Team River 2021

WINTER PRESENTATION
INTRODUCTION
PROJECT SITE

SYMBIOSIS

NEXT YEAR’S SPRING

FINAL DECISION

CONTENT
INTRODUCTION
Team River

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DTU
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Clemens | LCFM
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Wraps

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ETH Zurich
Spaghetti Carbonara

A
Moussaka

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Gecknödel
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Location
Location
I want to learn, make friends and partyyyy!

I need a quiet workspace to plan my lectures.

It would be great to find somewhere to sit while walking my dog.

I love visiting culturally rich cities.
Site Conditions

- UNESCO World Heritage City
- Narrow access roads
- Risk of flooding
- Shallow water table
- Snow loads in winter
- Wind from south, west
- Oriented for passive solar
# Team Targets

## Design
- Fully integrated big idea
- Site-specific design
- Natural solutions
- Innovative, modern systems
- Load reduction
- Bright and slender structure

## User Experience
- User friendly
- Daylight
- New ways of using building
- Human space
- Visible structural elements
- User comfort

## Construction and Use
- Happy owners
- Build to last
- Resilience
- Consistent component sizes
- On budget
- Quick construction

## Challenges
- Parametric design
- Sustainability and equity
- Buildings as products
SYMBIOSIS
SYMBIOSIS

Any relationship or interaction between two dissimilar organisms
Mutualism
Both organisms benefit

Commensalism
One benefits; the other is unaffected

Parasitism
One benefits; the other is harmed
Goal with Symbiosis

- Strive for Mutualism
- Accept Communalism
- Work against parasitism

Avoid
Initial sketches | Incorporating mutualism
Why this mass

Footprint
Follow hard restrictions
Use slope
Focus on auditorium
Clear cores
Trapeze-like auditorium
Concept Evolution

Feb 9 | First concept

Feb 15 | Second concepts

Feb 19 | Critical crit session

Feb 26 | Third concept

Mar 19 | Proposed concepts

Grove

Mesh

Meanwhile | Work in progress
# MEP Design for Mutualism

## Building and Occupants
- **Floor area**: 2944 m²
- **Peak occupancy**: 275

## User Comfort
- **Indoor temp**: 20-23°C
- **Humidity**: 35-45% RH
- **Ventilation**: DGNB Cat. II

## Resource Efficiency
- **Energy budget**: 111,872 kWh
- **Minimize water + natural gas use**
MEP Concept Evolution

Feb 9 - Peer Review
- Natural ventilation
- Variable air volume (VAV)
- Radiant floors

Primary system?

Feb 19 - Crit
- Boiler / chiller
- Zoning

Efficiency?

Feb-Mar - mentorship and refining

Primary
- Ground source heat pump
- Dedicated outdoor air system

Secondary
- Displacement ventilation
- Fan coil cooling
MEP Mutualism via Load Reduction

- Initial Massing
  - Late Jan: High R windows and curtain walls

- Building orientation
  - Mid Jan

- Tree location
  - Early Feb

- Window placement
  - Mid Feb

- Improved building envelope!
Approach

Main entrance - west

View from bridge over river
1. Follows water table
2. Staircase as a reflection
Symbiosis | Grove

**Lateral System**
- CLT walls
- Waterproof concrete walls
- Waterproof concrete foundation slab

**Floors**
- Concrete roof slab
- CLT panels

**Framing**
- Inclined timber columns
- Glulam trusses
Gravity Load

- Gravity load
- Transfer (compression)
- Transfer (tension)
- Foundation (tension)

Lateral Load

- Lateral load
- Transfer (compression)
- Transfer load
- Foundation load

Load Path | Symbiosis Grove
Symbiosis | Mesh

Lateral System

- Inclined steel columns
- Braced core

Floors

- Concrete roof slab
- 3D printed concrete slabs

Framing

- Castellated beams
- Parametric roof
# MEP System Selection

<table>
<thead>
<tr>
<th>Primary</th>
<th>Mesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grove</td>
<td>Mesh</td>
</tr>
<tr>
<td>Electric boiler + air-cooled chiller</td>
<td>Ground source heat pump</td>
</tr>
<tr>
<td>Dedicated outdoor air system (DOAS)</td>
<td>Air handler unit</td>
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<td>Air handler unit</td>
<td>Natural ventilation</td>
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</table>

<table>
<thead>
<tr>
<th>Secondary</th>
<th>Ground and upper levels</th>
</tr>
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<tbody>
<tr>
<td>Atrium and basement level</td>
<td>Ground and upper levels</td>
</tr>
<tr>
<td>Displacement ventilation</td>
<td>Dedicated outdoor air system (DOAS)</td>
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<tr>
<td>Radiant floors</td>
<td>Radiant floors</td>
</tr>
<tr>
<td></td>
<td>Fan coil cooling system</td>
</tr>
</tbody>
</table>
0 = Entrance and exploration

Room Legend
- Elevator
- Entrance
- Fire stairs
- Makers Space
- Quiet Study space
- Student Coffee cafe
- Tech
-1 = Class and Collaboration

Room Legend
- Auditorium
- Elevator
- Entrance
- Fire stairs
- Large Classroom
- MEP
- Small Classroom
- Storage
Multifunctional auditorium

- Light stackable chairs
- Multiple arrangements
- Storage incorporated
Mutualism in the Auditorium

Project

Blackout

Open up
2.8m

Castellated beams

Our ventilation solution is very easy to operate
Room Legend
- Elevator
- Fire stairs
- Group work area
- Instructional Lab
- Main Staircase landscape
- Seminar Room
- Seminar room
- Small Classroom
- Storage
- Tech
- Toilets
Level 1 Floor Sandwich | Mesh

Castellated beam

It's a breeze!
2 = Focus and group work

Room Legend

- Elevator
- Fac. Offices
- Faculty Admin. area
- Fire stairs
- Group work area
- Server Backup Room
- Storage
- Tech
- Technical support
- Toilets
Level 2 | Grove

Dimensions in [m]

- Columns 0.3 x 0.3 and 0.2 x 0.2
- Inclined columns 0.4 x 0.3
- Primary beams 0.4 x 0.3
- Secondary beams 0.3 x 0.3
- CLT core walls
- Long span glulam trusses 0.7m

Cantilever
**Level 2 | Mesh**

Dimensions in [m]

- **Columns HEA 260 and HEA 300**
- **Inclined columns hollow steel 0.4m, thickness 0.1m**
- **Primary beams honeycomb 0.5m**
- **Secondary beams honeycomb 0.3m**
- **Braces in the core**
- **Long span honeycomb 0.8m (above auditorium)**

→ **Cantilever**
Site Context | Opportunities + Challenges

- Environmental Protection
- Noise Protection
- Water Protection
- Building Protection

Site Location:
- Park
- ILM River
- Tight Intersections

Site Access:
- South West Access
- North East Access

Historical City Center
Residential Area
Castle
Tight Intersection

Tight Intersections
Site Context | Material Source Map - SMEs

Small Business
“CO2 neutral website”

Off-site Storage
Off-site Parking

Site Location
Timber Supplier
Rammed Earth
Green Roof
Equipment Rental
Storage Facility
Furniture Supplier
Bauhaus-Universität Weimar
Timber Supplier
Insitu Concrete
Cross Laminated Timber
Precast Concrete
Windows & Doors
Steel Supplier
Facade Supplier
Solar Roof & Heat Pump
Dewatering Equipment
Site Logistics | The Water Riddle

- Precast Sloped Trench Drain
- Decorative Gutter
- Pedestrian Path 1m wide & 0.5m deep
- Water Treatment Tank & Submersible Electric Pump 20,000 Liter Capacity

Earth Embankment

20,000 Liter Capacity

Precast Sloped Trench Drain

Water Treatment Tank & Submersible Electric Pump
Site Logistics | The Water Riddle

- Well-point dewatering system
- Spacing between wellpoints: 1.5m Depth of wellpoints: 3m
- Travelling Sprinkler with Hose reel
- Irrigation
- Water Treatment Tank & Submersible Electric Pump

- Depth of Excavation: 1.5 m
- Spacing between wellpoints: 1.5m
- Depth of wellpoints: 3m
Site Logistics | Preserve + Protect

Stormwater Pollution Prevention Plan (SWPPP)

Site Safety and Emergency

Erosion & Sediment Control BMP
- Silt Fence
- Slope protection
- Trench Drain for Rain
- Tree relocation

Material Handling and Waste Management
- Concrete washout areas
- Recycling Area
- Proper material staging areas

SigePlan
- Appoint Safety Manager
- Daily safety training
- Daily Risk analysis

Inspection & Training
- Delegation of authority
- Blweekly training
- Weekly inspections

Corrective Action Log & Scoring
- Corrective action log based on inspections
- Rating chart over time
- Trend improvement using ROI

1: 0 corrective items
2: 1-2 corrective items
3: 3-4 corrective items

Tally of ratings per month

Flood Emergency Plan
- Flood maps
- Local Flood Warning
- Disinfecting post flood
- Move equipment and chemicals
Site Logistics | Drone Topography

Drone photos

- Mesh exported
- Mesh converted
- Mesh inserted

Accurate Topography

Precise construction plan

A - SE - MEP - CM - LCFM

+ Drone photos

Mesh exported
Mesh converted
Mesh inserted

R PRO

RhinoCeros

AUTOCAD

Revit
**Site Logistics | Delivery tracking**

*Vehicle restrictions*

- **Length**: 10m
- **Width**: 2.5m

---

**Vehicle Diagram**

- Mercedes Actros Car Transporter Rigid 4x2 1836L
  - Overall Length: 9.455m
  - Overall Width: 2.494m
  - Overall Body Height: 2.674m
  - Min Body Ground Clearance: 0.173m
  - Track Width: 2.494m
  - Deck to deck line: 9.00m
  - Wall to Wall Turning Radius: 10.360m
<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT excavator (313 GCCAT 323F Z-LINE)</td>
<td>Unplugged Capacity: 6 hours</td>
</tr>
<tr>
<td></td>
<td>Charging Time: 6 hours</td>
</tr>
<tr>
<td>Volvo FE Electric</td>
<td>Width: 2.30m</td>
</tr>
<tr>
<td></td>
<td>Charging Time: &lt; 2 h/11 h</td>
</tr>
<tr>
<td>Liebherr T Electric truck mixer</td>
<td>Capacity: 11.05 m³</td>
</tr>
<tr>
<td>(ETM 1004)</td>
<td>Battery Capacity: 32 kW</td>
</tr>
<tr>
<td>Liebherr mobile crane</td>
<td>Max. radius: 45.00 m</td>
</tr>
<tr>
<td></td>
<td>Max lifting capacity: 8,000 kg</td>
</tr>
<tr>
<td></td>
<td>Electric when plugged</td>
</tr>
<tr>
<td>Volvo L25 Electric</td>
<td>Indicative runtime: Up to 8 hours</td>
</tr>
<tr>
<td>Mercedes Actros Rigid 6x2 2536L</td>
<td>Max Length: 11m</td>
</tr>
<tr>
<td></td>
<td>Electric when plugged</td>
</tr>
<tr>
<td>Liebherr Tower crane (85 EC-B 5)</td>
<td>Max. radius: 50.00 m</td>
</tr>
<tr>
<td></td>
<td>Max. capacity: 5,000 kg</td>
</tr>
<tr>
<td></td>
<td>Electric when plugged</td>
</tr>
</tbody>
</table>
Site Logistics | Excavation phase

- Office
- Shower/W.C.
- Dry/wet Area
- First Aid
- Generator
- Recycle bin
- Concrete washout
- Personnel path
- Stockpile
- Laydown
- Laydown
- Temp. Fence
- Silt Fence (SWPPP)
- Header Pipe
Site Logistics | Foundation phase
**Site Logistics | Superstructure phase | Grove**

**Tower crane**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less expensive</td>
<td>Assembly time</td>
</tr>
<tr>
<td>Not weather sensitive</td>
<td>Foundation required</td>
</tr>
<tr>
<td></td>
<td>Not flexible</td>
</tr>
</tbody>
</table>

- **Advantages**
  - Less expensive
  - Not weather sensitive

- **Disadvantages**
  - Assembly time
  - Foundation required
  - Not flexible
NEXT YEAR’S SPRING
Next Year’s Spring

Johann Wolfgang von Goethe
(German poet, 18th century)

The bed of flowers,
Hidden with care;
If works and thrives.
Her glances light;
And blooming mind;
In sport, unsullied,
Concept Goals
What will the building augment about reality?

Past - Rammed Earth
- Senses
- Sustainability
- Indoor climate

Future - Walls become alive
- Connectivity
- Immersion
- Interaction
# MEP Design Baseline

## Building and Occupants
- **Floor area**: 2530 m²
- **Peak occupancy**: 250

## User Comfort
- **Indoor temp**: 20-23°C
- **Ventilation**: DGNB Cat II
- **Humidity**: 35-45% RH

## Resource Efficiency
- **Energy budget**: 96,140 kWh
- **Minimize water + natural gas use**
MEP Concept Evolution

Jan 28 | First Concept
Variable air volume (VAV)
Where's the rest of it?

Feb 19 | Crit
Primary
- Boiler / chiller
- Dedicated outdoor air system
- Variable refrigerant flow

Secondary
- Displacement ventilation
- Radiant floors
- Zoning

Complicated!

Stop:
redesign time

Mar | refine + rethink
Primary
- Ground source heat pump

Secondary
- Fan coil cooling
 MEP Load Reduction

- **Initial Massing**
  - Mid Jan
    - Orientation analysis

- **High R windows and curtain walls**
  - Late Jan

- **Window placement**
  - Mid Feb

- **Rammed earth wall insulation**
  - Mid Jan

- **Tree location**
  - Early Feb

- **Improved building envelope!**
  - Late Jan
0 = Variation of spaces
<table>
<thead>
<tr>
<th>Sprout</th>
<th>Steel Flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glulam</td>
<td>Steel</td>
</tr>
<tr>
<td>Glulam</td>
<td>Castellated Steel</td>
</tr>
<tr>
<td>CLT shear walls and glulam bracing</td>
<td>Concrete shear walls and steel bracing</td>
</tr>
<tr>
<td>Nanocrystal wood fiber concrete</td>
<td>3D printed concrete</td>
</tr>
<tr>
<td>Shallow piles</td>
<td>Shallow piles</td>
</tr>
</tbody>
</table>
Next Year’s Spring | Sprout

Lateral System
- CLT walls
- Movement joint
- Glulam V bracing

Floors
- 3D printed nanocrystal reinforced concrete slabs

Framing
- Timber Warren trusses
- Glulam columns
- Glulam beams
Next year’s spring | Steel Flower

Lateral System
- Concrete walls
  - Steel X bracing

Framing
- Steel trusses
- Honeycomb steel beams
- Steel columns

Floors
- Movement joint
  - 3D printed concrete slab

Steel Flower Lateral System
- Concrete walls
  - Steel X bracing

Steel Flower Framing
- Steel trusses
- Honeycomb steel beams
- Steel columns

Steel Flower Floors
- Movement joint
  - 3D printed concrete slab
Load Path  |  Steel Flower

**Gravity Load**

- Gravity load
- Transfer (compression)
- Transfer (tension)
- Foundation (tension)

**Lateral Load**

- Lateral load
- Transfer (compression)
- Transfer load
- Foundation load
# MEP System Selection

## Primary

<table>
<thead>
<tr>
<th>Sprout</th>
<th>Steel Flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric boiler + air-cooled chiller</td>
<td>Ground source heat pump</td>
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<tr>
<td>Dedicated outdoor air system (DOAS)</td>
<td>Air handler unit</td>
</tr>
</tbody>
</table>

## Secondary

<table>
<thead>
<tr>
<th>Auditorium + 4-5m ceiling spaces</th>
<th>3m Ceiling Spaces (NW lobe; above auditorium)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement ventilation</td>
<td>Dedicated outdoor air system (DOAS)</td>
</tr>
<tr>
<td>Radiant floors</td>
<td>Radiant floors</td>
</tr>
<tr>
<td></td>
<td>Fan coil cooling system</td>
</tr>
</tbody>
</table>
0 = Leading one along

Room Legend
- Auditorium
- Elevator
- Entrance
- Fire stairs
- Group work area
- Large Classroom + sem. rooms
- Sem. Room
- Small Classroom
- Tech shaft
- Toilets

Legend:
- A = SE - MEP - CM - LCFM
Auditorium Floor Sandwich | Sprout

How does Rapunzel keep cool in summer?
1 = Work and views

Room Legend
- Elevator
- Fac. offices
- Fire stairs
- Open student area
- Tech shaft
- Toilets
2 = Visual connections

Room Legend
- Elevator
- Fac. collaboration area
- Fac. Lounge
- Fac. Offices
- Faculty Admin. area
- Fire stairs
- Group work area
- Instructional Lab + Sem. Rooms
- MEP
- Storage
- Storage/ Server room
- Tech shaft
- Tech Support
- Toilets

A - SE - MEP - CM - LCFM
Level 2 | Sprout

Dimensions in [m]

- Columns Glulam 0.35 x 0.35 and 0.2 x 0.2
- Mega columns 0.4 x 0.4
- Primary beams 0.4 x 0.2
- Secondary beams 0.4 x 0.2
- Braces and core walls
- Long spans beams 0.6 x 0.2
- Trusses 0.7m

← Cantilever
Level 2 | Steel Flower

Dimensions in [m]

- Columns HEA 300
- Mega columns HEA 400
- Primary beams honeycomb 0.4m
- Secondary beams HEA 100
- Braces and core walls
- Long spans trusses
- Cantilever
Level 2 Floor Sandwich | Sprout

hAIR conditioning!
Site Logistics | The Water Riddle

What about Dewatering?

Self-drilling micropiles

No Dewatering!

Precast Concrete Bench Wall
Site Logistics | 3D Printing Process

But How?

Max size = 2.5m x 10m
Site Logistics | 3D Printing Process

Sprout - 3D printed Formwork
Steel Flower - 3D printed Concrete
## Site Logistics | 3D Printing Process

<table>
<thead>
<tr>
<th></th>
<th>3D Printed Slab</th>
<th>3D Printed Formwork</th>
<th>Factors</th>
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<tbody>
<tr>
<td>1</td>
<td>Construction Cost</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost of 3D Printer</td>
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<tr>
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<td>X</td>
<td>High Cement Content</td>
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<tr>
<td>2</td>
<td>Construction Schedule</td>
<td>X</td>
<td>✓</td>
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<td>Availability of 3D Printer</td>
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<td>X</td>
<td>Preparation of Panels</td>
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<tr>
<td>3</td>
<td>CO2 Impact</td>
<td>X</td>
<td>✓</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>High Cement Content</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>Wasted Material</td>
</tr>
</tbody>
</table>
Site Logistics | Green Construction

**Drilling rig MM4**
- Maximum line pull: 600 daN
- Maximum stroke of rotary head: 3.350 m

**Volvo FE Electric**
- Width: 2.30m
- Charging Time: < 2 h/11 h

**Volvo L25 Electric**
- Bucket capacity: 0.9 m³
- Indicative runtime: Up to 8 hours

**Liebherr T Electric truck mixer (ETM 1004)**
- Capacity: 11.05 m³
- Battery Capacity: 32 kW

**Liebherr mobile crane**

**Mercedes Actros Rigid 6x2 2536L**
- Max Length: 11m
- Charging time: < 2 h/11 h
Site Logistics | Construction not Feasible!

Initial Building Layout

No delivery space

New Building Layout
Site Logistics | Foundation Phase + Micro-Piling

- Office
- Shower/W.C.
- Dry/wet Area
- First Aid
- Generator
- Recycle bin
- Concrete washout

Personnel path
Stockpile
Laydown
Temp. Fence
Silt Fence (SWPPP)
Site Logistics | Superstructure Phase

Next Year’s Spring - Sprout

Next Year’s Spring - Steel Flower

Office
Shower/W.C.
Dry/wet Area
First Aid
Personnel path
Stockpile
Laydown
Temp. Fence
Silt Fence (SWPPP)
Generator
Recycle bin
Concrete washout
Site Logistics | Crane comparison

Pay more for less time?

Two mobile cranes
Site Logistics | Robots integration

Grove  Sprout  Mesh  Sprout  Steel Flower

Overhead Drilling Robot

- Grove
- Sprout
- Mesh
- Steel Flower

Robot-assisted manufacturing process

SafeAI and autonomous Vehicle

Grove  Mesh
FINAL DECISION
The Integration

BKI

River Team | Cost Database

Quantity Takeoff

Life Cycle Cost

BIM Execution Plan
Team River
AEC Class 2021

STV

The Integration

A - SE - MEP - CM - LCFM
Target Value Design | Comparison

A - SE - MEP - CM - LCFM
Sustainable Target Value | Comparison

Symbiosis | Grove

Next Year's Spring | Sprout

Next Year's Spring | Steel Flower

A - SE - MEP - CM - LCFM
Life Cycle Cost | Comparison

- Symbiosis's Grove: 2.860.000 €
- Symbiosis's Mesh: 2.790.000 €
- NYS Sprout: 2.910.000 €
- NYS Steel Flower: 3.030.000 €

Construction Costs: Green
M&O: Blue
Replacement Costs: Yellow
Risk and Insurance: Orange
Total Financing Costs: Lt. Green
Total Taxes: Two Tones Blue

Costs: €
## Life Cycle Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>Symbiosis</th>
<th>Symbiosis</th>
<th>NYS</th>
<th>NYS</th>
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<tbody>
<tr>
<td></td>
<td>Grove</td>
<td>Mesh</td>
<td>Sprout</td>
<td>Steel Flower</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>8.250.000 €</td>
<td>8.420.000 €</td>
<td>8.130.000 €</td>
<td>7.820.000 €</td>
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<tr>
<td>M &amp; O Cost</td>
<td>4.160.000 €</td>
<td>4.220.000 €</td>
<td>4.350.000 €</td>
<td>3.900.000 €</td>
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<tr>
<td>Replacement Cost</td>
<td>1.500.000 €</td>
<td>1.570.000 €</td>
<td>1.310.000 €</td>
<td>1.640.000 €</td>
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<tr>
<td>Risk &amp; Insurance</td>
<td>1.210.000 €</td>
<td>1.150.000 €</td>
<td>1.120.000 €</td>
<td>1.120.000 €</td>
</tr>
<tr>
<td>Financing Cost</td>
<td>3.900.000 €</td>
<td>3.850.000 €</td>
<td>3.930.000 €</td>
<td>4.010.000 €</td>
</tr>
<tr>
<td><strong>Total Life Cycle Cost</strong></td>
<td><strong>19.020.000 €</strong></td>
<td><strong>19.210.000 €</strong></td>
<td><strong>18.840.000 €</strong></td>
<td><strong>18.490.000 €</strong></td>
</tr>
</tbody>
</table>
Risk Management | Calculation

“A good rule of thumb is to assume that everything matters.”
Richard Thaler

1. Analyze Data to calculate annual **probability**
2. Apply Binomial Distribution with 24 repetitions
3. Apply Triangle Distribution **Impact** Low, Likely, High
4. Multiply Probability and Impact Receive **Risk Costs**
Risk Management | What matters?

Identify  Analyze  Evaluate  Treat  Monitor

Climate > News

Hibernating lizards and snakes halt construction at Tesla ‘gigafactory’ in Berlin

Environment groups warn relocation of European protected species cannot be done quickly

Harry Cockburn  |  Wednesday 09 December 2020 11:46  |  comments
Executive Summary | Symbiosis + Next Year’s Spring

- Build around the auditorium
- Integrated Staircase
- Either Glulam vs. Steel Structure
- CLT vs. 3D printed slab
- Boiler, chiller vs. heat pump system
- Just in time vs. Off-site storage facility

- Rammed Earth
- Large variation in spaces
- 3D printed slabs
- CLT vs Concrete Walls
- Timber Trusses vs Steel Diagrid
- Boiler, chiller vs. heat pump system
Communication
Collaboration
Cooperation
A Week in the life of an AEC Student
Decision Making

- ARCHITECTURAL
- SUSTAINABILITY
- THRILL
- USABILITY
- FINANCING

A - SE - MEP - CM - LCFM
Continuing with Next Year's Spring
Outlook and Challenges
THANK YOU FOR YOUR ATTENTION!

Teamwork makes the dream work
### Construction Schedules | Symbiosis Grove

**Table of Activities**

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**Diagram**

- **Extraction Phase 1**: Extraction Phase 1
- **Wet-and-Dry Work**: Wet-and-Dry Work
- **Waterproofing**: Waterproofing
- **Service Fixtures**: Service Fixtures
- **Testing of MEP**: Testing of MEP
- **Commissioning and Handover**: Commissioning and Handover
- **Final Completion (FOC)**: Final Completion (FOC)
- **Shelving**: Shelving
- **Electrical**: Electrical
- **Reinforcement**: Reinforcement
- **Framing**: Framing
- **Plumbing**: Plumbing
- **Electrical**: Electrical
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**Legend**

- **Dark Green**: Construction
- **Dark Blue**: Site Preparation
- **Dark Red**: MEP
- **Dark Purple**: CM
- **Yellow**: LCFM

**Timeline**

- **Jan**: January
- **Feb**: February
- **Mar**: March
- **Apr**: April
- **May**: May
- **Jun**: June
- **Jul**: July
- **Aug**: August
- **Sep**: September
- **Oct**: October
- **Nov**: November
- **Dec**: December
# Construction Schedules | Symbiosis Mesh

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### Construction Schedules | Next Year’s Spring - Sprout

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### Timeline

- **2024:**
  - January: Planning and Design
  - February: Site Preparation
  - March: Preconstruction
  - April: Refining and Design
  - May: Site Preparation
- **2025:**
  - January: Site Preparation
  - February: Preconstruction
  - March: Design Finalization

### Milestones
- Mobilization
- Electric Charging Station
- Grading
- Precast Concrete Deck
- Hollowbar micropiles
- Pile cap
- SOG
- Shell
- Roofing
- Exterior finishes
- Interior finishes
- Services 1st Fix
- Services 2nd Fix
- Furnishing & Equipment
- Testing of MEP
- Contingency allowance
- Commissioning and Handover
- Final Project Completion Date
# Construction Schedules | Next Year’s Spring Steel Flower

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<td>EF-100 Exterior finishes</td>
<td>30</td>
<td>06-Jul-24</td>
<td>16-Aug-24</td>
<td>25</td>
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<tr>
<td></td>
<td><strong>NYS.2.3.6 Interior Finishes &amp; Specialties</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>F-100 Interiors</td>
<td>50</td>
<td>06-Jul-24</td>
<td>23-Sep-24</td>
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<td><strong>NYS.2.3.7 MEP</strong></td>
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<td>ME-100 Services 1st Fix</td>
<td>15</td>
<td>09-Jul-24</td>
<td>29-Jul-24</td>
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<td>ME-110 Services 2nd Fix</td>
<td>15</td>
<td>24-Sep-24</td>
<td>14-Oct-24</td>
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<tr>
<td></td>
<td><strong>NYS.2.3.8 Furnishing and Equipment</strong></td>
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<tr>
<td></td>
<td>F-100 Furnishing &amp; Equipment</td>
<td>20</td>
<td>13-Nov-24</td>
<td>10-Dec-24</td>
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<tr>
<td>NYS.2.4</td>
<td>CLOSEOUT</td>
<td>86</td>
<td>15-Oct-24</td>
<td>1-HFeb-25</td>
<td>0</td>
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<tr>
<td></td>
<td>C-101 Testing of MEP</td>
<td>20</td>
<td>15-Oct-24</td>
<td>12-Nov-24</td>
<td>0</td>
<td></td>
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<tr>
<td></td>
<td>C-102 Contingency allowance</td>
<td>25</td>
<td>11-Dec-24</td>
<td>14-Jan-25</td>
<td>0</td>
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<tr>
<td></td>
<td>C-103 Commissioning and Handover</td>
<td>20</td>
<td>15-Jan-25</td>
<td>1-HFeb-25</td>
<td>0</td>
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<td></td>
<td>C-104 Final Project Completion Date</td>
<td>0</td>
<td>11-Feb-25</td>
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</tbody>
</table>
TVD Symbiosis Grove

TARGET VALUE DESIGN WALL - Symbiosis Grove

Budget = €11,000,000

<table>
<thead>
<tr>
<th>RIVER TEAM</th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>€ 8,251,016.57</td>
<td>€ 10,000,000.00</td>
<td>€ 1,748,983.43</td>
</tr>
</tbody>
</table>

Gross Square Meters: 2,814
Price = € 2894/m²

COST ESTIMATE

- Building Structure: € 326,951.90 (4%)
- General Conditions: € 1,002,228.49 (32%)
- A Substructure: € 948,985.48 (32%)
- E Equipment and Figs: € 55,086.55 (1%)
- C Shell: € 2,553,000 (50%)
- F Specialty Construction: € 620,022.35 (22%)

A - SE - MEP - CM - LCFM
# TVD Symbiosis Mesh

## TARGET VALUE DESIGN WALL - Symbiosis Mesh

Budget = €11,000,000

<table>
<thead>
<tr>
<th>RIVER TEAM</th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>€8,490,714.25</td>
<td>€10,000,000.00</td>
<td>€1,509,285.75</td>
</tr>
</tbody>
</table>

### TVD - SUMMARY

- **€10,000,000.00**
- **€8,490,714.25**
- **€1,509,285.75**

### TVD - TARGETS BY CLUSTER

- **TARGET VALUE**
- **ESTIMATED VALUE**
- **VALUE DELTA**

### COST ESTIMATE

- **A Substructure**: €1,011,643.64 (11%)
- **B Shell**: €2,036,100.15 (11%)
- **C Interiors**: €598,428.27 (6%)
- **D Services**: €2,671,906.10 (11%)
- **E Equipment and Furnishing**: €31,207.66 (1%)
- **F Speciality Construction**: €270,251.15 (3%)
- **G Building Shellwork**: €240,336.83 (4%)
- **H General Conditions**: €1,108,851.37 (13%)

### TVD - TRACKING TARGET OVER TIME

- **TARGET**
- **ESTIMATE**
- **DELTA**

### ESTIMATE OVERALL RELIABILITY

- High: 9%
- Medium: 64%
- Low: 27%

### ESTIMATE COST DATA RELIABILITY

- High: 11%
- Medium: 79%
- Low: 10%

### ESTIMATE QUANTITY RELIABILITY

- High: 48%
- Medium: 28%
- Low: 23%
TVD | Next Year’s Spring Sprout

TARGET VALUE DESIGN WALL - Next Year’s Spring Sprout

Budget = €11,000,000

<table>
<thead>
<tr>
<th>RIVER TEAM</th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>€ 8,134,284.75</td>
<td>€ 10,000,000.00</td>
<td>€ 1,865,715.25</td>
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</tbody>
</table>

Gross Square Meters 3,140

Price = € 2569/m²

COST ESTIMATE

- G Building Infrastructure € 203,038.45 3%
- I General Conditions € 5,000,000.00 13%
- II Speciality Construction € 270,920.15 3%
- III Equipment and Furnishing € 55,000.11 1%
- IV Services € 2,656,251.12 39%
- D Interiors € 1,653,300.55 51%

TVD - SUMMARY

- € 12,000,000.00
- € 10,000,000.00
- € 8,154,284.75
- € 2,845,715.25

TVD - TARGETS BY CLUSTER

- TARGET VALUE
- ESTIMATED VALUE
- VALUE DELTA

TVD - TRACKING TARGET OVER TIME

TARGET

- € 14,000,000.00
- € 12,000,000.00
- € 10,000,000.00
- € 8,000,000.00
- € 6,000,000.00
- € 4,000,000.00
TVD | Next Year’s Spring Steel Flower

TARGET VALUE DESIGN WALL - Next Year’s Spring Steel Flower

Budget = €11,000,000

RIVER TEAM

<table>
<thead>
<tr>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>€7,816,963.25</td>
<td>€10,000,000.00</td>
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</table>

Gross Square Meters | 3,056
Price = € 2536/m²

COST ESTIMATE

ESTIMATE QUANTITY RELIABILITY
HIGH 40%
LOW 22%
MEDIUM 38%

ESTIMATE COST DATA RELIABILITY
HIGH 11%
LOW 8%
MEDIUM 81%

ESTIMATE OVERALL RELIABILITY
HIGH 0%
LOW 36%
MEDIUM 66%
Site Logistics | Preserve & Protect

Stormwater Pollution Prevention Plan (SWPPP)

- Historic Preservation
- Erosion & Sediment Control BMP
- Concrete Washout
- Training and Tracking
- Biweekly Training
- Trench Drain
- Silt Fence
- KPI
**Site Layout | Supermarket Approach**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement freedom</td>
<td>Tight intersections</td>
</tr>
<tr>
<td>Lower delay risk</td>
<td>Road restrictions (width)</td>
</tr>
<tr>
<td>No material storage</td>
<td></td>
</tr>
</tbody>
</table>

**Route (9 mins by car)**

- **Storage**
- **Site**
- **Truck route from storage to site**
Site Logistics | Equipment Selection

**CAT small excavator (313 GC)**
- **Bucket:** GD 0.53 m³ (0.69 yd³)
- **Max Digging Depth:** 6.04 m

**JCB articulated truck (ADT 714)**
- **Capacity:** 7.34 m³
- **Width:** 2.50m

**Liebherr concrete mixer (LTB 12 RO/GL)**
- **Radius:** 11.5m
- **Capacity:** 70 m³/h

**Liebherr Tower crane (85 EC-B 5)**
- **Max. radius:** 50.00 m
- **Max. capacity:** 5,000 kg

**Mercedes Actros Rigid 6x2 2536L**
- **Length:** 9.5m
- **Width:** 2.5 m
Symbiosis Level -1 Distribution Tree
Symbiosis Level 0 Distribution Tree
Symbiosis Level 1 Distribution Tree
Symbiosis Level 2 Distribution Tree
Next Year's Spring Level 0 Distribution Tree
Next Year's Spring Level 1 South Distribution Tree

5m ceilings
Next Year’s Spring Level 2 Distribution Tree
## Full Life Cycle Cost

<table>
<thead>
<tr>
<th>Life Cycle Cost</th>
<th>Symbiosis Grove</th>
<th>Symbiosis Mesh</th>
<th>NYS Sprout</th>
<th>NYS Steel Flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>€ 23,687,853,17</td>
<td>€ 23,687,853,17</td>
<td>€ 23,687,853,17</td>
<td>€ 23,687,853,17</td>
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<tr>
<td>Construction Costs</td>
<td>€ 8,250,000</td>
<td>€ 8,420,000</td>
<td>€ 8,130,000</td>
<td>€ 7,820,000</td>
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<tr>
<td>M&amp;O</td>
<td>€ 4,160,000</td>
<td>€ 4,220,000</td>
<td>€ 4,350,000</td>
<td>€ 3,900,000</td>
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<tr>
<td>Replacement Costs</td>
<td>€ 1,500,000</td>
<td>€ 1,570,000</td>
<td>€ 1,310,000</td>
<td>€ 1,640,000</td>
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<tr>
<td>Risk and Insurance</td>
<td>€ 1,210,000</td>
<td>€ 1,150,000</td>
<td>€ 1,120,000</td>
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<tr>
<td>Total Financing Costs</td>
<td>€ 1,040,000</td>
<td>€ 1,060,000</td>
<td>€ 1,020,000</td>
<td>€ 980,000</td>
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<tr>
<td>Total Taxes</td>
<td>€ 2,860,000</td>
<td>€ 2,790,000</td>
<td>€ 2,910,000</td>
<td>€ 3,030,000</td>
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<tr>
<td>FT</td>
<td>€ 3,900,000</td>
<td>€ 3,850,000</td>
<td>€ 3,930,000</td>
<td>€ 4,010,000</td>
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<tr>
<td>Total Life Cycle Cost</td>
<td>€ 19,020,000</td>
<td>€ 19,210,000</td>
<td>€ 18,840,000</td>
<td>€ 18,490,000</td>
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<td>Net Present Value</td>
<td>€ 1,670,000</td>
<td>€ 1,550,000</td>
<td>€ 1,747,993</td>
<td>€ 2,020,000</td>
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<tr>
<td>Internal Rate on Return</td>
<td>11,3%</td>
<td>10,8%</td>
<td>11,6%</td>
<td>13,1%</td>
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<tr>
<td>Life Cycle Cost p.a.</td>
<td>€ 760,800</td>
<td>€ 768,400</td>
<td>€ 753,600</td>
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<tr>
<td>Architectural</td>
<td>Open Spaces, Aesthetics, Welcoming design</td>
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<tr>
<td>Sustainability</td>
<td>STV, Mental Health, Recyclability, Equity</td>
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<tr>
<td>Usability</td>
<td>Room for interactions, Innovations, Comfort</td>
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<td>Financing</td>
<td>Life Cycle Costs, Internal Rate on Return, TVD, Construction Costs</td>
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<tr>
<td>Thrill</td>
<td>Over all excitement for the concept, design, structure, construction</td>
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<tr>
<td>Total:</td>
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