing buildings by 50 – 100 yrs</td>
<td>2. Ease of Maintenance</td>
</tr>
<tr>
<td>4. Do the above without increasing energy or maintenance costs</td>
<td>3. Reasonable Cost/High Value</td>
</tr>
<tr>
<td>5. Do NOT approach this as Business as Usual</td>
<td>4. Very Sustainable</td>
</tr>
<tr>
<td></td>
<td>5. Highly Flexible</td>
</tr>
</tbody>
</table>
Our Approach

Goals

SUCCESS =

1. Excellent Indoor Environment
2. Ease of Maintenance
3. Reasonable Cost/High Value
4. Very Sustainable
5. Highly Flexible

Project Guiding Principle:

Sustainability Requires Maintainability

Deferred Maintenance

Our Approach

Goals

SUCCESS =

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Decision Matrix

Not Just USGBC LEED®
PasivHaus Guidelines for Buildings
Our Approach

Goals

SUCCESS =

1. Excellent Indoor Environment
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Loose Fit, Long Life

Rigidity = Obsolescence
Flexibility = Long Term Value

Decision-Making

TOUGH DECISIONS AHEAD

We have the Goals... now how do we meet them?
Data Collection and Documentation

MEP Systems

Air Conditioning Systems
Coordinate and Prioritize

University of Chicago - Quad Maker Plan
Evaluation of HVAC Concepts

<table>
<thead>
<tr>
<th>Evaluated Options</th>
<th>Options for 2011 Plan</th>
<th>Options for 2011 Plan</th>
<th>Options for 2011 Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUEL OIL</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>NATURAL GAS</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>ELECTRIC</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>OTHER</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

**Note:**
- This chart is to be used by all departments to evaluate the options.
- Each column represents a specific criterion for evaluating the options.
- The options are ranked from 1 (best) to 12 (worst).

**START WITH YOUR PRIORITIES**

**IDEAL:**
- Identify the most critical issue.
- Consider the impact on the overall plan.

**POSSIBLE:**
- Evaluate the feasibility of each option.
- Consider the cost implications.

**MINIMUM:**
- Ensure compliance with regulations.
- Minimize environmental impact.

**GRADE AND CONDENSUS**

- Evaluate the overall performance of each option.
- Consider the long-term benefits.

**FUEL OIL**
- Cost efficiency
- Energy conservation
- Maintenance

**NATURAL GAS**
- Cost efficiency
- Energy conservation
- Maintenance

**ELECTRIC**
- Cost efficiency
- Energy conservation
- Maintenance

**OTHER**
- Cost efficiency
- Energy conservation
- Maintenance

**Average Overall Score**

- Fuel Oil: 8
- Natural Gas: 8
- Electric: 8
- Other: 8

**Total Score:**

- Fuel Oil: 8
- Natural Gas: 8
- Electric: 8
- Other: 8
“Top Down” Approach

Campus Systems

Buildings

Building Systems

Basement services connectivity linked to whole building renovation
“Top Down” Approach

Campus Systems

Buildings

Building Systems

Geothermal Field

55F Water → Earth

66F

Avg. Temp:

60F

Water

Radiant Coils in Conditioned Space
"Top Down" Approach

The Envelope

- Energy conservation begins with Architecture.
- STOP energy flow before it happens.
- Envelope improvements can yield significant benefits.
“Top Down” Approach

Campus Systems

Buildings

Building Systems

Leakage of almost 50,000 CFM

CFM/SF (1.18)

4x MORE than USACE Standard
"Top Down" Approach

Campus Systems

Buildings

Building Systems
“Top Down” Approach

Long Term Plan

- Dedicated Outside Air Systems.
  - H₂O, not air
- Radiant Panels.
- Dehumidification Using Liquid Desiccant.
- Renewable (or waste) source of heat.
- Geothermal fields without heat pumps.
- Prototype.

Combined improvement strategies in the Quad for a shoulder season
Next Steps: Campus Energy Optimization

Our Approach

**SUCCESS =**

1. Excellent Indoor Environment
2. Ease of Maintenance
3. Reasonable Cost/High Value
4. Very Sustainable
5. Highly Flexible

<table>
<thead>
<tr>
<th>Decision Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAV system/CP</td>
</tr>
<tr>
<td>DDA/TCP</td>
</tr>
<tr>
<td>DDA/Red/CP</td>
</tr>
</tbody>
</table>

Cost Benefit Scale - Net Present Value

$
Next Steps: Finding the Sweet Spot

Planning & Logistics

- Comparison of construction costs to ISES assumptions
- Replacement cost studies (Rosenwald)
- Basement Utility Service Corridor (North quad and South Quad Strategies)
- Construction logistics based of schedule and flex space
  - (i) 100,000 SF of Flex Space in the Quad 18-20 years
  - (ii) 200,000 SF of Flex Space outside the Quad 12-16 years
  - (iii) 350,000 SF of Flex Space outside the Quad 7-8 years
### Quad Capital Renewal

#### Individual Building Sequence

(100,000 – 200,000 SF of Swing Space)

<table>
<thead>
<tr>
<th>Years 1-5</th>
<th>Years 6-25</th>
<th>Years 26-29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming, Planning, Design and Logistical Analysis and Updating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic Demolition, Building Improvements, Radiant, DOA and Desiccant Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of Geo-field, Solar Collectors and New Technology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quad in Quadrants

Quad Capital Renewal
Quadrant Sequence

Programming, Planning, Design and Logistical Analysis and Updating

Strategic Demolition, Building Improvements, Radiant, DOA and Desiccant Systems

Commissioning, Testing and Evaluation

Years 1-5

Years 6-14

Future
Planning & Logistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Total Price</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reconstruct the Roosevelt Building</td>
<td>$115,720,869</td>
<td>Includes building shell and interior buildout construction.</td>
</tr>
<tr>
<td>2</td>
<td>Demolition of existing Roosevelt Building and Related Site (2007)</td>
<td>$75,777,984</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTALS</td>
<td>$191,498,853</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. New Roosevelt Building will match design below original building. New building will utilize modern design and materials as appropriate for an institutional structure.
2. Site work includes: excavation, grading, utility work, and other development costs are excluded and should be included in the overall project budget.

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Gross Floor</th>
<th>Useful Floor</th>
<th>Program Area</th>
<th>Floor</th>
<th>Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roosevelt Mall</td>
<td>12,649</td>
<td>12,281</td>
<td>9,373</td>
<td>1.06</td>
<td>1,396</td>
</tr>
<tr>
<td>1st Floor</td>
<td>12,109</td>
<td>12,109</td>
<td>9,090</td>
<td>1.08</td>
<td>10,000</td>
</tr>
<tr>
<td>2nd Floor</td>
<td>12,649</td>
<td>12,649</td>
<td>9,373</td>
<td>1.06</td>
<td>1,396</td>
</tr>
<tr>
<td>3rd Floor</td>
<td>11,678</td>
<td>11,678</td>
<td>8,737</td>
<td>0.92</td>
<td>9,700</td>
</tr>
<tr>
<td>4th Floor</td>
<td>1,500</td>
<td>1,500</td>
<td>1,125</td>
<td>0.75</td>
<td>1,125</td>
</tr>
<tr>
<td>5th Floor</td>
<td>900</td>
<td>900</td>
<td>720</td>
<td>0.80</td>
<td>720</td>
</tr>
<tr>
<td>Attic (15%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9,792</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>12,649</strong></td>
<td><strong>12,649</strong></td>
<td><strong>9,373</strong></td>
<td></td>
<td><strong>1,396</strong></td>
</tr>
</tbody>
</table>

Planning & Logistics

Programming Studies

- 7 Divisions, 83 Departments are in the Quad

<table>
<thead>
<tr>
<th>Quad by Occupancy Type</th>
<th>Room Usage</th>
<th>Not Area (%)</th>
<th>% of Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Classroom</td>
<td>$18,800</td>
<td>8.5%</td>
<td></td>
</tr>
<tr>
<td>2. Laboratory</td>
<td>9,265</td>
<td>7.2%</td>
<td></td>
</tr>
<tr>
<td>3. Office</td>
<td>11,900</td>
<td>53.9%</td>
<td></td>
</tr>
<tr>
<td>4. Classroom</td>
<td>272,811</td>
<td>21.4%</td>
<td></td>
</tr>
<tr>
<td>5. Marketing</td>
<td>181,655</td>
<td>14.4%</td>
<td></td>
</tr>
<tr>
<td>6. Food Service</td>
<td>22,415</td>
<td>1.8%</td>
<td></td>
</tr>
<tr>
<td>7. Conference</td>
<td>29,796</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>8. Other</td>
<td>27,840</td>
<td>10.6%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>877,477</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
</tr>
</tbody>
</table>

- Data and document collection on program areas and locations on the Quad
- Psychology Department programming studies
Planning & Logistics

Affected by our Heritage

Heritage

Heritage Resource Strategy: PHASE 1
How has business changed?

New model for collegiate gothic renovation

The most important aspect of a building is its occupants.

Sustainability starts with the building (NOT the systems)

Don’t be married to existing systems – Everything is on the table

Sustainability demands Maintainability.

Think Differently

As of July 1, we added a supplement to our standards.

The key principles presented in this Supplement are:

1. The primary purpose of HVAC systems is to achieve the highest levels of occupant comfort and productivity.

2. Sustainability requires high Maintainability.

3. The energy performance of HVAC systems shall contribute to meeting the University’s goal of 20% reduction of Greenhouse Gas (GHG) emissions by 2025. (Note: The performance of the building envelope and other passive are also recognized as key contributors to this goal.)
Think Differently

Acceptable range of operative temperature and humidity for spaces that meet the criteria specified.

REAL WORLD APPLICATION
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