Team River

Jordan
MEP
Lanxi
SE
Liyi
SE
Arnaud
CM
Carl
LCFM
Sara
ARC
Eline
CM
Team River Owners

- Satej CM
- Tyler CM
- Andrej ARC
- Steve SE
- Janine LCFM
Weimar in Winter
Weimar in Summer
Weimar in Fall
Weimar, Germany
“If you want to win the challenges you should build your concept on solving the challenges”
Project Drivers: Air Quality

Indoor

Local

Global
Air Quality in Ilm Park
NO BUILDING
Class in the Park
Client Affinity Challenge

‘Think outside the box’

‘We want value for money’

‘We want you to win the challenges’

‘Design a university for the future’

‘Surprise us and be creative!’

What do you want?
Designing for the Future

UNIVERSITY 1950

UNIVERSITY 2016

UNIVERSITY 2070
Optimal Learning Conditions

MASLOWS HIERACHY OF NEEDS

- Talent
- Creativity
- Fulfillment
- Self-esteem
- Reputation
- Achievement
- Connections
- Belonging
- Joining groups
- Health
- Safety
- Well-being
- Protection
- Warmth
- Food
- Water
- Sleep
- Shelter

ARCHITECTURAL NEEDS OF LEARNING

- Self-actualization
  - Individual
  - Social
  - Mental
  - Physical

- Shelter
  - Views
  - Security
  - Privacy
  - Sunlight
  - Air quality
  - Temperature

- Flexibility
  - Public, semi-private, and private spaces
  - Platforms for sharing knowledge
  - Niches for socialization
  - Informal places to gather
  - Exhibit work
  - Connections between spaces

- Ambitious
No building → NO BUILDING
Project Drivers: ‘No Building’

- Reduction
- Efficiency
- Flexibility
Project Drivers: Client Affinity

- Effective Communication
- Curated Transparency
- Honest Reflection
"There is nothing worse than being fed information you don't need"
Meetings / Effective Communication

Meetings
Meetings / Effective Communication

Owner Updates
Meetings / Effective Communication

Owner Facebook Group
Meetings / Effective Communication

Bi-weekly Surveys

SCORES
Thank you for the detailed overview! It was short, but with nearly all information we needed. Well done!

4

I am happy to see how enthusiastic you are about new concepts.

5

I’m convinced!

4
Meetings / Effective Communication

Clash Detection
Meetings / Effective Communication

Adaptability to Clients
Nein Project Drivers

Air Quality

‘No Building’

Client Affinity
### Decision Matrix

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<td>421,29</td>
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S.M.A.R.T. ‘No Building’
Reducing by 35%
Opening 1st floor
Anchoring floating space
Orienting 2nd floor
Building integrating with surroundings
Transition from Indoor to Nature
Floor Organization

- Private Offices
- Introvert Faculty Area
- Hybrid Learning Space
- Service
Space Evolution throughout Week

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<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
<th>WEEKEND</th>
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Layout 1

Layout 2

Layout 3

Individual work space
Collaborative space
Lecture space
Student office

Director of Flexible Spaces
Monday and Tuesday

- 28 student office spots
- 130 lecture seats
- 50 collaborative spots
- 22 introvert working chairs
Local Classes and Collaboration
Wednesday and Thursday

- 28 student office spots
- 100 collaborative spots
- 22 introvert working chairs
Collaborative and Individual Cyber Work
Friday, Saturday and Sunday

- 216 lecture seats
- 50 collaborative spots
- 22 introvert working chairs
Large Classes and Public Lectures
Semester Break

40 lounge chairs

22 introvert working chairs
Exhibition and Workshop Space
1st Floor - No Column Solution

- No interior column at all
- Ready for any weekly floor layout
1st floor - Structural Dimensions

- Steel column W24x104
- Steel column W14x74
- CLT shear wall 150 mm thick
- Glulam beam GL10.75 x 27
- Glulam beam GL 8.5x23.375
- Other beams
- CLT slab 100 mm thick 2mx6m
1st Floor Air Distribution Plan

- Supply
- Exhaust
- Radiators
- Floor Diffusers
1st Floor Air Distribution Plan

- Supply
- Exhaust
- Radiators
- Floor Diffusers
2nd Floor - Architectural

- Service
- Meeting room
- Faculty Lounge
- Offices

Dimensions:
- 20 m (65 ft)
- 2.5 m (8 ft)
- 3 m (10 ft)
- 36 m (118 ft)
2nd Floor - Structural

All columns are hidden inside walls

No column in the faculty lounge area
2nd Floor - Air distribution Plan

- Supply
- Exhaust
- Perimeter
- Radiators
- Floor Diffusers
Three integrated systems

- STRUCTURAL
- MECHANICAL
- ARCHITECTURAL
Floor Sandwich

9.1 m 29.8 ft
8.7 m 28.5 ft
8.6 m 28.2 ft

7.2 m 23.6 ft

4.05 m 13.2 ft

4.55 m 14.9 ft

4.05 m 13.3 ft

2.95 m 9.6 ft

0 m 0 ft
-0.4 m -1.3 ft

STRUCTURAL, MECHANICAL, ARCHITECTURAL
Steel Portal Frame & Timber Structural System

Second Floor

First Floor
Load Conditions

Wind load = 0.65 kN/m²
Snow load = 0.86 kN/m²

Other design loads Info. from IDC

- Corridor: 3.8 kN/m²
- Classroom: 1.9 kN/m²
- Auditorium: 3.8 kN/m²
- Office: 2.4 kN/m²
- Lab: 2.4 kN/m²
- Lounge: 5.0 kN/m²
Steel portal frame

- 9.1 m (29.8 ft)
- 30 m (98.4 ft)
- 2.5 m (8.2 ft)
- 600 mm (23.6 in)
- 1400 mm (55.1 in)
- 35 mm (1.4 in)
- 45 mm (1.8 in)
Steel portal frame

Compression

MAX: 4729 kN*m
3497.9 kip-ft
Lateral Load path in Plan View

0.65 kN/m²

Atrium
Gravity Load path in Elevation

3 m 9.8 ft
30 m 98.4 ft
3 m 9.8 ft

4.55 m 14.9 ft
4.15 m 13.6 ft
6.35 m 20.8 ft

Grade 0
ETABS simulation results

Maximum stress of slab: 15 Mpa

Maximum of steel girder: 4729 kN*m

Deflection of steel girder: 43.4 mm (1.7in), about a ratio of L/829

Maximum Interstory drift: 0.05%
Steel Girders & Glulam Beams Connections
Steel Helical Piles (Screw Pile)

One Segment 1.52m (5 segments in total)

Sandy Soil

limestone 1.52m below grade

Filled Pad 2m above grade

Grade 0

6.35m 20.8ft
Project Drivers: Air Quality

Indoor

Local

Global
Client Affinity Challenge

What do you want?

‘Prove it!’

‘Show me the numbers’

‘How much does it cost?’

What do you want?
CO2 and Cognitive Functioning

Score (Normalized to Green+)

CO₂ Concentration (ppm)

Basic Activity Level

Information Usage

Strategy

Sources:

Harvard:  *Associations of Cognitive Function Scores with Carbon Dioxide* (Allen et al., 2015)

LBNL:  *Is CO₂ an Indoor Pollutant?* (Satish et al., 2012)
CO2 and Cognitive Functioning

Ventilation Rates x2

(500 ppm)
Air Distribution Mechanical Schematic

- Exhaust Air
- Heat Exchanger
- Interior AHU
- 100% OA
- Underfloor Air Ventilation Distribution System
- Exposed Round Exhaust Ducts
- Adjustable Floor Diffusers for User Control & Comfort
- Flexible Floor Diffusers for Future Adaptability
- Perimeter AHU
- Roof
- 2nd floor
- 1st floor
Volume Reduction

-28%
Volume Reduction

4.615 € Average Annual Savings

4.5 million kg CO2e reduction
Floor Area Reduction
Volume Reduction

2.500 € Average Annual Savings

193,000 million kg CO2e reduction
STV Progression 33% Reduction from Target

[Graph showing life-cycle carbon emissions for different scenarios: No Building, S.M.A.R.T. Building, and New No Building. The graph indicates a significant reduction in emissions for the S.M.A.R.T. Building during the winter quarter.]
STV Progression

- **Life-Cycle Carbon (kgCO2e)**
- **Millions**

**Legend:**
- New No Building

**Dates:**
- 11-Mar
- 21-Mar
- 31-Mar
- 10-Apr
- 20-Apr
- 30-Apr

The graph shows a progression of Life-Cycle Carbon emissions from March 11 to April 30.
STV Progression
STV Progression

- Faculty Offices 2.1
- Faculty Lounge 2.3
- Faculty Zones 2.5
- Faculty Offices 2.4
- Faculty Offices 2.2
- Atrium

Life-Cycle Carbon (kgCO2e)

- New No Building

11-Mar, 21-Mar, 31-Mar, 10-Apr, 20-Apr, 30-Apr
STV Progression

x2 Ventilation

Life-Cycle Carbon (kgCO2e)

11-Mar 21-Mar 31-Mar 10-Apr 20-Apr 30-Apr

New No Building
STV Progression

- x2 Ventilation

Life-Cycle Carbon (kgCO2e) vs. Time

- New No Building

MECHANICAL
STV Progression

Life-Cycle Carbon (kgCO2e)

- New No Building

x2 Ventilation

MECHANICAL
STV Progression: 33% Reduction

x2 Ventilation

33%
Air Quality Display

BAUHAUS UNIVERSITY BUILDING EMISSIONS

% of predicted emission

100%

Time

ART
Architecture
Engineering
NO BUILDING
Suppliers

1. G&R Crane, Transport
2. Thyssen Steel, Cement, Building Services and Systems
3. Loxan Rental Equipment
4. Thomas-Gruppe Concrete
5. JoKa Timber
Site Logistics

- Site Office
- Tracking Pad
- Staging Area
- Site fence / Silt fence
- Emergency Exit
- Protected Area
- Uninterrupted Pedestrian Traffic Flow
- Trench + Berm
- Waste & Recycling
- Sedimentation Basin
- Crane
- Uninterrupted Pedestrian Traffic Flow

CONSTRUCTION MANAGEMENT
Safety on Site
Planning of Construction Elements

CONSTRUCTION MANAGEMENT
Supplier: G&R Cranes, Weimar Germany (1 km from site)

Price: €1,375 /week
vs. €4,300 /week (Mobile Crane)
vs. €1,050 /week (Tower Crane)

Critical Pick: 1.1 t load at tip (20 ft long W24x55)
Mobile Crane for Main Girders

**LIEBHERR LTM 1100-5.2**

**Supplier:** G&R Cranes, Weimar Germany (1 km from site)

**Price:** €850 /day

**Critical Pick:** 20 t load (Main Steel Girders)

**Specifications**

- 84 m Height (275.5 ft)
- 66 m Radius (216.5 ft)
- 100 t Max Cap.
- 2 t Tip Cap.
Crane Choice
Construction Time Reduced by 40%

- Excavation
- Zoning for concrete
- MEP Fix 1. 2. 3.
- PreFab Wall Elements

Finish September

Finish May
Main Floor Construction Zoning
4D visualization using Navisworks
BIM Coordination

Revit → Solibri → BCF → BIMcollab
Transparent Clash Detection using BCF

CONSTRUCTION MANAGEMENT
Quantity Take-off Starting March 27
Estimated Building Cost vs. Target Value in €

- **Estimated Value**:
  - General Conditions: €1,745,000
  - Building Sitework: €232,000
  - Specialty Construction: €210,000
  - Equipment and Furnishing: €78,000
  - Services: €1,376,000
  - Interiors: €528,000
  - Shell: €1,448,000
  - Substructure: €189,000
  - Total: €5,801,000

- **Target Value**:
  - General Conditions: €2,455,000
  - Building Sitework: €246,000
  - Specialty Construction: €246,000
  - Equipment and Furnishing: €410,000
  - Services: €982,000
  - Interiors: €2,373,000
  - Shell: €2,064,000
  - Substructure: €410,000
  - Total: €8,182,000
Estimated Building Cost vs. Target Value in $
Estimated Building Cost vs. Target Value in $ / ft²

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<th>TARGET VALUE per ft² (18,050 ft²)</th>
<th>TARGET VALUE per ft² (30,000 ft²)</th>
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Legend:
- General Conditions
- Building Sitework
- Specialty Construction
- Equipment and Furnishing
- Services
- Interiors
- Shell
- Substructure
Estimated Building Cost vs. Target Value in € / m²
CONSTRUCTION MANAGEMENT
## LEED - Gold Certified

**LEED v4 for BD+C: New Construction and Major Renovation**

### Project Checklist

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<th>Description</th>
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<td>Regional Priority: Access to quality Transit</td>
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### Totals

- **Certified**: 40 to 49 points
- **Silver**: 50 to 59 points
- **Gold**: 60 to 79 points
- **Platinum**: 80 to 110 points

**Possible Points**: 110

*Date: 2016-05-01*
DGNB - Gold Certified

- Economic Quality: 89%
- Social Quality: 91%
- Environmental Quality: 77%
- Technical Quality: 82%
- Process Quality: 87%

DGNB CERTIFICERING 85% GOLD
Life Cycle Cost

- Initial Construction: 6,220,000 € (↓ 15%)
- Replacements: 1,110,000 € (↓ 31%)
- Operation & Maintenance: 4,570,000 € (↓ 29%)
- Risks: 350,000 € (↓ 75%)
- Interests: 2,980,000 € (↓ 26%)

Legend: No Building, First Calculation
Rent Evolution

- Required Rent: €910,000
- Needed Rent: €774,500

Energy Optimization:
- €810,100
Rent Evolution - Financial Modelling
Loan Structure & Cover Ratios

![Graph showing Rent Evolution and Loan Structure with various financial ratios over time.](image-url)
"We want value for money"
Value for Money Approach

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<tr>
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<th>No Building</th>
<th>Average Building</th>
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<td>9.814.000 €</td>
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<tr>
<td>Flexible Spaces</td>
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<tr>
<td>CO² - Certificates</td>
<td>2.790.000 €</td>
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LIFE CYCLE FINANCIAL MANAGEMENT
Flooding on Site

Normal water level

Worst flood last 100 years
2,5 m - 2 ft

Worst case future scenario
4,5 m - 15 ft

http://www.ukrivers.net/climate.html 10 Feb 2016
Flooding risk

The bar chart illustrates the risk costs over the Life Cycle (LC) with and without moving 4 meters. Without moving, the risk cost is €1,276,000. Moving 4 meters reduces the risk to €0.
Risk Costs over the Life Cycle

Risk Costs

Planning | Construction | Contract Time (25Y) | Prolongation / New Use

25,000 € | 161,000 € | 172,000 €

Normal Building

'No Building'
Air Quality Summary

- x2 Ventilation Rates
- Occupant Control

- 40% EUI Reduction
  - 136 kWh/m²/yr (43 kBtu/ft²/yr)

- 33% Carbon Emission Reduction
Client Affinity Summary

"I believe you have established a very useful and overall high performance protocol of communication. I would not change a thing."
"Very nice! Love it. You guys are creating one very sexy building!"

“A, E, MEP, CM and LCFM: Well done!”

“I would not change a thing.”

“High performance by each team member”

“I’m convinced!”
TEAM TAKE-AWAY

Lanxi: “No building - No columns!”

Arnaud: “No building - No problem!”

Sara: “Have fun!”

Eline: “It’s only school – to be friends is more important”

Carl: “To get heard, unmute yourselves”

Jordan: “NEIN! Building”

Liyi: “Challenge yourself!”
A special thanks to:

Facades

South Facade

West Facade

9 m
30 ft
Facades

East Facade

North Facade
2nd Floor Ceiling Heights

- 3050 mm (10 ft)
- 440 mm (1.4 ft)
- 905 mm (2.9 ft)
- 3995 mm (13.1 ft)
- 2650 mm (8.7 ft)
Green Walls

Green Wall CO2 Fixation from photosynthesis

Full Sunlight $\sim 1.0 \text{ m}^3/\text{h per} \ 100 \text{ m}^2$

Human Respiration $\sim 0.1 \text{ m}^3/\text{h}$
1 Person Working $\sim 10 \text{ m}^2$ of Green Wall

Issue: almost never full sunlight on walls
Green Walls

TOTAL: 216 m²
PV System on the Roof
1st Floor Structural
### Bolts in connections

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</table>

*Note: The table above provides dimensions for bolts in connections, with columns for different sizes and corresponding measurements.*
Section View of Structure below Grade

- Architecture floor
- Underfloor air distribution system
- Structural concrete slab
- Pile cap
- Pile cap
- Pile cap

Filled pad
1st Floor Mechanical
Second Floor & Roof Mechanical
Underfloor Air Distribution

Conventional HVAC

Underfloor Air Distribution

Dilution / Mixing

Higher Air Quality
Underfloor Air Distribution Simulation
Underfloor Air Distribution
2nd Floor

Hydronic Plan
Rainwater Collecting System
Sensitivity Analysis
Green Walls and CO$_2$ Fixation

$216 \text{ m}^2$ green wall $\sim 21$ people working
Weather Conditions

![Wind](image)

**Temperature**

![Temperature Chart](image)

**Humidity**

![Humidity Chart](image)

**Rain**

![Precipitation Chart](image)

![Number of Rain Days Chart](image)
Electricity Costs

- Miscellaneous Equipment: 10,083 € (40%)
- HVAC: 6,733 € (26%)
- Lighting: 8,588 € (34%)
Fuel Costs

Average Annual Life Cycle Costs

- Heating: 22,491 € (89%)
- Dometric Hot Water: 2,913 € (11%)