USGBC, Zero Net Energy Conference, Fresno, 11/2/17

# BIM for Sustainable Outcomes

Michael Floyd

Sustainable Industry Technology Manager | @eco_humanism

AUTODESK.

American Institute of Architects, San Joaquin Chapter

BIM for Sustainable Outcome

Michael Floyd

AIA San Joaquin

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# Course Description

BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure. BIM presents some unique advancements in terms of sustainable design, engineering, and construction.
From conceptual, to schematic, to detailed design, today's BIM technology makes building energy optimization exponentially easier, faster, and more cost effective. Architects and engineers now have access to fast, accurate, actionable guidance throughout the design lifecycle, turning energy analysis into a bona-fide design decision-making tool. BIM is an incredible enabler of integrated project delivery (IPD), called out as "Integrative Design Process" in LEED V4. BIM helps stakeholders work across silos, exploiting cross-discipline insights to capture efficiencies that would not otherwise have come to light.

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# Learning Objectives

At the end of the this course, participants will be able to:

Attendees will walk away with a solid high-level understanding of:

1. What BIM is, and why it's a game changer for design, construction, and occupancy.
2. How BIM is accelerating energy optimization to support design and delivery of high performance buildings.
3. How BIM can streamline construction, reduce material waste, and reduce embodied carbon.
4. How BIM supports "circular" buildings (design and build for material reclamation, reuse, and recycling).

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# Rapid Urbanization

## A design challenge and opportunity


10B
People
75%
Urban Dwellers
5B
Middle Class
2X
Energy Demand


40%
energy consumption
1/3
of GHGs from energy
30%
of wasted energy
$60B
cost to US business / year


Construction & demo account for:
50% of raw material consumption
1/3 of waste (in the EU)
50% of waste (in the US)

# BIM (Building Information Modeling)

is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.

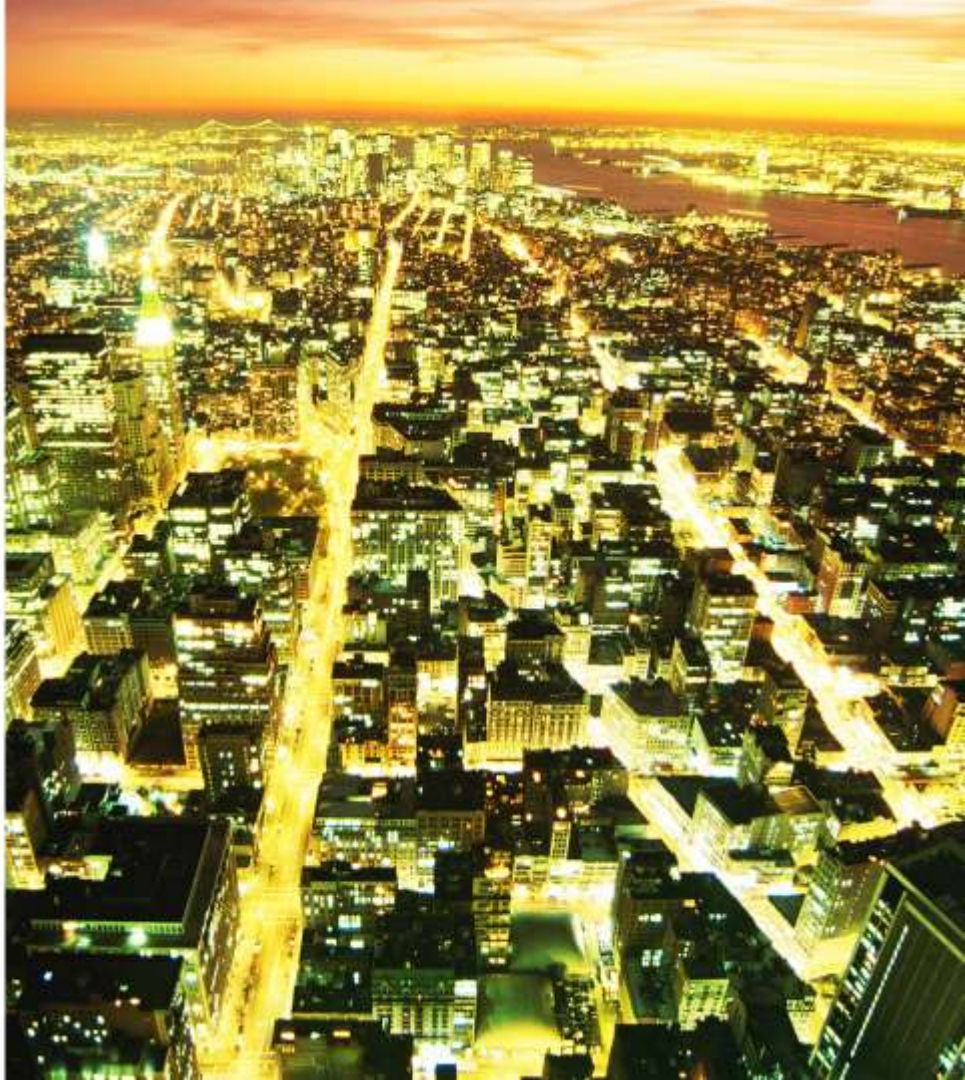
Image courtesy of WU Jiming

# HIGH-PERFORMANCE BUILDINGS

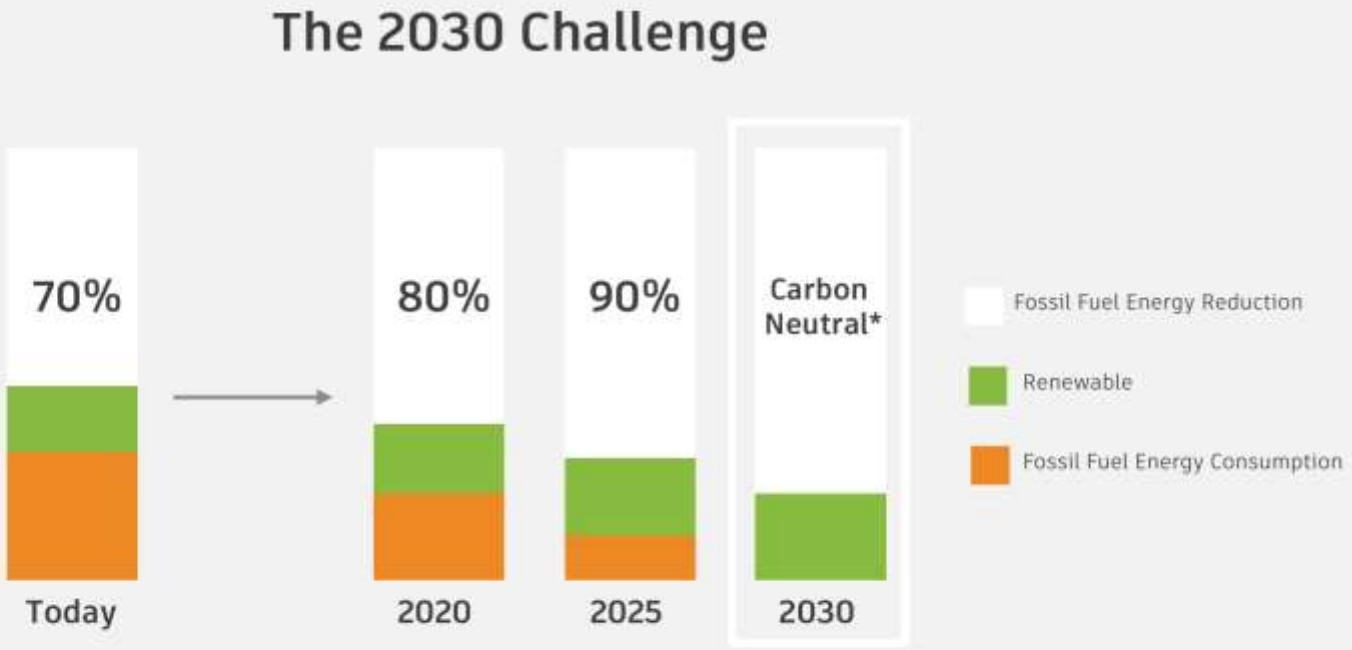
Image courtesy of SHOP Architecture

# Energy & Buildings

- >70% of energy consumption in US
- **90% of environmental impacts**
- Commercial buildings:
  - 40% HVAC
  - 33% plug and process
  - 20% lighting
- Residential buildings:
  - HVAC = primary consumer



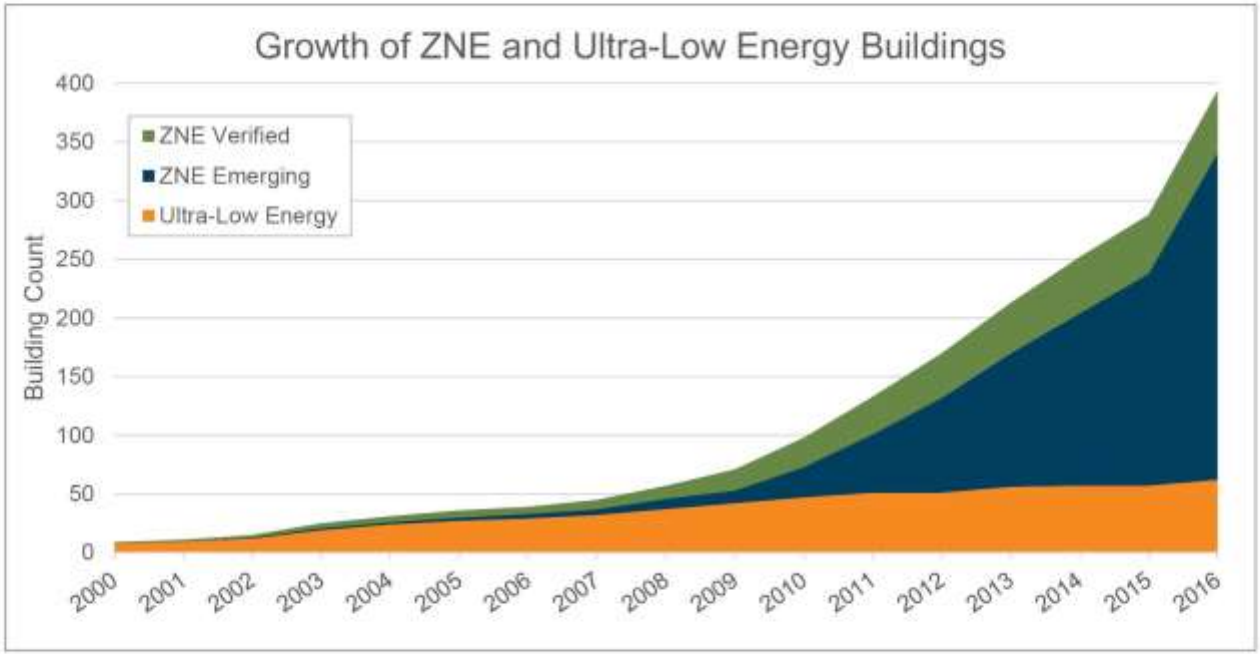
# Addressing climate change – designing a carbon-neutral built environment by 2030




# Global net-zero energy building market to reach **$1.4T by 2035**

David and Lucille Packard Foundation. Courtesy New Buildings Institute and Jeremy Bitterman

# Growth of Net Zero Buildings






nbi new buildings institute

Source: http://newbuildings.org/resource/2016-list-of-zne-buildings/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REVIT® 2018
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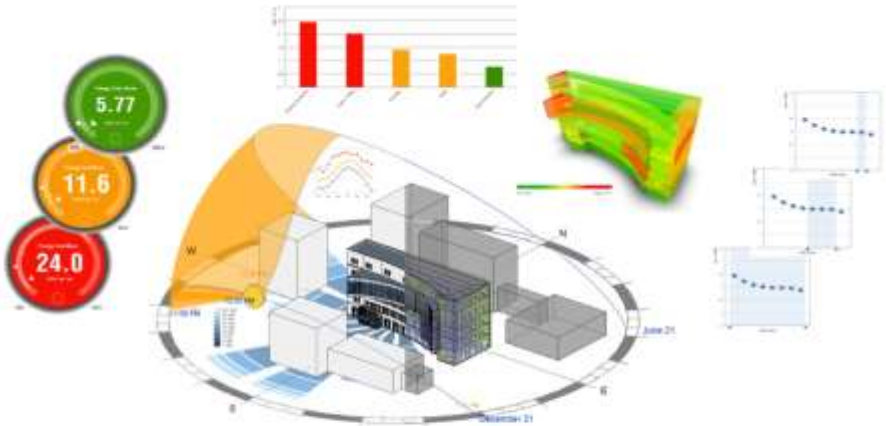
AUTODESK®
FORMIT® 360 PRO
AUTODESK.

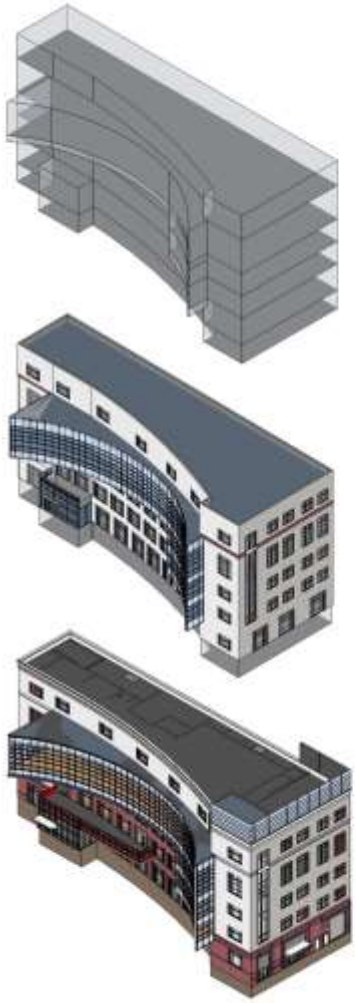

AUTODESK®
INSIGHT™
AUTODESK.


Autodesk® FormIt
formit360.autodesk.com/app/
Office Park Site
Properties
Location
Gross Area
105,200 sq ft
Target Area
Floor Area Ratio
N/A
Site Area

# Autodesk Insight: Technology for High Performance Building Design




- An in-BIM building energy analysis tool– no more “throw away” models!
- Fast, easy, and intuitive tools for energy performance, that can be used by designers (not just specialists anymore)
- Cost-effective + highly accurate
- Offers TRUE real-time feedback
- Robust analysis informs throughout design lifecycle, from conceptual to detailed
- Compare energy cost and performance data across 1000s of design options



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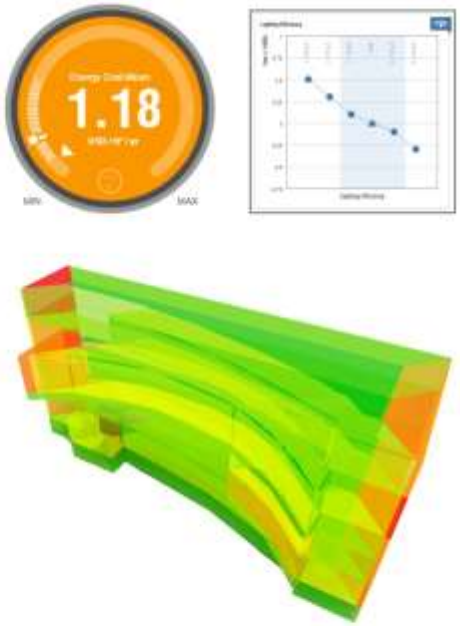
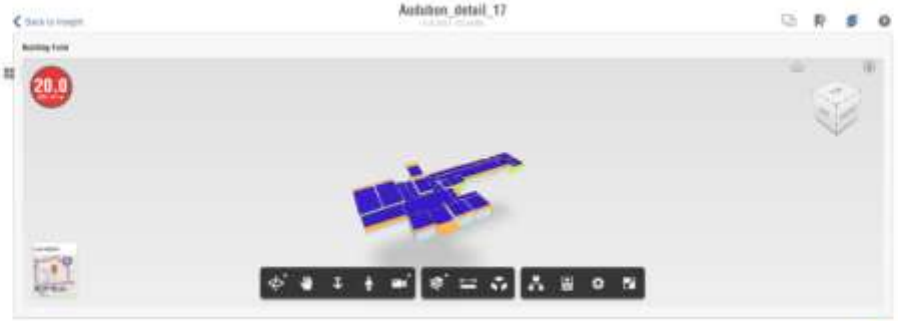
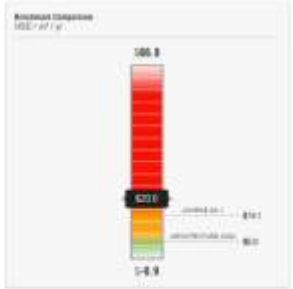
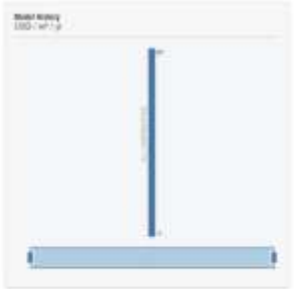
INSIGHT™





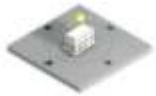





## Building Orientation

Rotates a building clockwise from 0 degrees. e.g. 90 degrees rotates the North side of the building to face East.

Current Setting:
90 - 0



## WWR - Southern Walls

Window-Wall-Ratio (glazing area / gross wall area) interacts with window properties to impact daylighting, heating & cooling.

Current Setting:
85% - 9%

## Window Shades - South

Shades can reduce HVAC energy use. The impact depends on other factors, such as window size and solar heat gain properties.

Current Setting:
**BIM - 2/3 Win Height**

## Window Glass - South

Glass properties control the amount of daylight, heat transfer & solar heat gain into the building, along with other factors.

Current Setting:
**Sgl Clr - Trp Low**

## WWR - Northern Walls

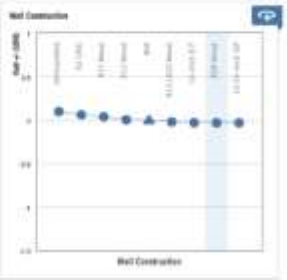
Window-Wall-Ratio (glazing area / gross wall area) interacts with window properties to impact daylighting, heating & cooling.

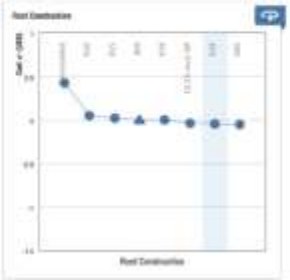
## Window Shades - North

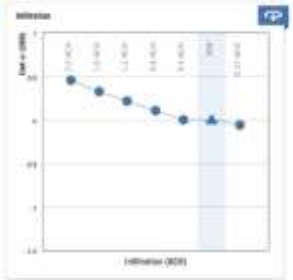
Shades can reduce HVAC energy use. The impact depends on other factors, such as window size and solar heat gain properties.

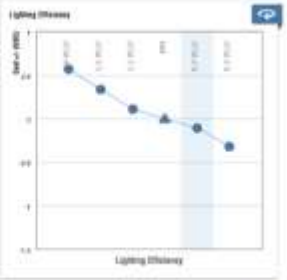
## Window Glass - North

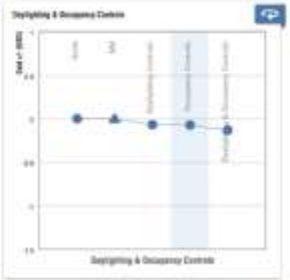
Glass properties control the amount of daylight, heat transfer & solar heat gain into the building, along with other factors.

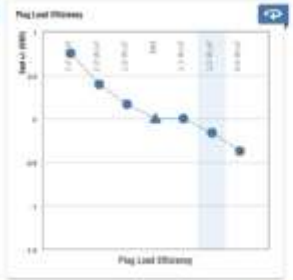

Wall Construction
Wall Construction

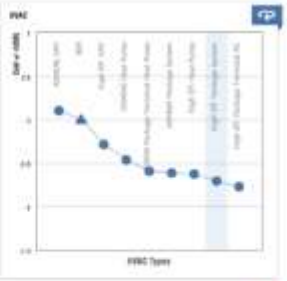

Roof Construction
Roof Construction

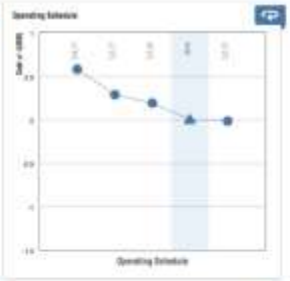

Infiltration
Infiltration (ACH)

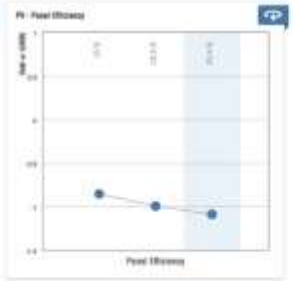

Lighting Efficiency
Lighting Efficiency


Daylighting & Occupancy Controls
Daylighting & Occupancy Controls


Plug Load Efficiency
Plug Load Efficiency

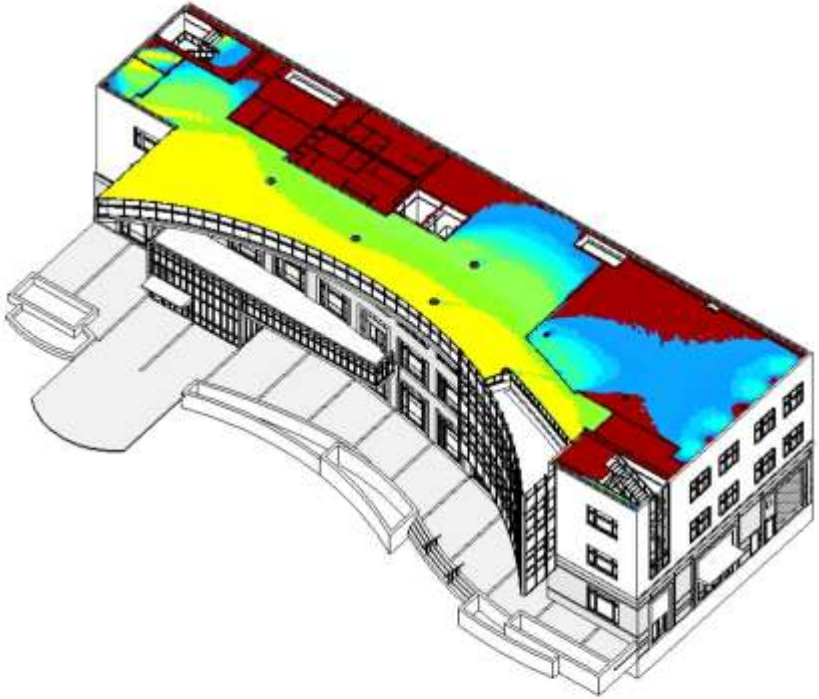

HVAC
HVAC Types

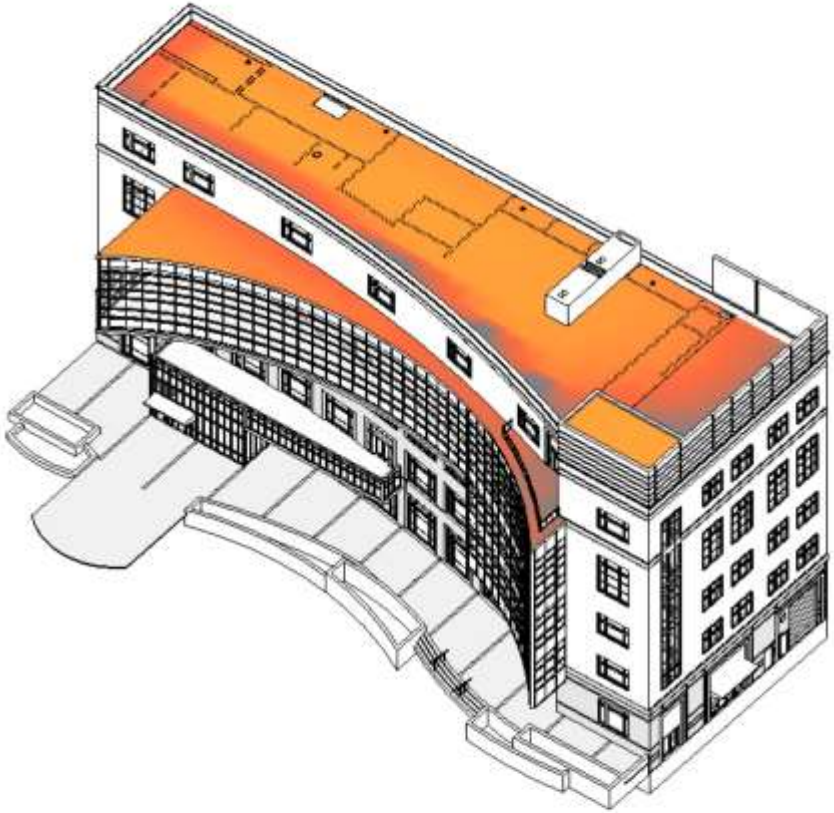

Operating Schedule
Operating Schedule


PV - Panel Efficiency
Panel Efficiency


PV - Purchase Limit


PV - Surface Coverage





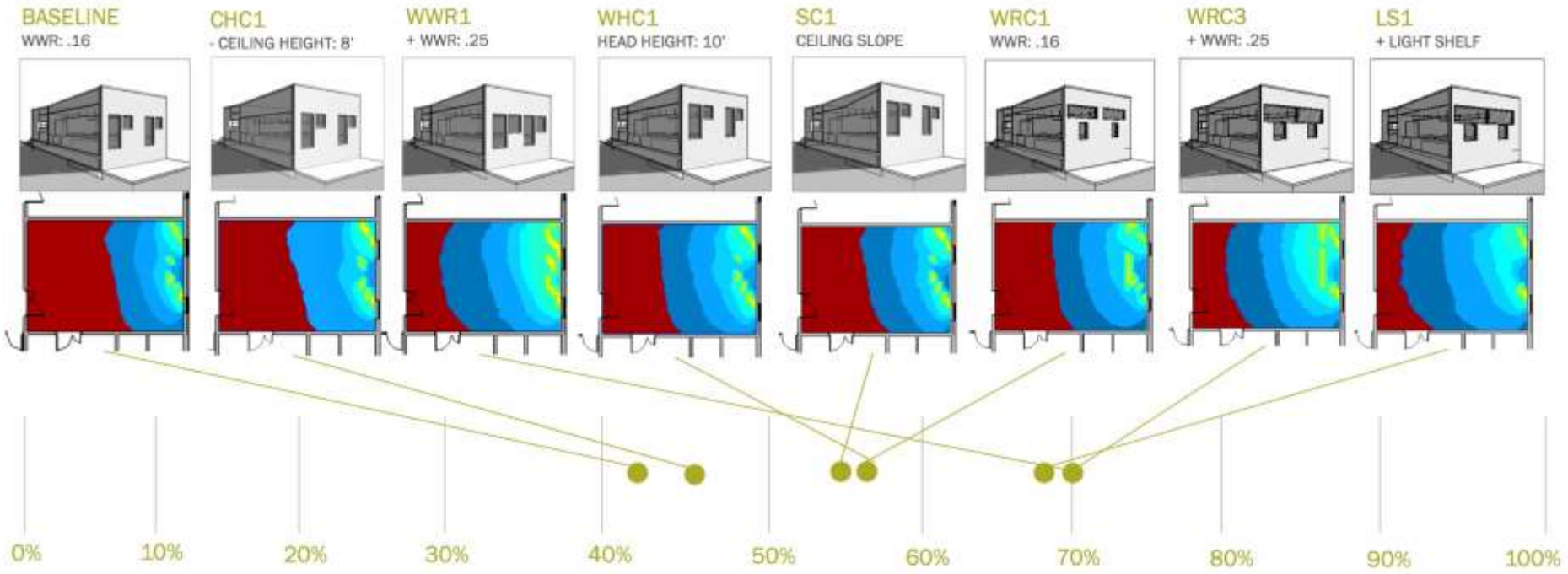



Image courtesy Eskew+Dumez+Ripple

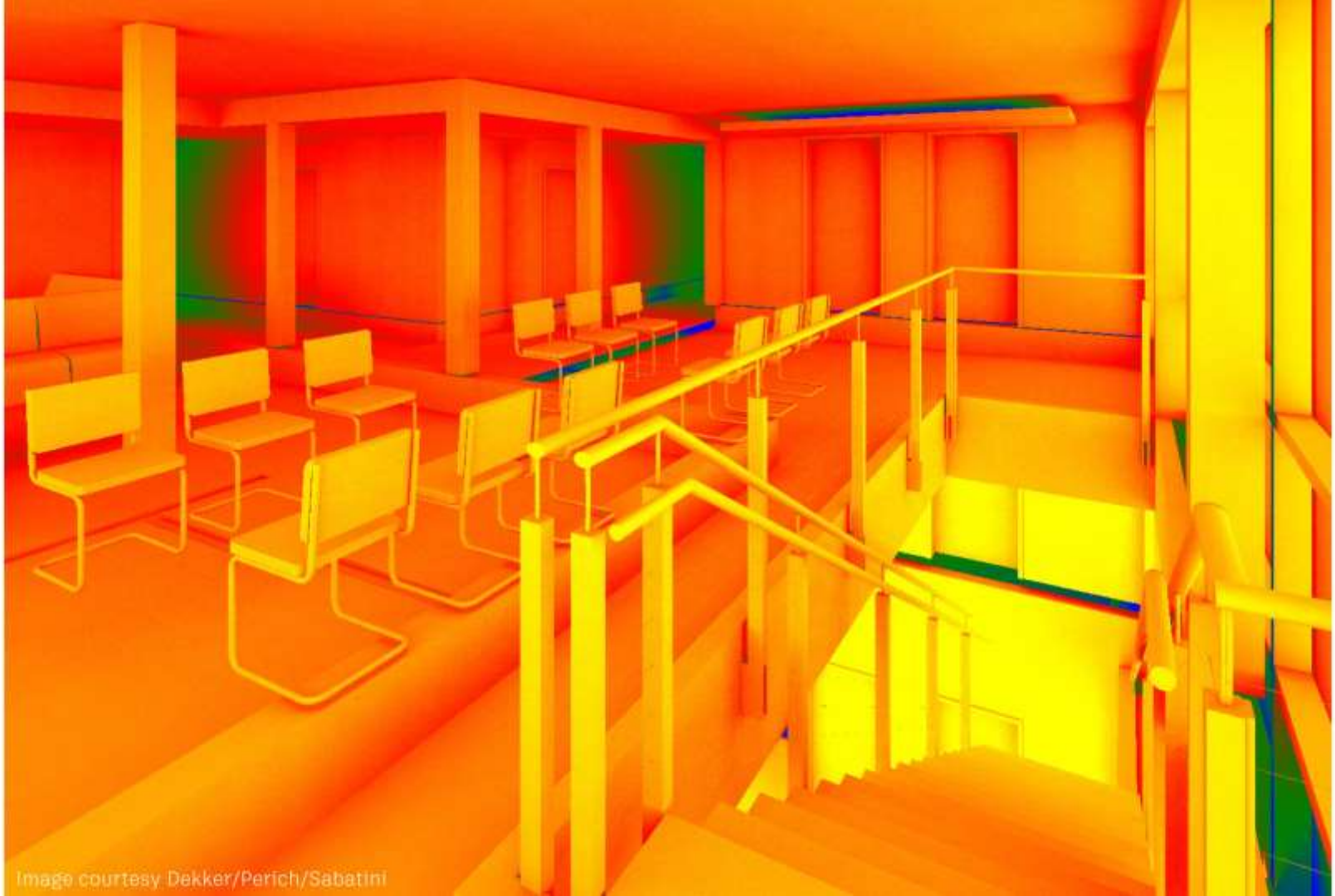
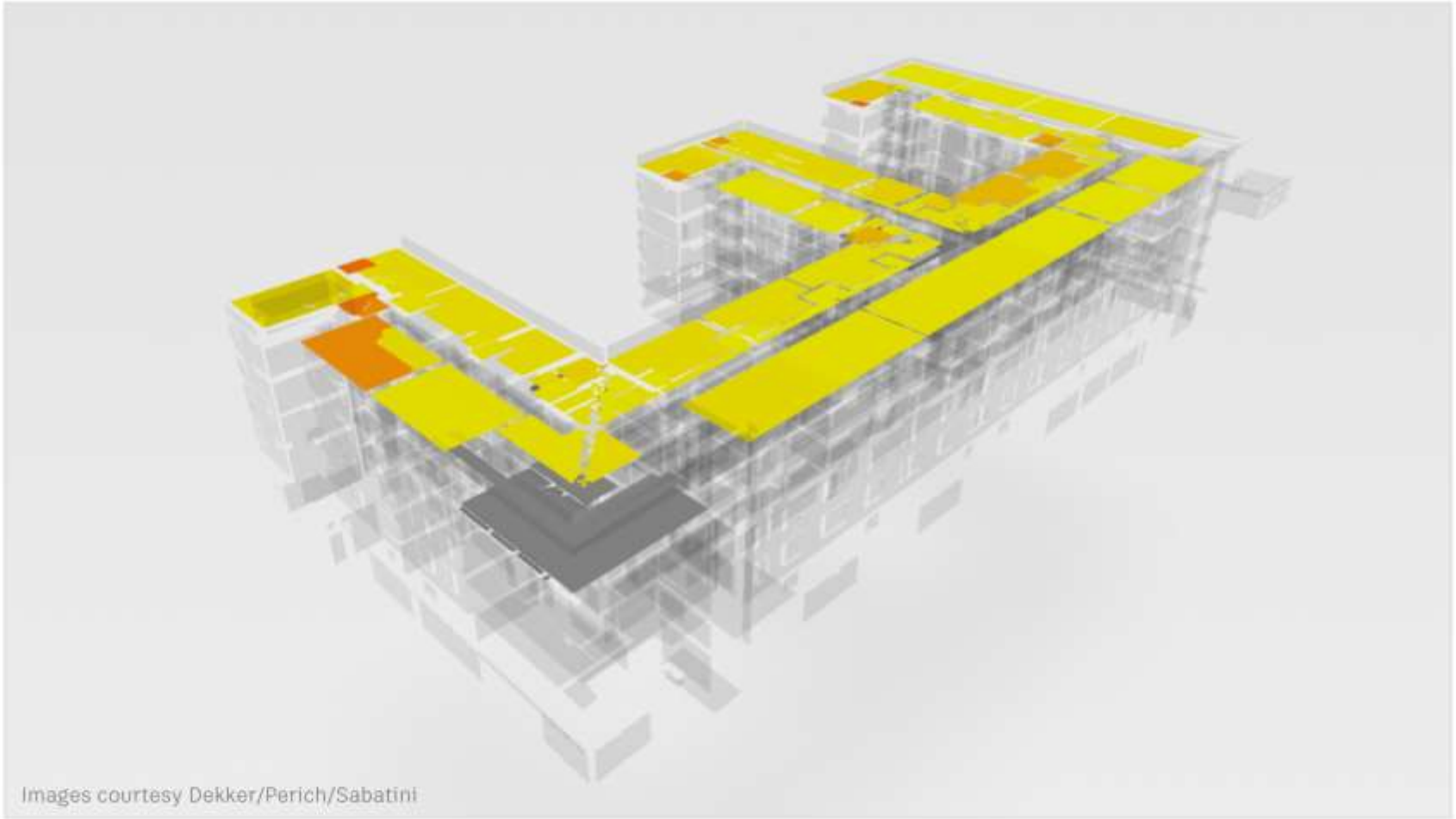
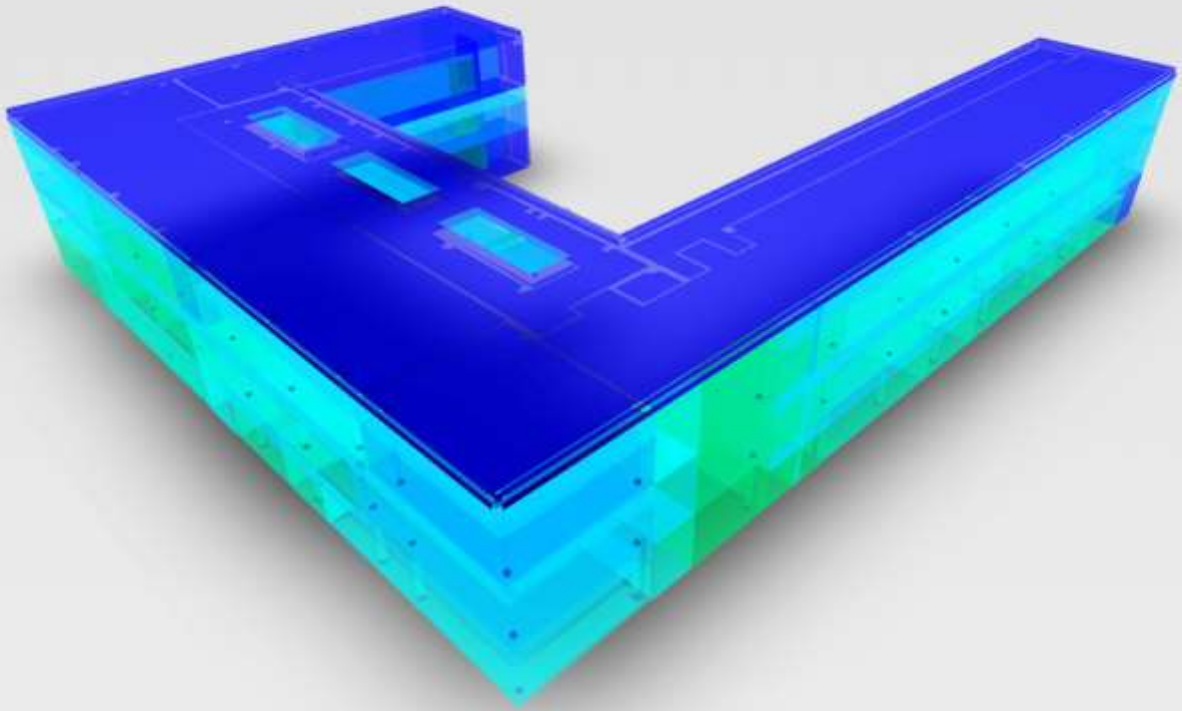
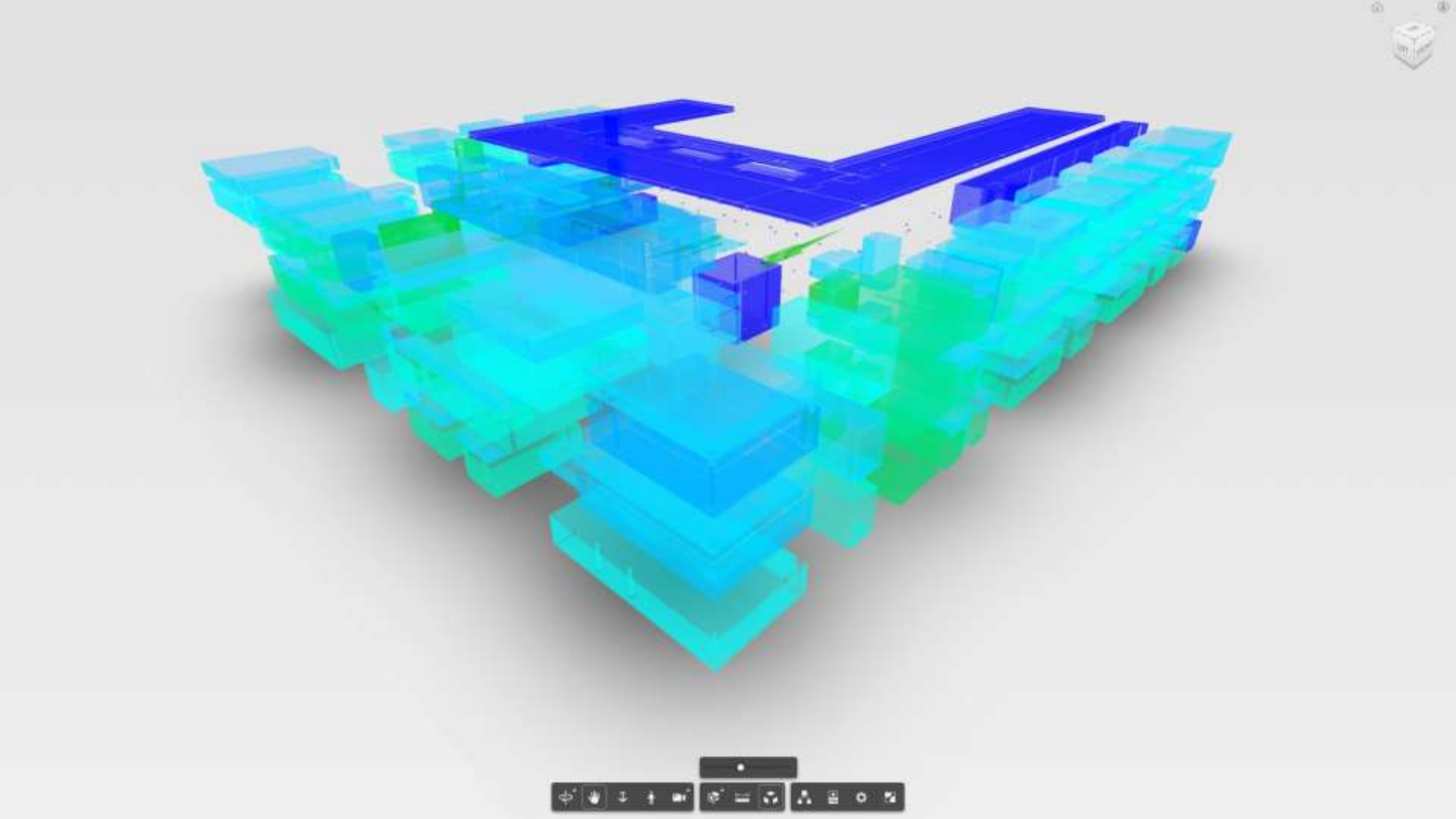


Image courtesy Dekker/Perich/Sabatini



Images courtesy Dekker/Perich/Sabatini





Courtesy Mills Group

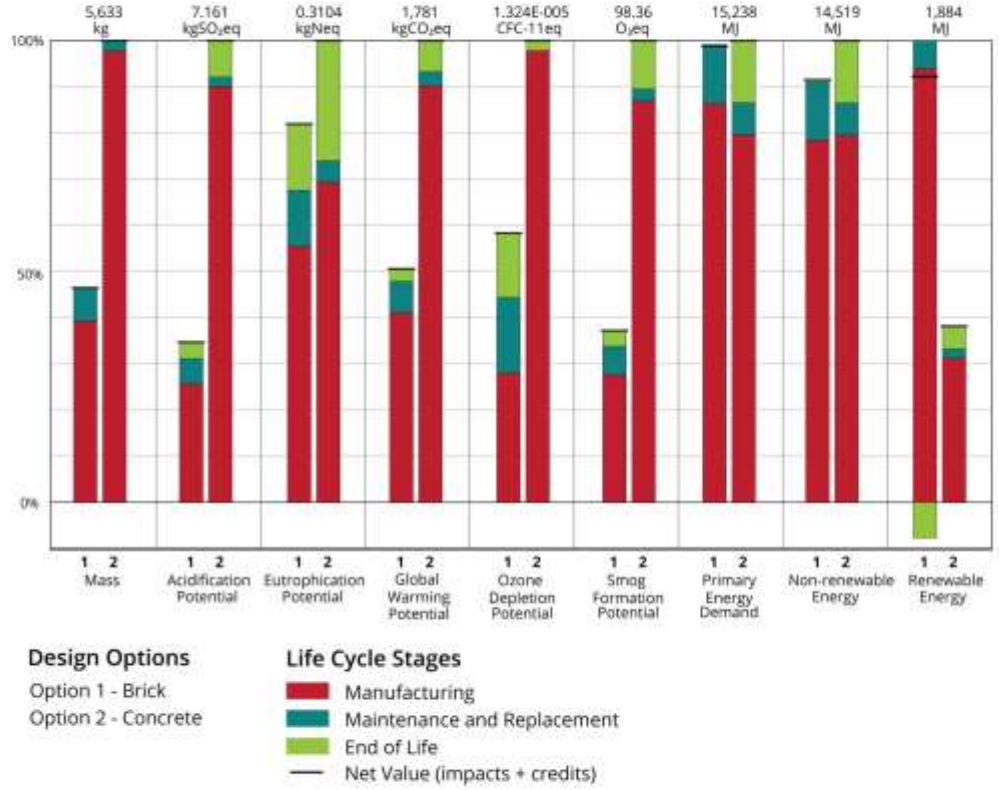
Courtesy Eskew+Dumez+Ripple

Courtesy Dekker/Perich/Sabatini
Photographer: Tim Hursley

Courtesy CTA

Lustron House, source: http://www.aarch.org/tours/pre-fab-plattsburgh/

# LCA (Life Cycle Assessment)




Logo & chart courtesy of **Tally** www.choosetally.com

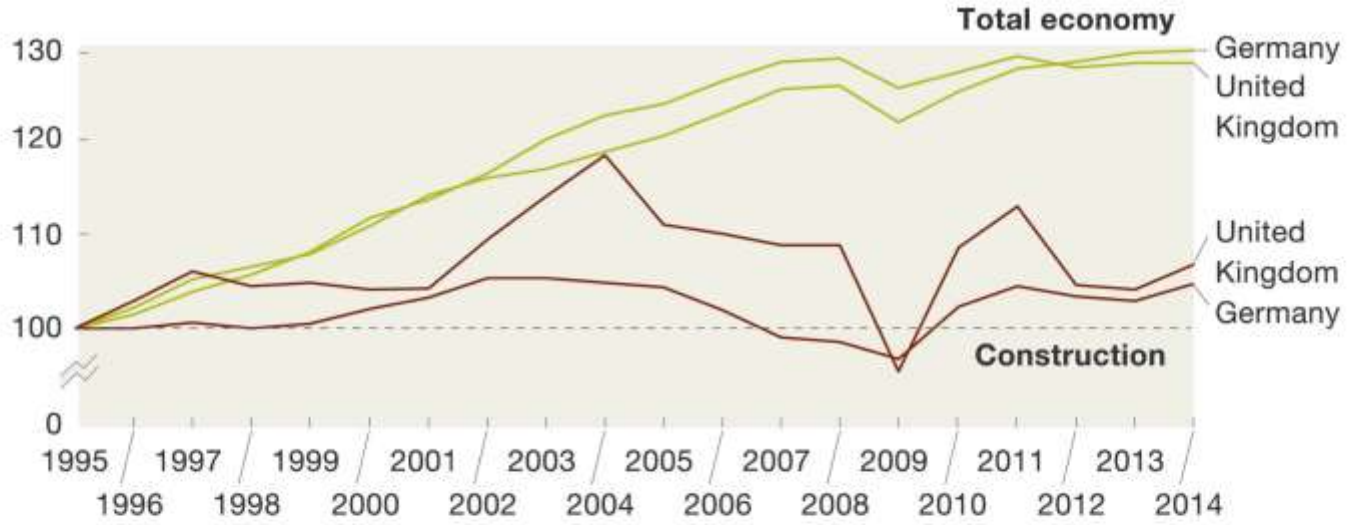

STREAMLINING
CONSTRUCTION

# Challenges:

- High failure rates, especially on large projects
- Cost & schedule overruns
- High-risk, slim margins
- Labor productivity lags
- Safety issues
- Material productivity issues

# Construction labor productivity has not kept pace with overall economic productivity.

**Labor productivity, gross value added per hour worked, constant prices,**[1]
index: 100 = 1995




[1]Based on 2010 prices.

McKinsey&Company | Source: Organisation for Economic Co-operation and Development

Low Margin

High Risk

Fragmented

# Analog

5 Wholesale Trade

6 Manufacturing

3.3% Investment

...

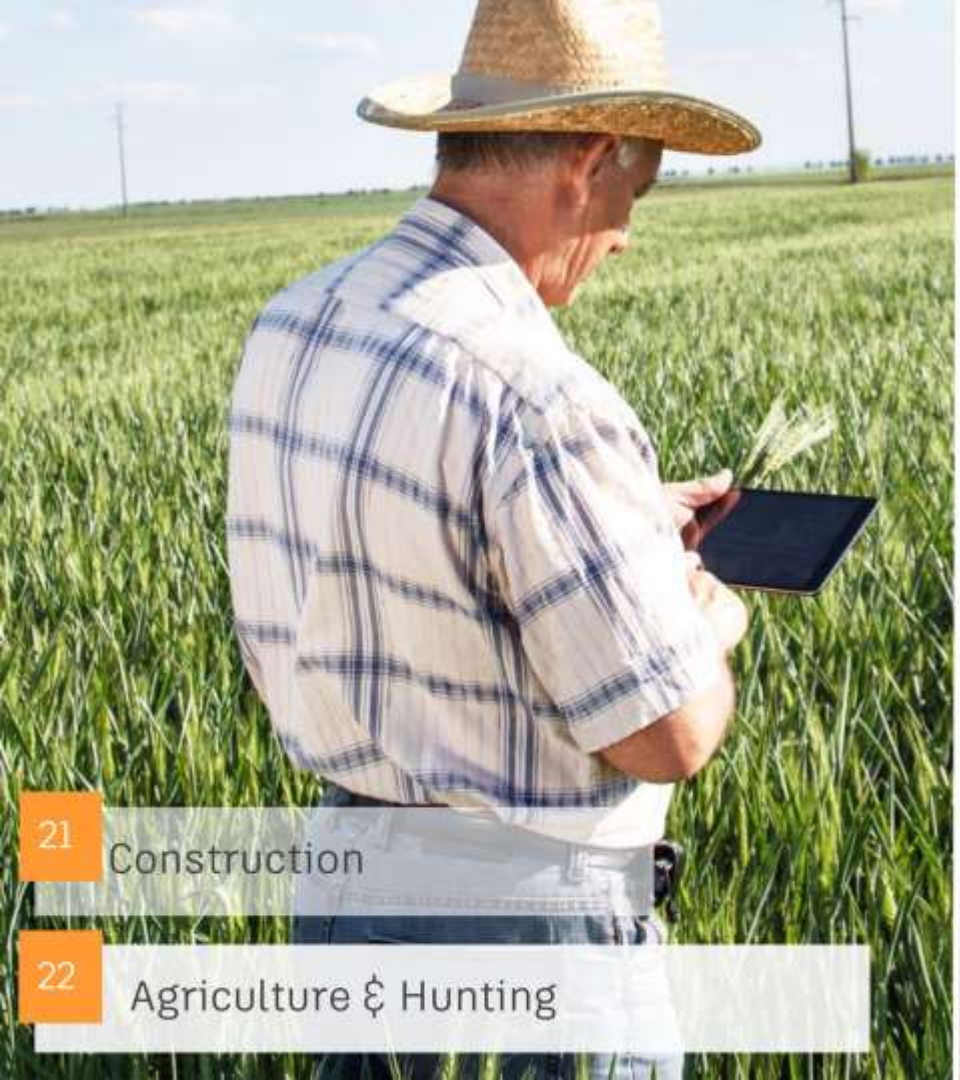
18 Government

19 Healthcare

20 Hospitality

21 Construction

1.2% Investment



21 Construction

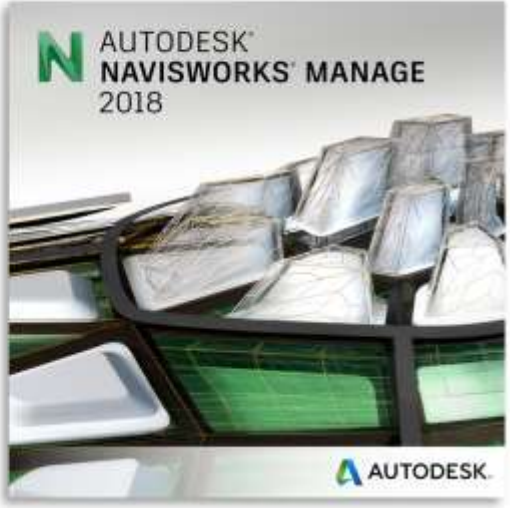
22 Agriculture & Hunting


AUTODESK BIM 360 | United Construction
3D
4D
5D
United Construction

# $1.2 Trillion

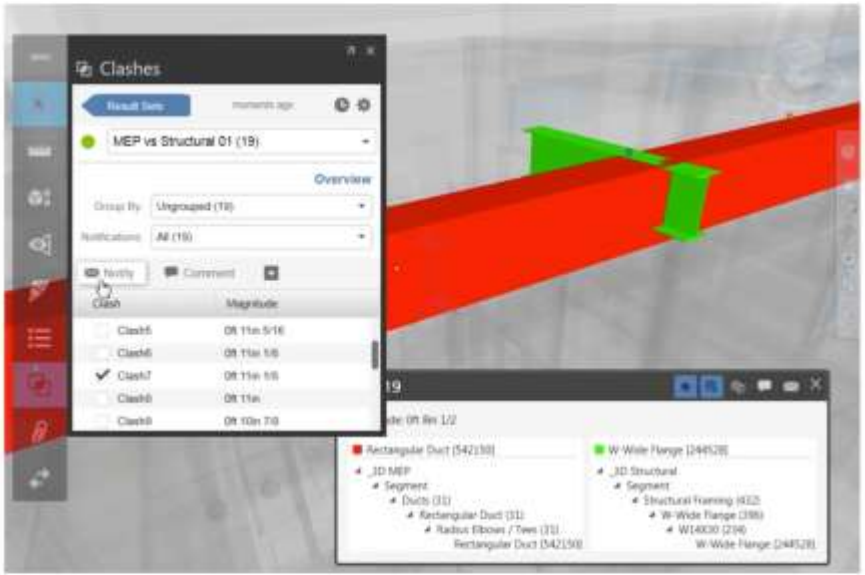

AUTODESK
REVIT 2018
AUTODESK

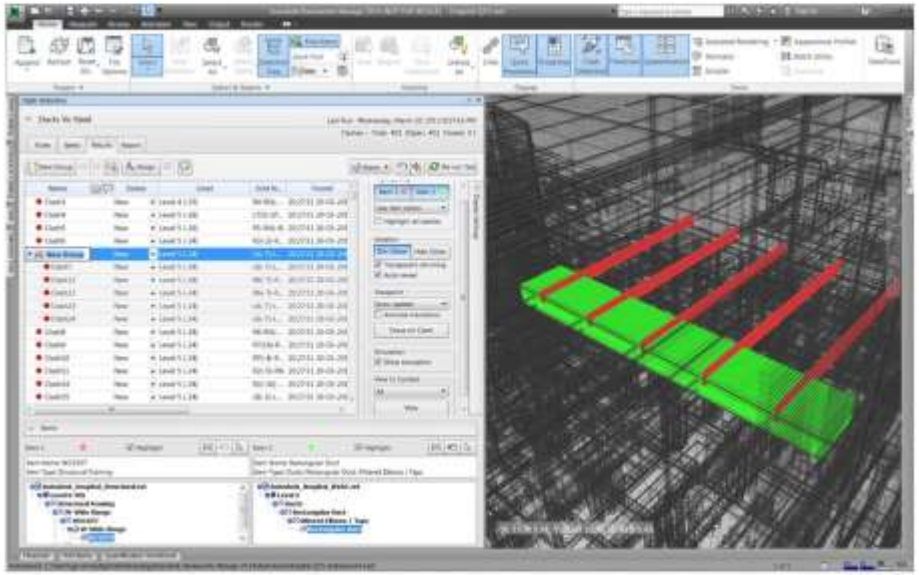

AUTODESK
BIM 360
AUTODESK


AUTODESK
NAVISWORKS MANAGE
2018
AUTODESK

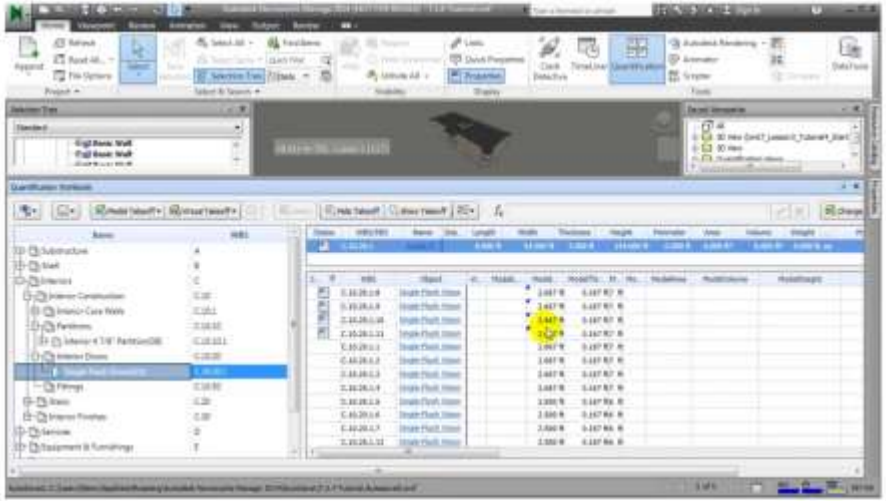

AUTODESK
FABRICATION
CADMEP 2018
AUTODESK

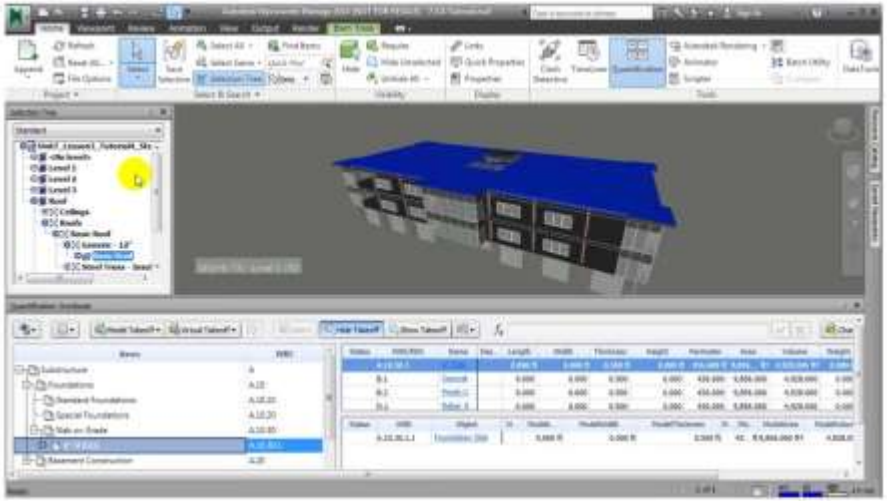
# Clash detection



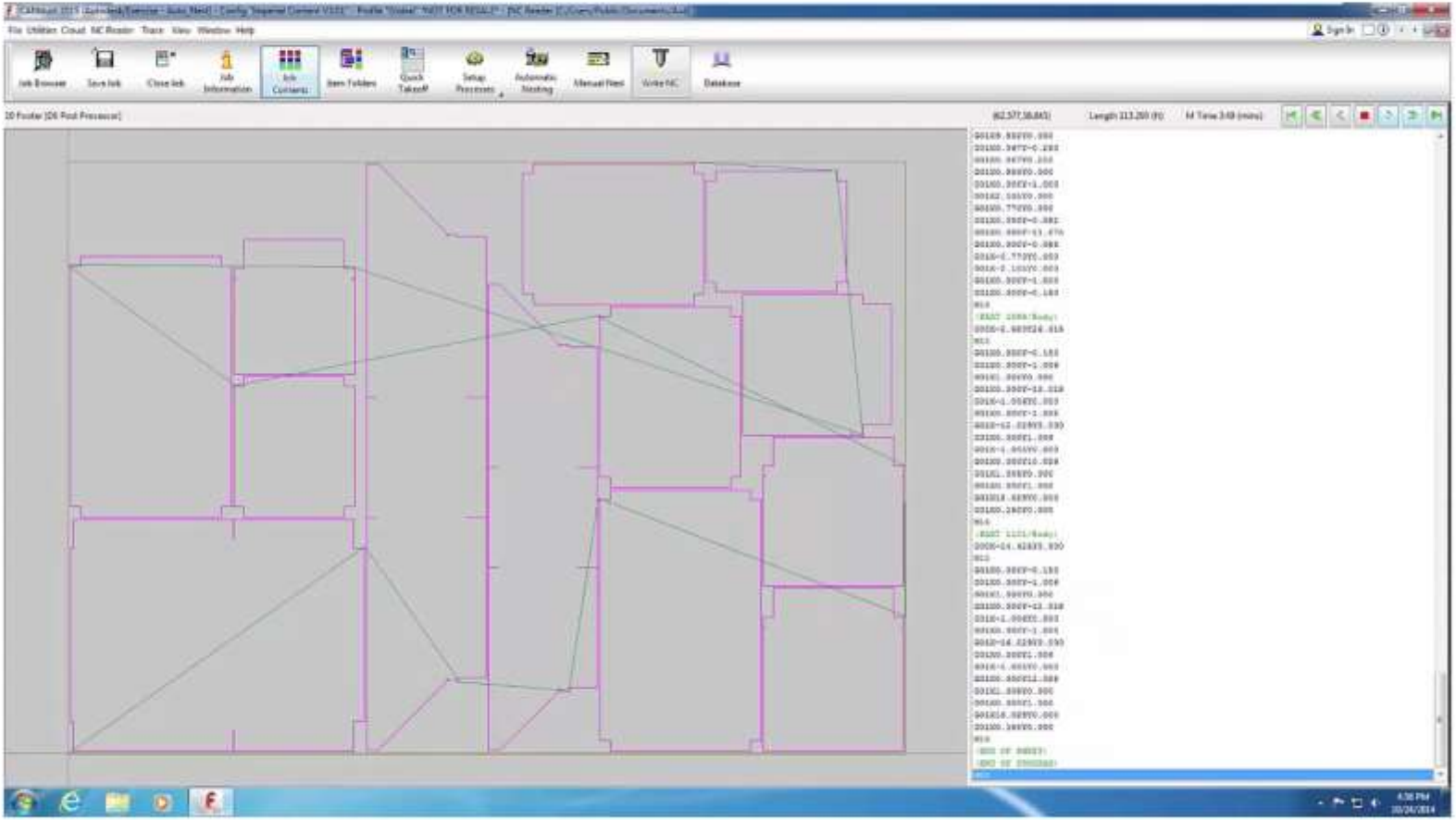



# Accurate BOMs

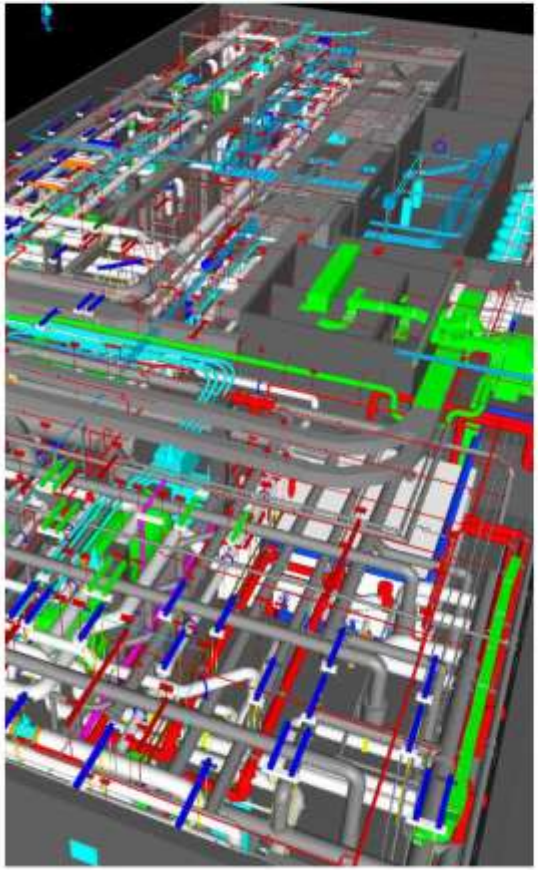




# Optimized stock utilization



# Modular, Offsite & Prefabrication



Autodesk Customer Success Story

COMPANY
**SC (SHoP Construction)**
LOCATION
**Manhattan, New York, United States**
USED PRODUCTS
**Autodesk® BIM 360™ Glue**
**Autodesk® Revit® Architecture**
**Autodesk® Revit® MEP**
**Autodesk® Revit® Structure**

## A tall order

### Autodesk BIM 360 Glue enhances project visualization and collaboration on world's tallest modular building.

Autodesk BIM 360 Glue is filling a need in the industry to expedite the VDC process. We are already seeing an increase in the rate of evaluation and decision making. We are establishing more efficient workflows and improving our ability to collaborate; each is required for BIM/VDC to be ultimately successful.

—**Jonathan Mallie**
Principal/Managing Director
SC

Images courtesy of SHoP Architects

**Project summary**

SC (SHoP Construction) is a sister company of SHoP Architects, a Manhattan-based firm widely known for innovative designs that blend business and art. Founded in 2007 by SHoP, SC was established to provide a range of services, including virtual design and construction (VDC) services to owners, architects, and contractors. Over the years, Building Information Modeling (BIM) has played a central role in the construction management process at SC, enabling them to create and explore virtual designs before building. Recently, the firm has been able to accelerate and streamline its processes even further by hosting live model data in the cloud with Autodesk® BIM 360™ Glue, one of the Autodesk® BIM 360™ cloud-based services.

The 32-story, 82 Bklyn residential tower adjacent to the Barclays Center Arena in Brooklyn, New York, is part of a US $2.9 billion, 22-acre entertainment, business, and residential complex, which includes an 18,000-seat arena for the new Brooklyn Nets, who are set to move to the new venue in 2012. Once constructed, the 356-unit 82 tower will be the largest modular building in the world.

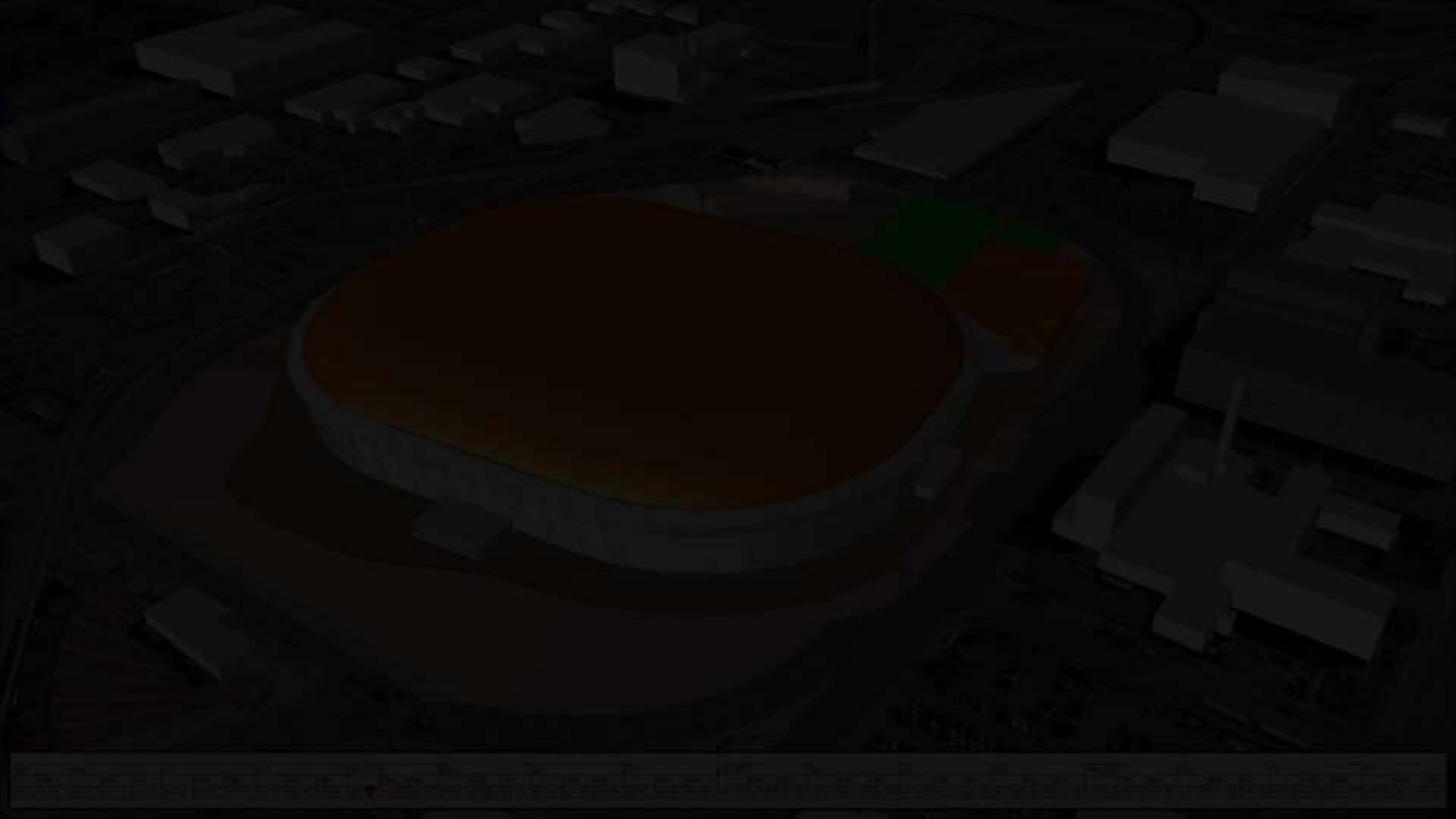
**The challenge**

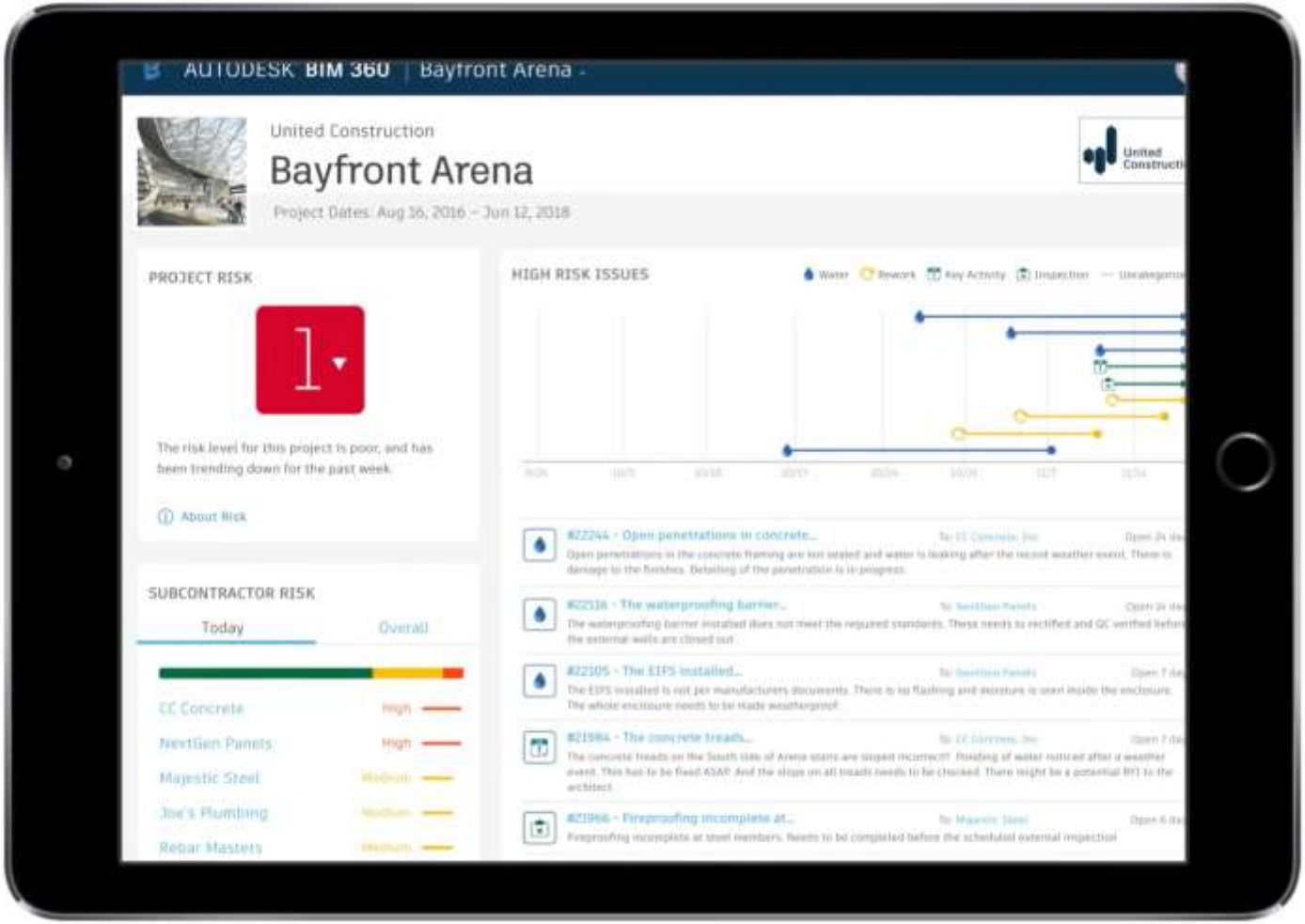
Since the 82 Bklyn tower is, in large part, being assembled in a factory, tolerances are much tighter, requiring that complex engineering details and interdisciplinary coordination be resolved far sooner than in the traditional design process. To address the unique construction requirements of modular, SC is now developing an information-rich consolidated virtual model of the 82 Bklyn tower—complete with detailed architecture as provided by SHoP Architects, and structural, mechanical, electrical, and plumbing (MEP) systems as provided by Arup, a professional services firm—using Autodesk® Revit® Architecture and Autodesk® Revit® Structure and Autodesk® Revit® MEP software, respectively.

"It's a 360-degree shift from the traditional process," says Erik Churchill, project manager at SC. "Usually, you start with a macro and end with the detail. Modular requires that you think the opposite way. You have to really understand how the project is going to fit together. Due to this requirement, the design team has to focus on the details much earlier in the design process—such issues would otherwise be considered further downstream in a conventional project."

AUTODESK


usbank
stadium




AUTODESK BIM 360 | Bayfront Arena -
United Construction
Bayfront Arena
Project Dates: Aug 16, 2016 – Jun 12, 2018
PROJECT RISK
1
The risk level for this project is poor, and has been trending down for the past week.
About Risk
SUBCONTRACTOR RISK
Today
Overall
CC Concrete
High
NextGen Panels
High
Majestic Steel
Medium
Joe's Plumbing
Medium
Rebar Masters
Medium
HIGH RISK ISSUES
Water
Rework
Key Activity
Inspection
#22244 - Open penetrations in concrete...
#22116 - The waterproofing barrier...
#22105 - The EIFS installed...
#21984 - The concrete treads...
#21966 - Fireproofing incomplete at...


CIRCULAR
CONSTRUCTION

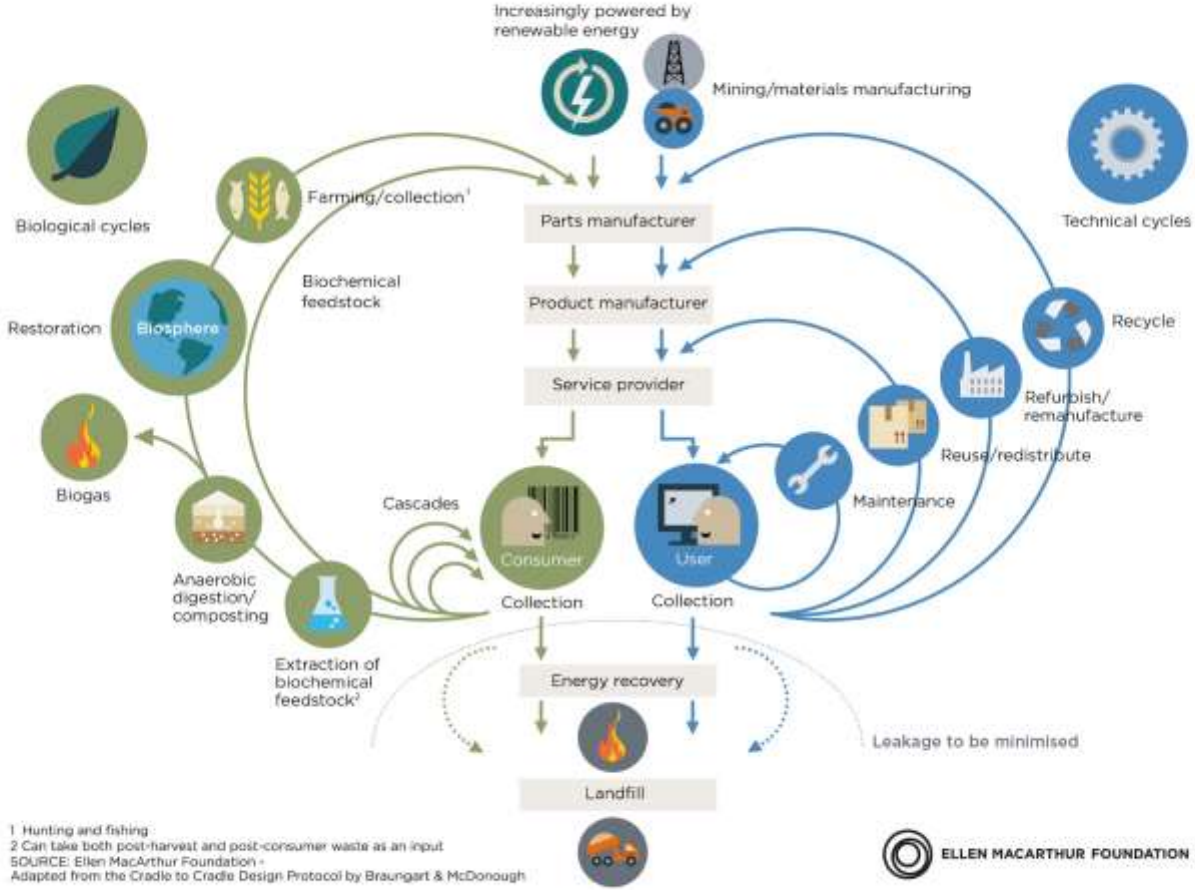
# Circular Economy

"A circular economy is one that is **restorative and regenerative by design**, and which aims to **keep products, components and materials at their highest utility and value** at all times, distinguishing between technical and biological cycles."

—Ellen MacArthur Foundation

www.ellenmacarthurfoundation.org

CIRCULAR ECONOMY - *an industrial system that is restorative by design*




1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input
SOURCE: Ellen MacArthur Foundation -
Adapted from the Cradle to Cradle Design Protocol by Braungart & McDonough

ELLEN MACARTHUR FOUNDATION

Source: www.ellenmacarthurfoundation.org


Construction & demo account for:
50% of raw material consumption
1/3 of waste (in the EU)
50% of waste (in the US)

# Circular Construction best practice

- Design for disassembly (D4D) & material recovery
- Connect D4D with economic systems
- Modular
- Integrated Project Delivery


ARUP Circular Building, London


Quay Quarter, Sydney


Brummer Town Hall


Circular Pavilion, Paris


Bosch-Siemens Home HQ


Alliander HQ

This concludes The American Institute ofArchitects
Continuing Education Systems Course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