Spring Presentation

RIVER TEAM 2014
INTRODUCTION

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Spring Presentation

INTRODUCTION

Site conditions

<table>
<thead>
<tr>
<th></th>
<th>Dec 21</th>
<th>Mar 21</th>
<th>June 21</th>
<th>Sept 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime (Hours)</td>
<td>7.5</td>
<td>12</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Highest Altitude Angle</td>
<td>15°</td>
<td>40°</td>
<td>63°</td>
<td>40°</td>
</tr>
<tr>
<td>Average Solar Radiation (W/m²/day)</td>
<td>734</td>
<td>2590</td>
<td>5440</td>
<td>3060</td>
</tr>
<tr>
<td>Average High Temp (°C)</td>
<td>3</td>
<td>8</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>Average Low Temp (°C)</td>
<td>-2</td>
<td>-1</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Average Precipitation (mm)</td>
<td>30</td>
<td>28</td>
<td>67</td>
<td>46</td>
</tr>
<tr>
<td>Heating Degree-days</td>
<td>572</td>
<td>378</td>
<td>44</td>
<td>164</td>
</tr>
</tbody>
</table>
Site conditions

Building Value – DPR Challenge

Who
✓ Owner
✓ Students
✓ Professors

Community
Environment
Future Generation

When
✓ Design
✓ Construction

Operation
After the contract

How
✓ Lower LCC
✓ Higher Quality
✓ Lower Risk
✓ Lowest Rent

Lower LCC
Higher Quality
Lower Risk
Lowest Rent

Healthier Building
Higher Income for Owners
Fun and productive environment

Building Health – Swinerton Challenge

Environmental Health
Low energy consumption
Low impact on the environment

User and Learning Experience
Reduction of stress-related illness
High daylight level
High speech intelligibility
Good thermal comfort
High IAQ

Bridge the Users to Nature
Invites the nature into building
Encourages active living

Healthy Building
Higher Income for Owners
Fun and productive environment
INTRODUCTION A SE CM MEP LCFM PROJECT EVOLUTION

Weimar – to connect the city with the park

The open floorplan:
- Architecture which refers to the surrounding (arches) + Bauhaus (open floorplan)
- Creating the public space for events
- Activities on the ground
- Against flood

Surrounding architecture

Weimar

Brickwork & Concrete

The role of arches
Both the park and the plaza become part of the building.

View from the river side

Weimar

The square in front of the castle

A "wing" of the castle
Daylight trouble-shooting

**Faculty Offices**
Level 3

**Solution**
- Skylights & glazing in upper part of partition wall

**Before:**
- 0.3% daylight factor

**After:**
- 6.5% daylight factor
Daylight trouble-shooting

**Small Classrooms**

**Level 1**

*Before:* 5.7% daylight factor

*Solution*

- No change necessary

---

**Instructional Labs**

---

**Daylight trouble-shooting**

**Small Classrooms**

**Level 1**

*Before:* 5.7% daylight factor

*Solution*

- No change necessary

---
Acoustic treatment of classrooms

- Acoustic panels in ceiling and rear wall to help reduce the reverberation time
- Reflective surface above lecturer to support the lecturer’s voice

Acoustic treatment of auditorium

- Acoustic panels on the side walls and rear wall help increase the speech intelligibility
- Reflectors in the ceiling ensures evenly distributed sound pressure level
Success Criterion of Comfort Level and Energy

European Standard of Class II indoor climate requires
- CO2 level below 900 ppm
- Indoor temperatures between 20-26°C
- Preferably relative humidity between 25-60%

German Regulations of 2018 requires
- A primary energy consumption of 120 kWh/m²/year
- Consumption for space heating of 15 kWh/m²/year

Success criterion accomplished?
- Thermal comfort
- Indoor air quality
- Relative humidity
- Primary energy consumption
- Space heating consumption

Total = 121 kWh/m²/year

Energy factors on Germany (2020):
- Heating = 1.1
- Electricity = 2.2

Ground Level- flood risk

Parallel layout minimizes flood damage.

The main entrance to the building is highlighted by atrium light.
Auditorium rendering

Instructional Labs

2nd Level
Floorplan

The bridge between an atriums

River front – public space for entertain
3rd Level Floorplan

Faculty lounge with cafeteria with the view for the Park an der Ilm

(-) Server room

Faculty Office

Longitudinal Sections

Instructional Labs
### Cross Sections

The height of the space depends on its size.

![Cross Sections](image)

### Elevation Views

- **North elevation**
- **East elevation**
- **West elevation (main entrance)**

![Elevation Views](image)

### Load

<table>
<thead>
<tr>
<th></th>
<th>Dead Load [kN/m²]</th>
<th>Live Load [kN/m²]</th>
<th>Snow Load [kN/m²]</th>
<th>Wind Load [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>4th Floor (Roof)</td>
<td>6.7</td>
<td>0.96</td>
<td>0.96</td>
<td>56</td>
</tr>
<tr>
<td>3rd Floor</td>
<td>6.7</td>
<td>2.39</td>
<td></td>
<td>105</td>
</tr>
<tr>
<td>2nd Floor</td>
<td>6.7</td>
<td>2.39</td>
<td></td>
<td>71</td>
</tr>
<tr>
<td>1st Floor</td>
<td>6.7</td>
<td>4.79</td>
<td></td>
<td>62</td>
</tr>
<tr>
<td>Ground Floor</td>
<td>6.7</td>
<td>4.79</td>
<td></td>
<td></td>
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</table>

Load Combinations:
- 1.2D+1.6L
- 1.2D+1.6L+0.8W
- 1.2D+1.8W+L
- 0.9D+1.6W

![Etabs Model](image)
Render Structural Model

Concrete Bridge

Ground Floor Plan

1st Floor Plan
2nd Floor Plan

- 250mm Shear Walls
- 250mm Arch Beam
- 300mm x 600mm Beam
- 250mm x 400mm Beam
- 300mm x 450mm Column

3rd Floor Plan

- 250mm Shear Walls
- 250mm Arch Beam
- 300mm x 600mm Beam
- 300mm x 450mm Column

Deformed Shape

- 1.2DL + 1.6LL
- Scale = 20

Deformed Shape (Live Load)

<table>
<thead>
<tr>
<th>Element</th>
<th>Deflection (mm)</th>
<th>Limit (L/360)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midspan</td>
<td>16.20</td>
<td>41.67</td>
</tr>
<tr>
<td>Arch End</td>
<td>9.30</td>
<td>31.11</td>
</tr>
</tbody>
</table>
Concrete Bridge

Auditorium Detailing

Interior Arches Auditorium

Connection Arches-Seating

<table>
<thead>
<tr>
<th>Concept</th>
<th>Qty</th>
</tr>
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<tbody>
<tr>
<td>Tendons</td>
<td>2</td>
</tr>
<tr>
<td>Strands</td>
<td>12</td>
</tr>
<tr>
<td>0.6 in Wires</td>
<td>7</td>
</tr>
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</table>

\[
\phi V_n = 93 \text{ kN} > V_u = 87 \text{ kN}
\]
Foundation

Mat Foundation
- H = 300 mm
- Rebar #8
- Spacing 200x600mm

Piles
- D = 300 mm
- Rebar #8
- Z = 6 m

Ventilation system in North and South wing

AHU 1
AHU 2

UFAD – 1st & 2nd floor

Ducts to the classrooms and auditorium
Sloping plenums
Adjustable diffusers & Stratification Tool

TROX – FBA Underfloor Swirl Diffuser

Titus CT-480 Linear Bar Diffuser

Access to Weimar

Access from Interstate System

Construction Materials

<table>
<thead>
<tr>
<th>NAME</th>
<th>DISC/PME</th>
<th>DISTANCE FROM SITE (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Gruppe Concrete</td>
<td>G&amp;G Kran unf &amp; C. Crane</td>
<td>2.6</td>
</tr>
<tr>
<td>G&amp;G Kran unf &amp; C. Crane</td>
<td></td>
<td>1.9</td>
</tr>
<tr>
<td>WeGO Systems Interiors &amp; Fire Protection</td>
<td>Baumaschinen Reudiger Equipment (not crane)</td>
<td>8.8</td>
</tr>
<tr>
<td>Baumaschinen Reudiger Equipment (not crane)</td>
<td>Stahlwerk Thuringen Steel RSP Construction Waste &amp; Water management</td>
<td>10.1</td>
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<tr>
<td>Stahlwerk Thuringen Steel RSP Construction Waste &amp; Water management</td>
<td>RSP Construction</td>
<td>57.3</td>
</tr>
<tr>
<td>RSP Construction Waste &amp; Water management</td>
<td></td>
<td>51.5</td>
</tr>
</tbody>
</table>
Construction Site Layout

Traditional Construction Methods

Innovative Pull and Batch Scheduling

http://youtu.be/GmAVAq_vIKw

http://youtu.be/GmAVAq_vIKw

http://youtu.be/GmAVAq_vIKw

5/9/2014
Construction Zoning

DIRTT Solutions

Team Collaboration – Problem Solving

Empty Ground Floor
Reduce risk of flooding
Additional outdoor quality spaces
Create additional income

2 Atriums
6 cores – No Columns
Better Daylight Level
Redefining interior floorplans
Winter

Risk Surcharge =$698,000

Income Amount (Winter)

Income = 2,600,000

Spring

Risk Surcharge =$560,000

Income Amount (Spring)

Income = 3,700,000
DPR Total Value Assessment

STV

LCC
STV trouble-shooting

1) No energy production

Heat pump COP ≈ 3.5

2) PV/T

Heat pump COP ≈ 4

3) Energy Piles

Heat pump COP ≈ 4.5

4) PV/T + Energy Piles

Heat pump COP ≈ 6
1) No energy production

- Electricity from grid = 54 kWh/m²/yr
- LCC = $18,547,000
- Initial cost = No additional cost

2) PV/T

- Electricity from grid = 46 kWh/m²/yr
- LCC = $18,288,000
- Initial cost = $130,000

3) Energy piles

- Electricity from grid = 44 kWh/m²/yr
- LCC = $18,223,000
- Initial cost = $55,000 excl. structural piles

4) PV/T + Energy piles

- Electricity from grid = 40 kWh/m²/yr
- LCC = $18,093,000
- Initial cost = $185,000
**Cash Flow Model**

Connected Spreadsheets

- FloorPlans-A
- STV-MEP
- TVD-CM
- Risk SE
- Financial Parts-LCFM

Operation and Maintenance costs

Construction and Replacement costs

Risk Surcharge

Debt Service

More than 60 iterations

**LCC Simulations**

Spider Graph of LCC

Input % Change

Electricity/Heating (B2)
Janitor (B4)
Finishes (B17)
Electrical equipment (B18)
Senior Loan (B22)
Junior Loan (B23)
Additional Loan (B24)

**Return on Equity Simulations**

Rent, Construction costs and income have major impact on return on equity

Spider Graph of Return on equity

Input % Change

**TVD PROPORTIONS**

$7,500,000 (2020 DOLLARS)

I. Senior Loan
II. Junior Loan
III. Additional Loan
IV. Construction
V. Replacement and Renovation
VI. Income
VII. Service
VIII. Shell
IX. HVAC
X. General Calculations
TVD TOTALS

<table>
<thead>
<tr>
<th>ESTIMATE AND TARGET VALUE - SUMMARY</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>ESTIMATED VALUE</strong></td>
<td><strong>TARGET VALUE</strong></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$6,745,000</td>
</tr>
<tr>
<td>A. Substructure</td>
<td>$367,000</td>
</tr>
<tr>
<td>B. Shell</td>
<td>$2,911,000</td>
</tr>
<tr>
<td>C. Interiors</td>
<td>$874,000</td>
</tr>
<tr>
<td>D. Services</td>
<td>$2,572,000</td>
</tr>
<tr>
<td>E. Equipment and Furnishing</td>
<td>$332,000</td>
</tr>
<tr>
<td>F. Specialty Construction</td>
<td>$187,000</td>
</tr>
<tr>
<td>G. Building Sitework</td>
<td>$189,000</td>
</tr>
<tr>
<td>H. General Conditions</td>
<td>$495,000</td>
</tr>
</tbody>
</table>

Expert Crowd Sourcing
LinkedIn Discussion Thread "Nominal or Exceeding Rent?"

Cosmin Aikeniz
International Business Development Consultant

Thank you literary for starting such an interesting yet critical discussion. I am working to conceptualize a financial model for a PPP project on a RTT (Regional Rapid Transit). This is a sensitive sector as it is a public transport. It is a ticket price sensitive issue and the costs and traffic assumptions and mobilization factor of the community make a use of it must support assumption. I would favor a fixed nominal return as well. Can have your and other participants comment on my thinking as well please. Thanks.

Like • Reply publicly • Flag as inappropriate • 7 days ago

Valentina Thijssen
Independent advisor, freelance at Independent consultant

with calculated versus actual return AND return for equity providers, return for debt providers. AND ticket prices in the future AND cost to the government. I assume they will provide some sort of investment or funding support, the factors to be taken into account and to be modelled are already quite complex. Much more so than the question of modeling a yield for equity investors, nominal or inflation linked.

Like • Reply publicly • Flag as inappropriate • 7 days ago

Cash Flow Options

Nominal and Exceeding Rent

<table>
<thead>
<tr>
<th>NPV</th>
<th>$152,233</th>
<th>NPV</th>
<th>$13,546</th>
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<tbody>
<tr>
<td>IRR</td>
<td>10.12%</td>
<td>IRR</td>
<td>10.03%</td>
</tr>
<tr>
<td>RENT</td>
<td>$1,997,500</td>
<td>RENT</td>
<td>$2,124,500</td>
</tr>
<tr>
<td>payback</td>
<td>16</td>
<td>payback</td>
<td>18</td>
</tr>
</tbody>
</table>

Expert Crowd Sourcing
LinkedIn Discussion Thread "Nominal or Exceeding Rent?"

Yuri Blondi
Tenured Research Fellow at CNRS


Like • Reply publicly • Flag as inappropriate • 7 days ago
Expert Crowd Souring
Linkedin Discussion Thread “Nominal or Exceeding Rent?”

Paul Booth
CEO - Brightstar

I agree, presentation in nominal terms as the actual indexing is on speculative at this stage. The more challenging related question is which indices do you use to inflate the different parts of your tariff and here these decisions are justified.

Like • Reply privately • Flag as inappropriate • 8 days ago

Noray Badasyan
Doctoral Research Scholar at Bauhaus University Weimar

thanks for the comment. Yes, this was another issue with indices as it is pretty difficult to justify their rise in future...now it seems that nominal is better with putting all the data in cash flow...rnr, it is also much more attractive...thanks again

Delete • 8 days ago

Break Even

Payback

Construction Cost
Risk Charge
Operation and Maintenance Costs
Replacement costs
Interest Payments
Rent
Coffee Income
Additional Income
Accumulated Cash Flow

Loan Structure

Senior Loan
Junior Loan
Additional Loan

$6,000,000.00
$5,000,000.00
$4,000,000.00
$3,000,000.00
$2,000,000.00
$1,000,000.00
$0.00

Building Value – DPR Challenge

Who
✓ Owner
✓ Students
✓ Professors
✓ Community
✓ Environment
✓ Future Generation

When
✓ Design
✓ Construction
✓ Operation
✓ After the contract

How
✓ Lower LCC
✓ Higher Quality
✓ Lower Risk
✓ Lowest Rent
✓ Community
✓ Environment
✓ Future Generation

Building Health – Swinerton Challenge

A building design which… Is environmentally healthy
✓ Low energy consumption
✓ Low impact on the environment

Provides comfortable and healthy interior spaces
✓ Reduction of stress-related illness
✓ Increased user and learning experience
  • High daylight level
  • High speech intelligibility
  • Good thermal comfort
  • High IAQ

Is aesthetically pleasing
✓ Invites the nature into building
✓ Encourages an active living
  • Parking area for bikes
  • Possibility to bike to work/school because of shower facilities
  • Flow in building, stairs …?

Difference between LEED & DGNB certification

Location & Transportation 10/15
Sustainable Sites 7/10
Water Efficiency 5/12
Energy & Atmosphere 26/38
Material & Resources 8/8
Indoor Environmental Quality 15/17
Innovation 4/6
Regional Priority 2/4
Total 77/110

Environmental Quality 35/60
Economic Quality 12/20
Sociocultural and Functional Quality 109/150
Technical Quality 45/90
Process Quality 33/100
Site Quality 27/60
Total 55%/100%

GOLD

Clash of the Cultural Titans

• 6 National Identities and Cultures

• 5 Professional Backgrounds

• 5 Organizational Contexts
Intentional Communication

- Informal Polling and Discussions
- Focused Facebook Chats and Events

Overcoming Miscommunication

Staying in the Know

Becoming a Team
The main thing we learned...

“Transparency and trust = Key factors of integrated design” ~ Anna

“It is as important to listen as to participate” ~ Rene

“It’s all about people” ~ Qi

“Always press ‘save’” ~ Ben

“Bridging professions, solving the problems” ~ Pawel

“7 minds are better than 1. Be sure to use them all” ~ Norayr

“Persistent patience is key to IPD.” ~ Randi

THANK YOU OWNERS
Gitte Sørensen, Milos Todorovic & Felix Bollwahn

THANK YOU MENTORS

THANK YOU SUPERMENTOR
Renate Fruchter