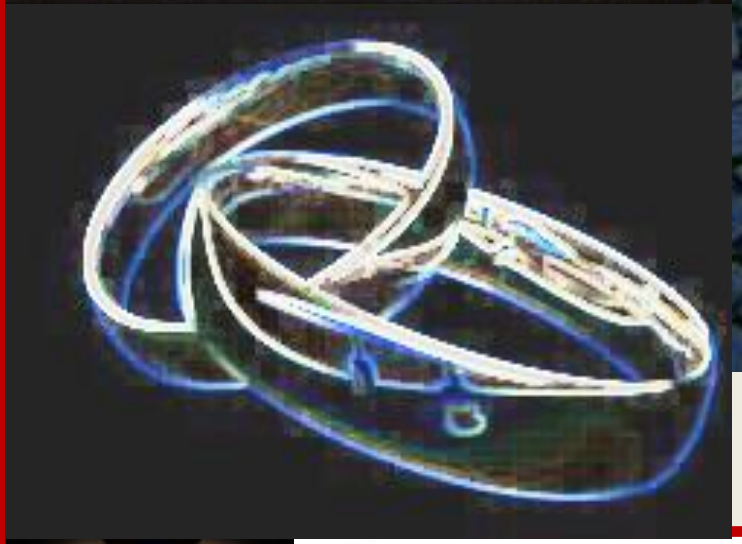
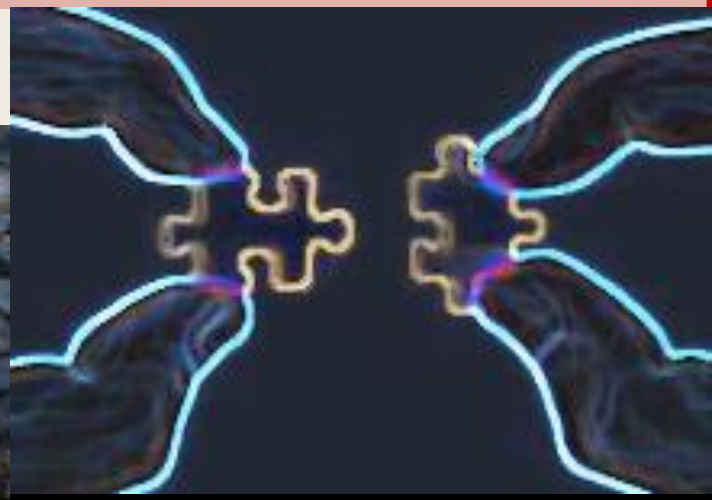
Market Rate High Performance –

Entering the New Paradigm

Presenter: **Adam J. Cohen**, RA VT, NH, CO, MD, CPHC NA & EU, LEED AP ®





BUILDINGENERGY 15

Design/Build and Integrated Project Management 101
- Are you ready?

Building Energy 15 Boston, MA

PASSIVSCIENCE
Knowledge saves power

BUILDING ENERGY 15

MARCH 3-5, 2015 AT THE SEAPORT WORLD TRADE CENTER

AIA Provider: Northeast Sustainable Energy Association

Provider Number: G338

Design/Build and Integrated Project Management 101 - Are you ready?

BE1525

Adam Cohen

Course Date

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

This course is registered with AIA CES

Course Description

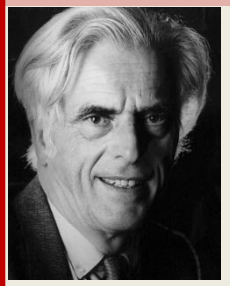
For many teams, it is an almost impossible challenge to simultaneously deliver high performance and cost efficient buildings while maintaining high customer satisfaction and profitability. Integrated design/build delivery providing single responsibility, from schematic design to construction through commissioning and monitoring has proved to be a viable model for successful delivery of cost efficient high performance buildings. This workshop will examine aspects of planning, marketing, estimating, system development, project management, human resources, accounting, and legal concerns.

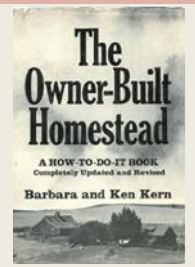
Learning Objectives

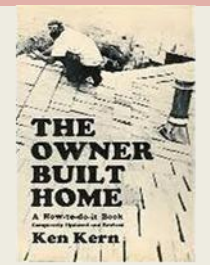
At the end of the this course, participants will be able to:

1. Understand the difference between traditional delivery methods and truly integrated delivery.
2. List the areas of skills required for a successful business operation.
3. Provide individuals with the tools to conduct a self-examination process to determine their areas of strength and the areas where they will need to improve their skills.
4. Provide individuals unfamiliar with the basic understanding to create an initial business plan for themselves.

Adam who?





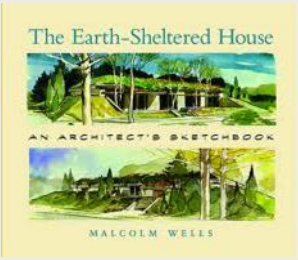


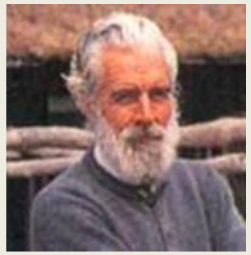












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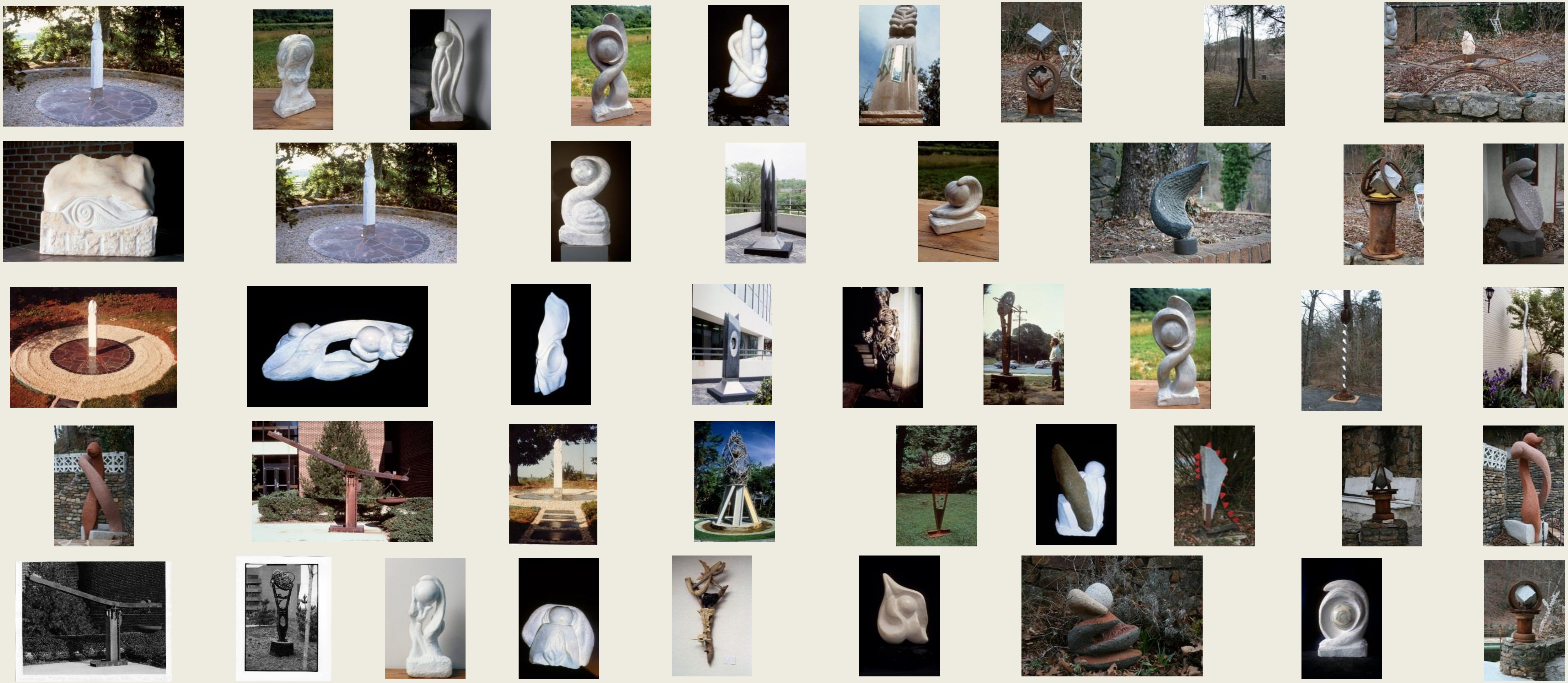
Adam who?



Adam who?



ARCHITECTURE PLANNING & PRESERVATION




STRUCTURES
Building with integrity

















PHIUS
Passive House Institute US

DESIGNER
CERTIFIED PASSIVE HOUSE DESIGNER

Adam who?

Near West Theater

- 20,000 sq ft
- Assembly
- New construction

The Distillery

- 50,000 sq ft
- Mixed Use
- New construction

2nd & Delaware

- 300,000 sq ft
- Mixed Use
- New construction

St. Paul's

- 6,000 sq ft
- Residential
- New construction

Care First

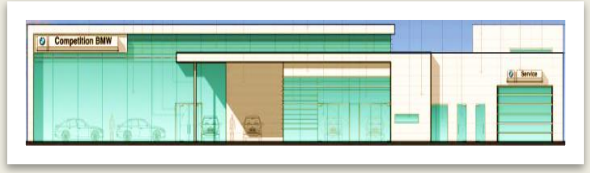
- 20,000 sq ft
- Animal Hospital
- New construction

Oracle Institute

- 8,000 sq ft
- Assembly
- New construction

Ambridge Crossing

- 50,000 sq ft
- Multi-Family
- New Construction



Competition BMW of Smithtown

- 20,000 sq ft
- Retail showroom
- Renovation and addition

Odin View Senior Living

- 50,000 sq ft
- Multi-Family
- New Construction

Westhampton Residence Hall

- 50,000 sq ft
- Dormitory
- New construction

Roxbury Place

- 50,000 sq ft
- Multi-Family
- New Construction

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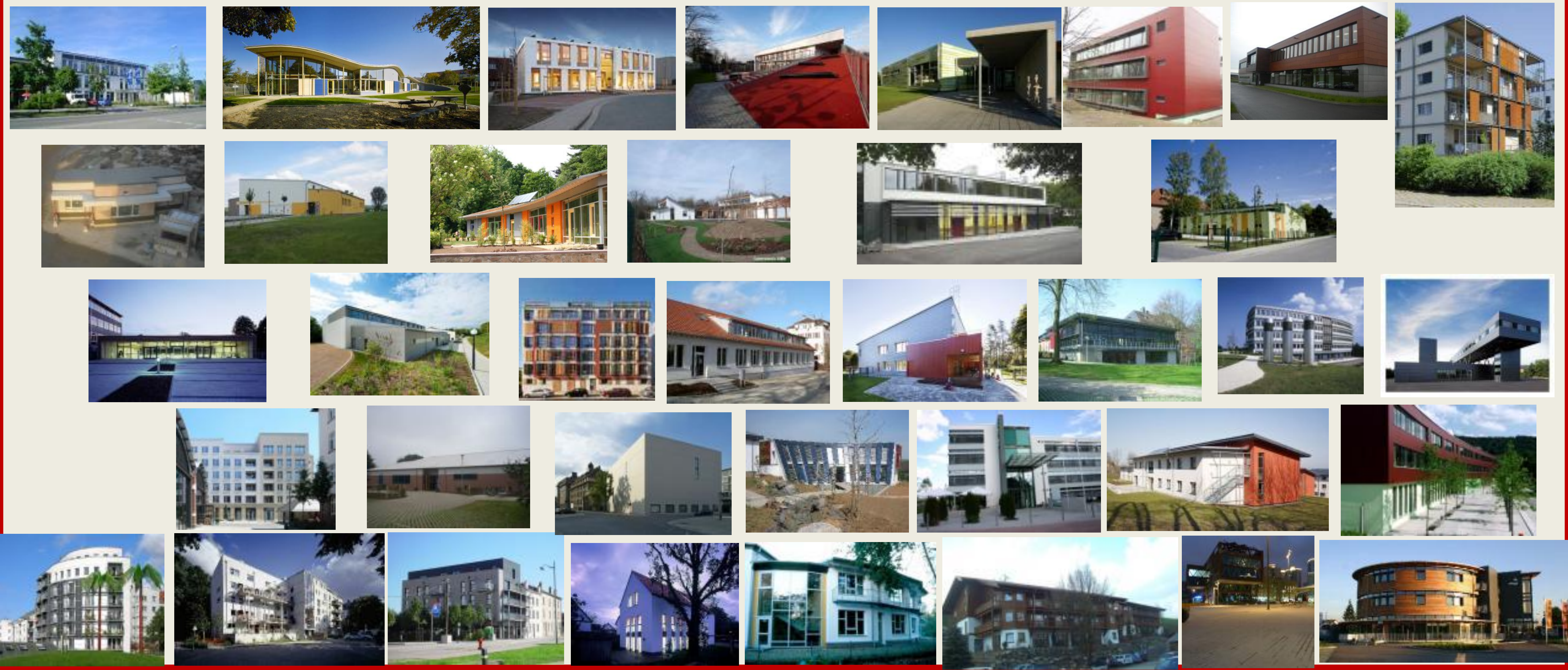
Commercial Passivhaus

European Examples



What Makes it So Attractive?

AR&T Architects

Passivhaus Principles

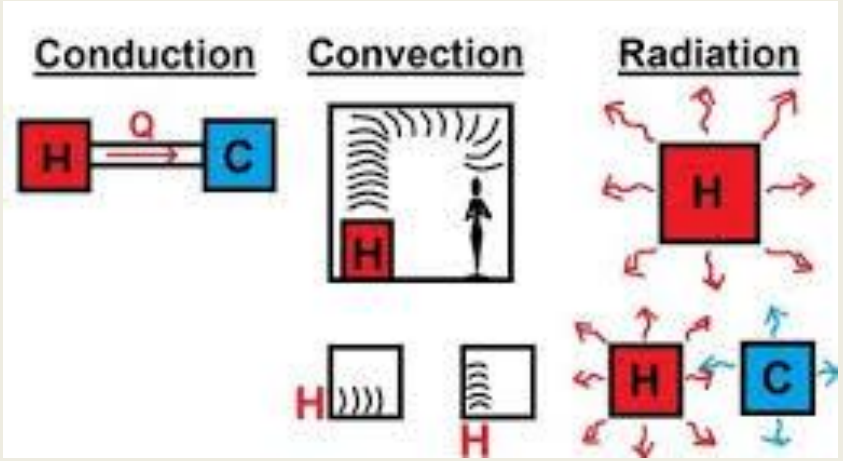
COLD

Scale

First Step

Understanding the Problem

- What is holding us back?
  - Understanding the basic physics



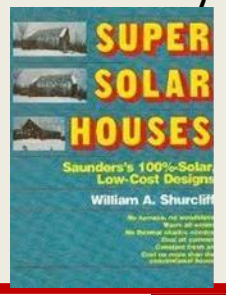
$$Q = H_c A(T_{Hot} - T_{Cold}) \qquad Q = m \times c \times \Delta T$$

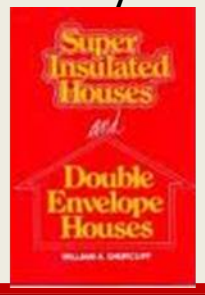
$$Q = \sigma(T_{Hot}^4 - T_{Cold}^4)A \qquad Q = \frac{kA\,(T_{Hot} - T_{Cold})\,t}{d}$$

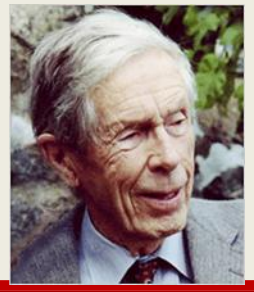
Passivhaus Principles

Basic Building Physics

- William Shurcliff - 1979
  - Truly superb insulation. Not just thick, but clever and thorough
  - Envelope of house is practically airtight.
  - No provision of extra-large thermal mass.
  - No provision of extra-large south windows.
  - No conventional furnace. Merely steal a little heat, when and if needed, from the domestic hot water system. Or use a minuscule amount of electrical heating.
  - No conventional distribution system for such auxiliary heat. Inject the heat at one spot and let it diffuse throughout the house.
  - No weird shape of house, no weird architecture.
  - No big added expense.
  - The passive solar heating is very modest — almost incidental.
  - Room humidity remains near 50 percent all winter. No need for humidifiers.
  - In summer the house stays cool automatically. There is no tendency for the south side to become too hot.







Passivhaus Principles

Basic Building Physics

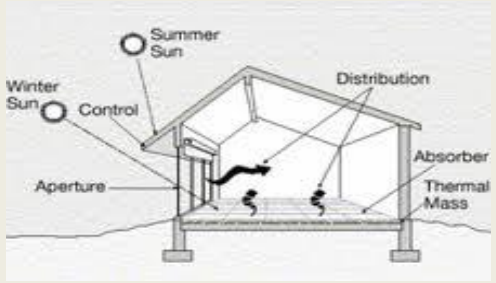
- Passive House Concept developed in the early 1990s by Dr. Wolfgang Feist and Professor Bo Adamson as optimization of early superinsulation work in North America and China
- First optimized Passive House Prototype built in 1990 in Kranichstein, Germany
- 60-70% reduction in overall energy consumption (compared to code base line), 90-95% reduction of heating and cooling energy
- Passivhaus Institut (PHI) founded in 1996

(W. Feist 2006)

Passivhaus Principles

Basic Building Physics

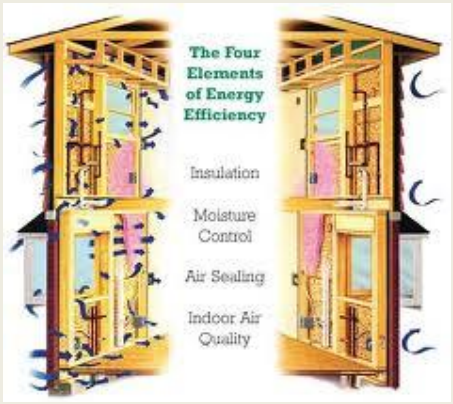
- Minimize losses through envelope
  - Increased insulation levels
  - Air tight
  - Thermal bridge free
- Maximize and balance gains
  - High performance glazing
  - Shading
  - Passive ventilation
  - Interior gains
- Use efficient systems
  - Fresh air heat (& energy) recovery
  - High performance mechanical equipment
  - Highly efficient electrical systems (lighting, appliances, etc.)



Passivhaus Principles

Basic Building Physics

- Computing Power
- Building Physics



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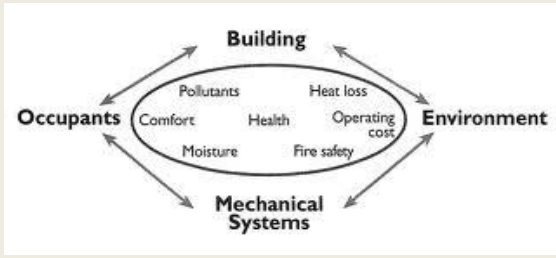

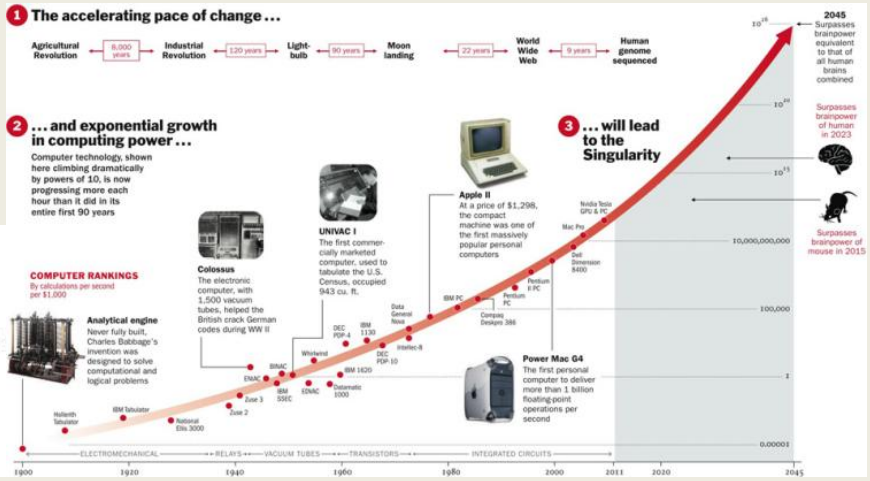

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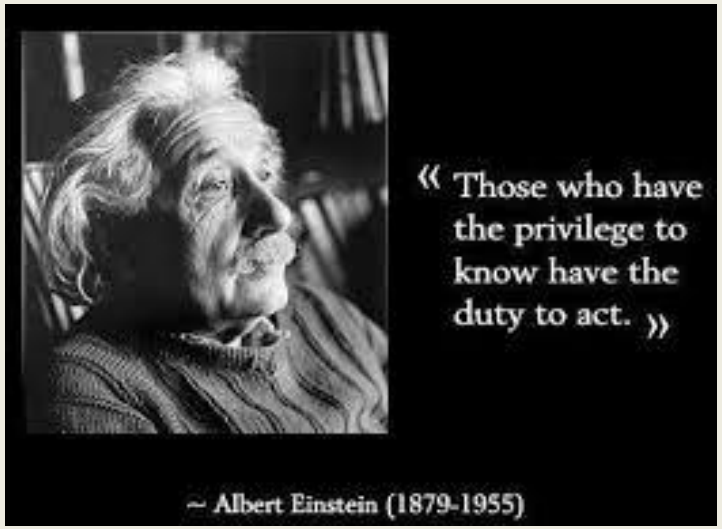
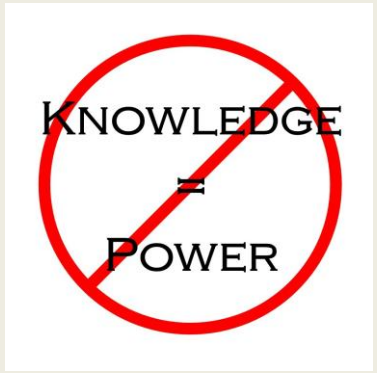
Step Two

Understanding the Problem

- What is holding us back?
  - Understanding the basic physics ☑
  - Understand how to use this knowledge.

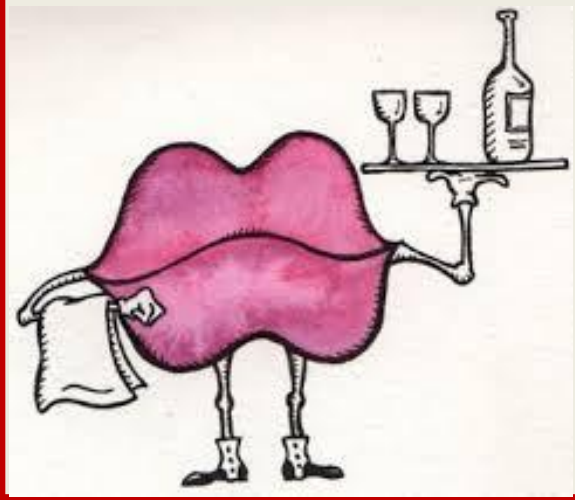


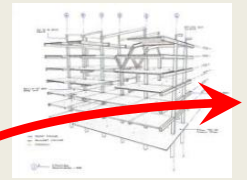


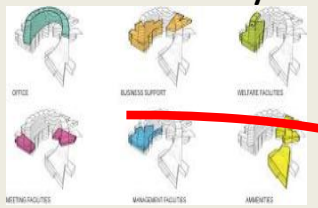
Synergy & Leverage

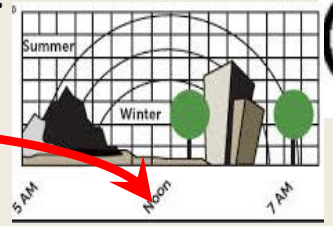
Buildings are viewed as functional wholes, with synergies inherent in the function and form

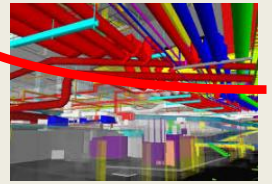
- Synergy is the interaction of multiple elements in a system to produce an effect different from or greater than the sum of their individual effects.
  - The term synergy comes from the Greek word synergia, συνέργια from synergos, συνεργός, meaning "working together".
- Leverage (verb) is to use (something) to maximum advantage.
- As an industry, we pay lip service to the concept, but to ***cost effectively*** meet the climate change imperative, we must understand this at a visceral level
- We can do this today if we understand:
  - Program, use, occupancy, site, form, structure, MEP systems, process energy, cost
- **AND**
  - All are analyzed and all considered in the design process from day 1.

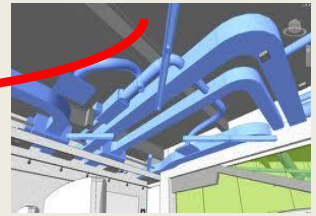


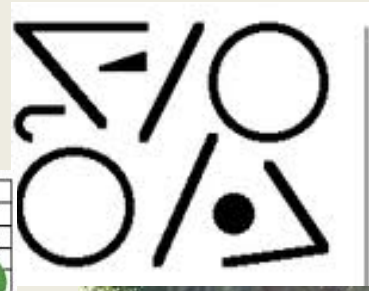












Scale

Skin to Volume Ratio (Form & Function)

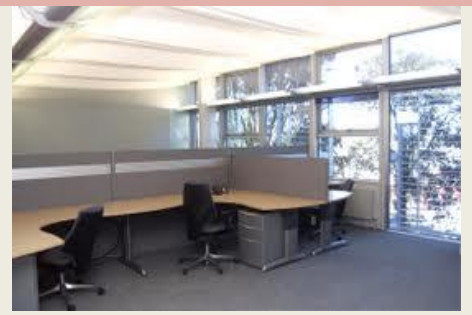
FABRIC FIRST

Scale

Shape (Form)

Scale

Interior Heat Gain (Function)



Scale

Interior Heat Gain (Function)

- Getting the heat balance right
  - Example: Dorm Room
    - Refrigerator - Y / N, #, type
    - Microwave - Y / N, #, type, usage
    - Tea Kettle - Y / N, #, type, usage
    - Hair Dryer - Y / N, #, type, usage
    - TV – Y/N, #, usage
    - Gaming systems – Y/N, #, usage
    - Peripherals - Y/N, #, type, usage
    - Task lighting – Y/N, #, type, usage
    - Bodies??

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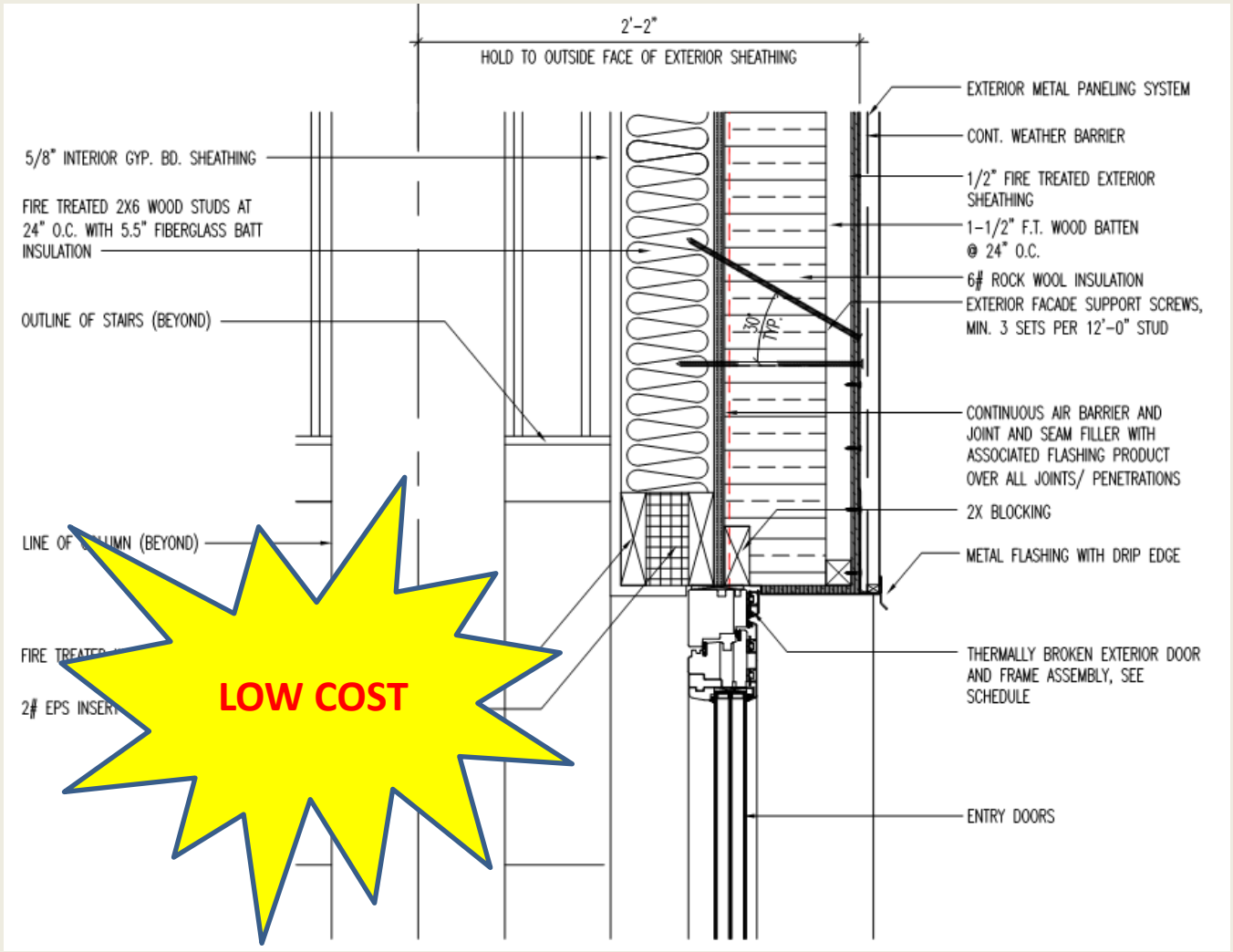
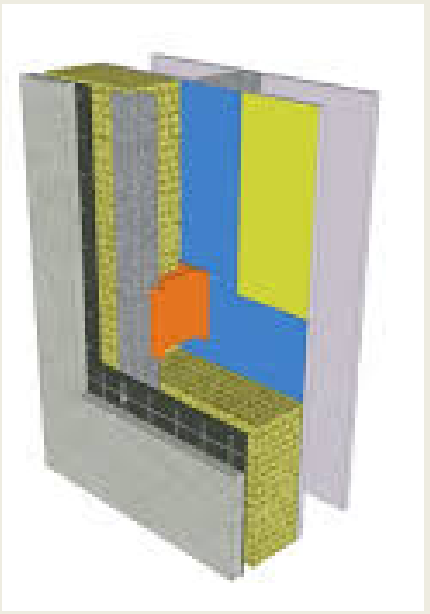
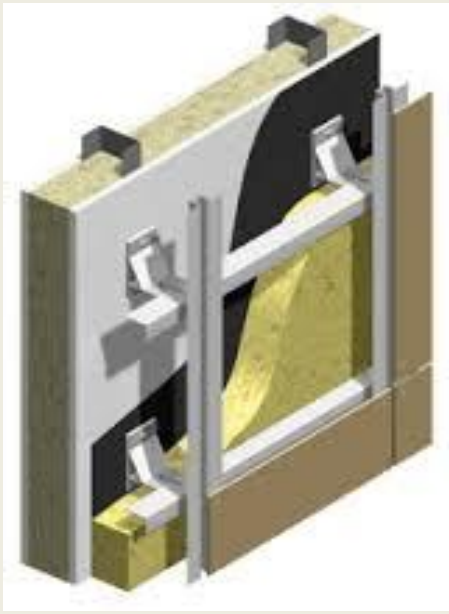
Scale

Commercial Construction – *We are so close already*







Scale

Commercial Construction – *We are so close already*

NO COST

THINK QUALITY!

DO IT RIGHT
THE FIRST TIME

The first one is on me, all the others are all you!

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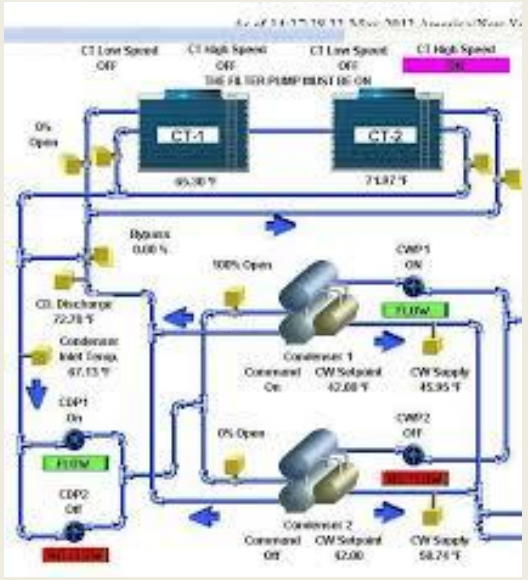
Scale

Commercial Construction – *We are so close already*

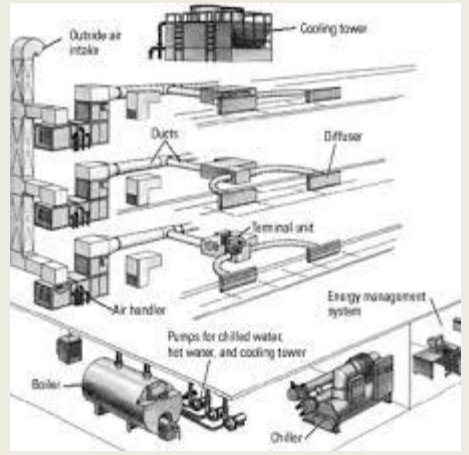


simple is beautiful.

Everything should be made as simple as possible, but not simpler.

Albert Einstein

COST SAVINGS



Step Three

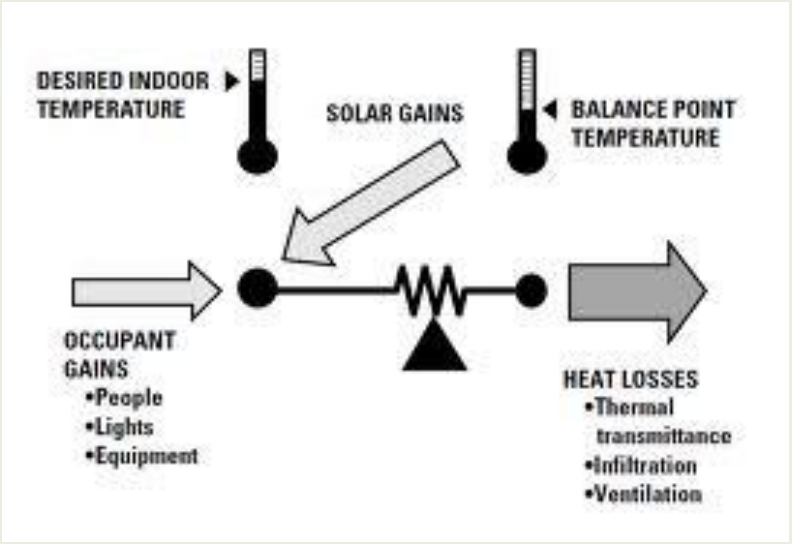
Understanding the Problem

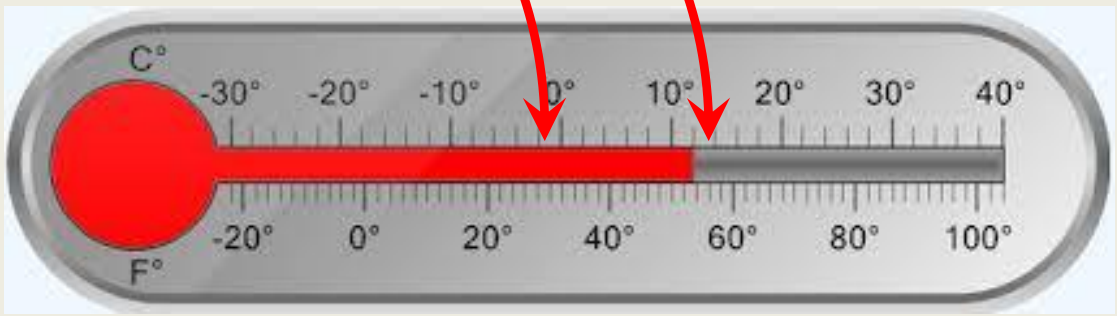
- What is holding us back?
  - Understanding the basic physics ☑
  - Understand how to use this knowledge ☑
  - Understand the implications of the use of this knowledge

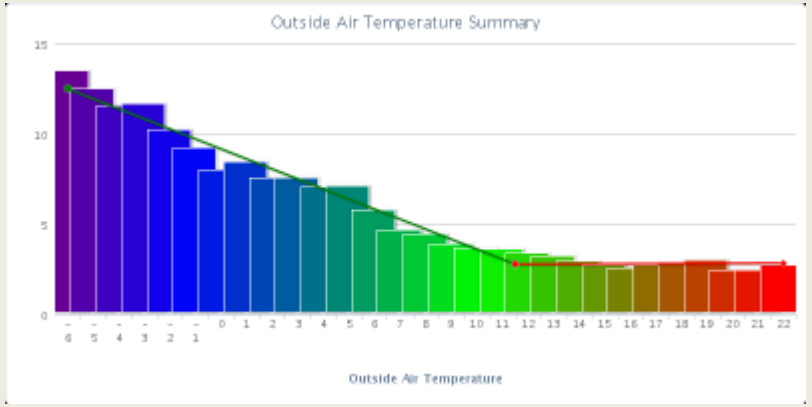
Passivhaus Principles

Basic Building Physics

- **Balance point:** Space heating is not required until outdoor temperature drops to a point at which building's heat gains are insufficient to provide the heating needs. This outdoor temperature is called the balance point temperature. Building's heat loss matches its gains at this point.
- Heating dominated vs cooling dominated buildings

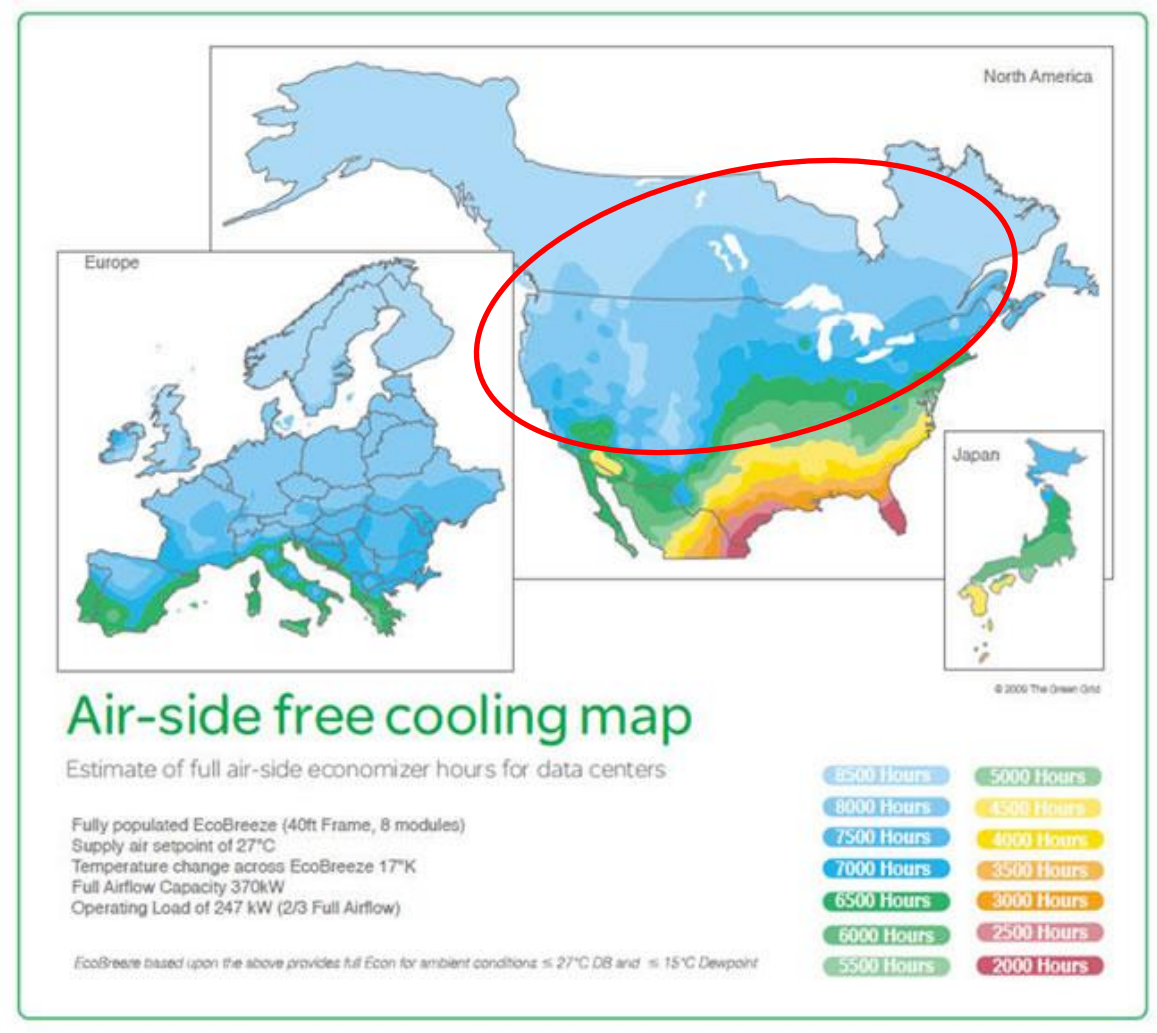


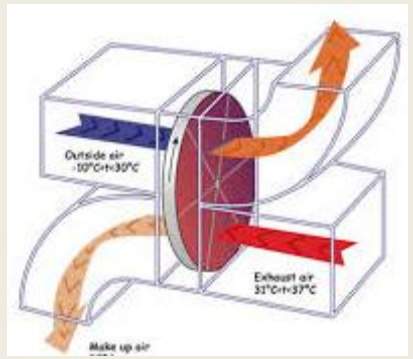




Passivhaus + Large Buildings + Cold Climate

Free cooling





Step Four

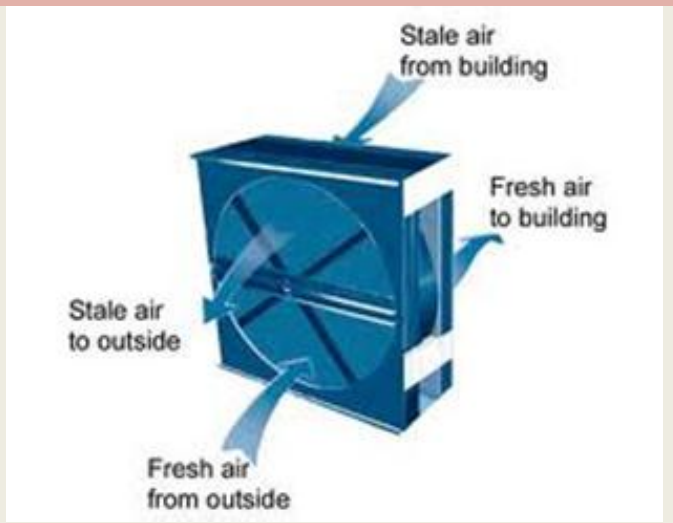
Understanding the Problem

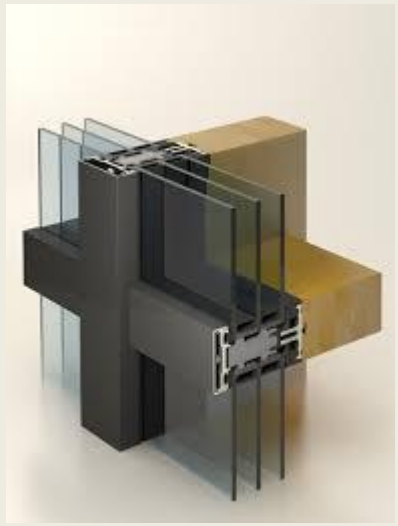
- What is holding us back?
  - Understanding the basic physics ☑
  - Understand how to use this knowledge ☑
  - Understand the implications of the use of this knowledge ☑
  - Understanding the obstacles

Physical Obstacles

Materials & Systems

- North American Obstacles
  - Curtain wall
  - Handicapped compliant doors
  - Fire rated doors
  - Mechanical systems
    - Fresh air
    - Integrated
    - Correctly sized
  - Standard monitoring & control

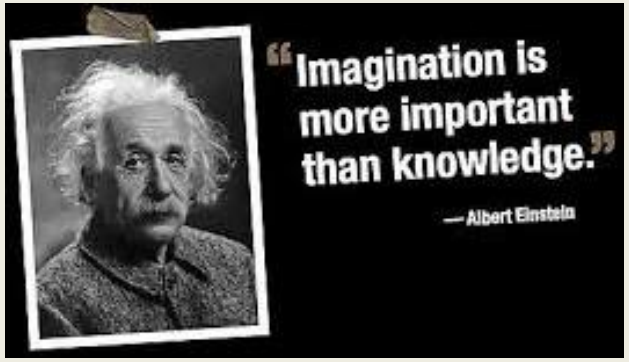




Physical Obstacles

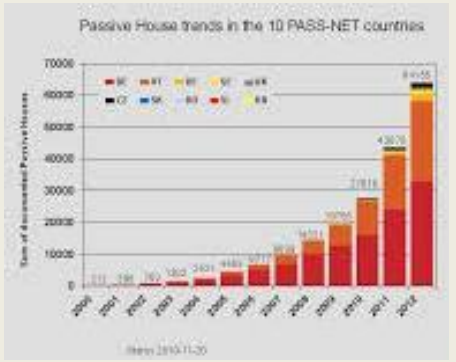
Materials & Systems

- North American Obstacles can be easily overcome
  - Time
  - Market scale
  - Creativity



GREEN JOBS FOR America

SCALE-UP



Mental Obstacles

Changing the way we do business

First and foremost is to know it is an option!

"Freedom is realizing you have a choice." - T.F. Hodge

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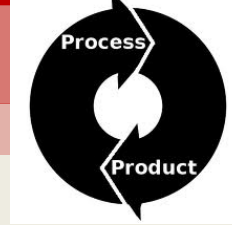
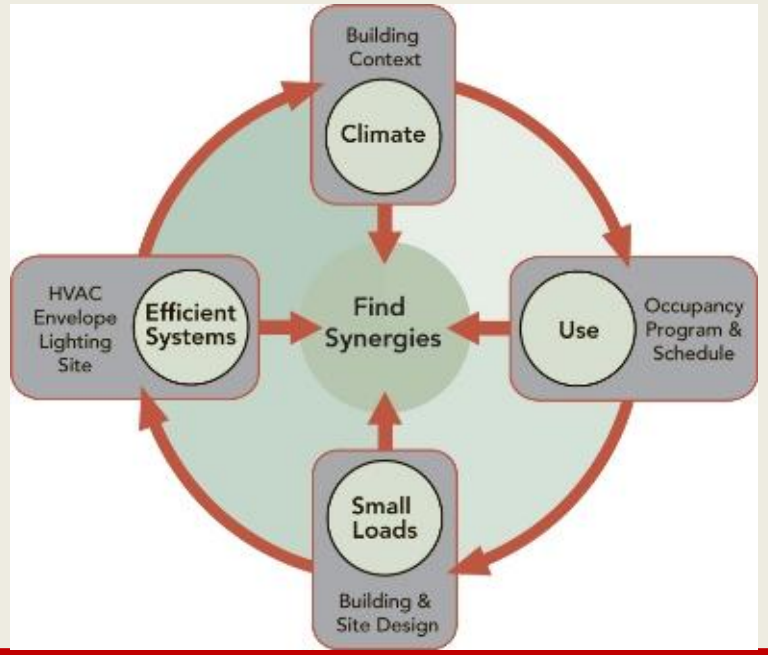
Knowledge saves power

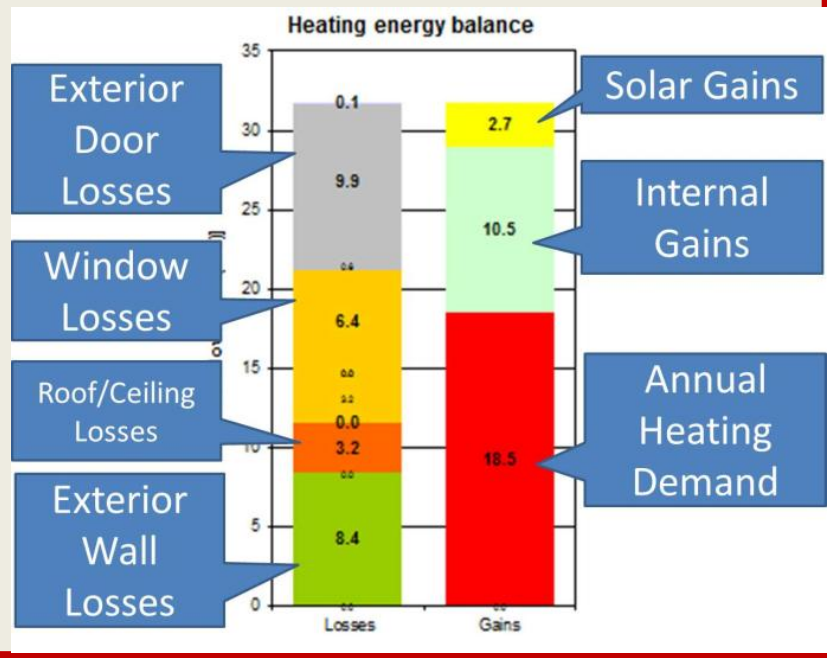
Mental Obstacles

Changing the way we do business



- The difference in the process changes the product
  - Design - The building is designed to work as a holistic system, working symbiotically with the occupants use pattern. The fresh air, cooling, dehumidification, heating, hot water system and usage are all considered in the design of the systems.
  - Construction – Passive Building goes beyond the typical commissioning of the mechanical systems, the building envelope is extensively commissioned with air tightness and thermal image testing to quality assure the built project.





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- Are you ready?

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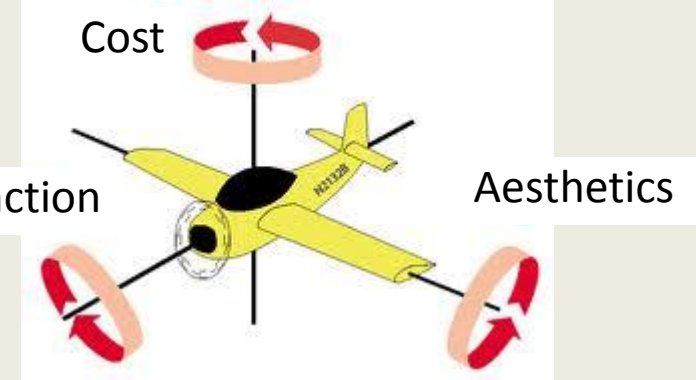
Knowledge saves power

Mental Obstacles

Changing the way we do business



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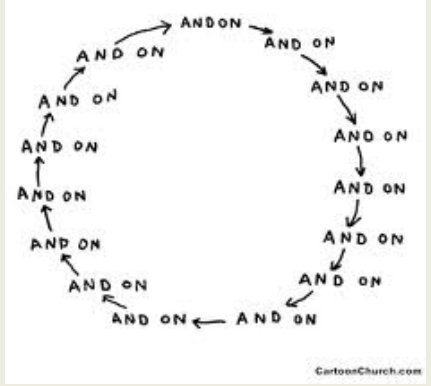
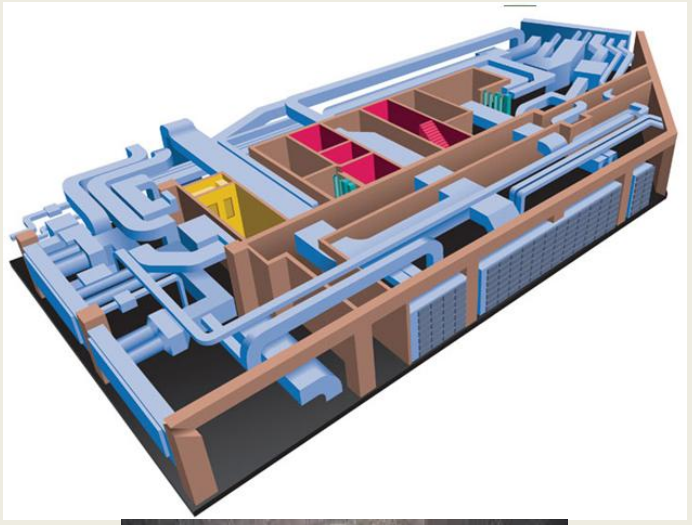
Changing the way we do business

Late 19th and 20th Century buildings -

- Industrialization, globalization and innovation frees designers from climatic constraints.
- In wealthy nations, form and function no longer require climatic responses
- Many designs depend on energy input and thus fossil fuel to function long term



Seagram Building, New York City (1954-58),
Mies van der Rohe & Philip Johnson

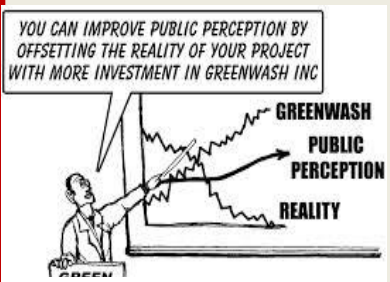


Mental Obstacles

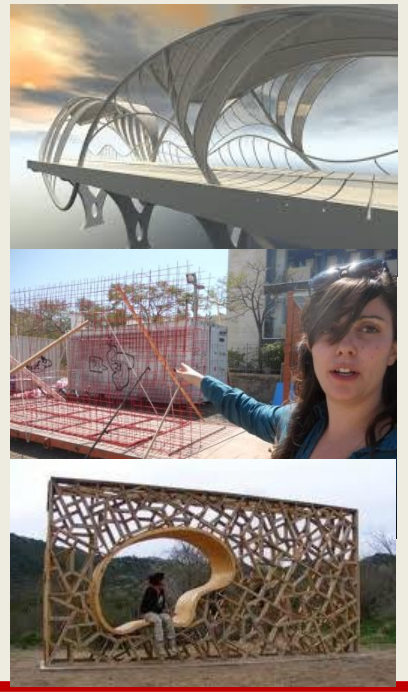
Changing the way we do business

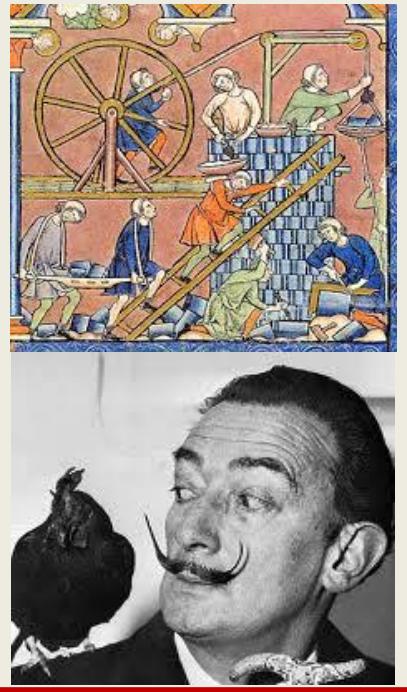
Architects no longer have to have an intimate knowledge of climate responsive design as engineering becomes the architect's crutch.

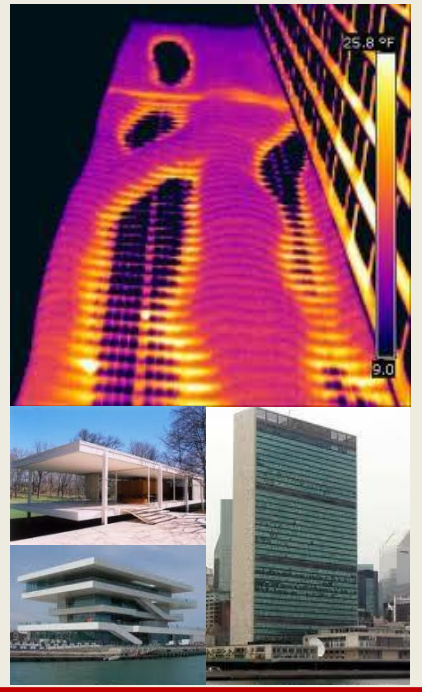
- Design takes precedence over sustainability and adaptability
- Architects become less master builder and more artist
- Reflected in the North American architectural education system until recently
- Even now sustainability is discussed without truly being understood and thus implemented in both education and the field.



HAHAHA!
Wait, i don't get it.







Mental Obstacles

Changing the way we do business

- Traditional Project Delivery
  - Information and design is siloed
    - Integration of information is based on assumptions
      - This can work for traditional buildings, but it will lead to waste
        - This waste is assumed and built into the project costs
          - Standard way of doing business

Division		Div. Cost
DIVISION 01 00 00 - GENERAL REQUIREMENTS	$	58,050.31
DIVISION 02 00 00 - EXISTING CONDITIONS	$	13,278.00
DIVISION 03 00 00 - CONCRETE	$	3,200.00
DIVISION 04 00 00 - MASONRY	$	8,400.00
DIVISION 05 00 00 - METALS	$	31,150.00
DIVISION 06 00 00 - WOOD, PLASTICS AND COMPOSITES	$	28,652.00
DIVISION 07 00 00 - THERMAL AND MOISTURE PROTECTION	$	51,654.00
DIVISION 08 00 00 - OPENINGS	$	7,230.00
DIVISION 09 00 00 - FINISHES	$	14,194.00
DIVISION 10 00 00 - SPECIALTIES	$	490.00
DIVISION 11 00 00 - EQUIPMENT	$	-
DIVISION 12 00 00 - FURNISHINGS	$	6,850.00
DIVISION 13 00 00 - SPECIAL CONSTRUCTION	$	-
DIVISION 14 00 00 - CONVEYING EQUIPMENT	$	-
DIVISION 21 00 00 - FIRE SUPRESSION	$	-
DIVISION 22 00 00 - PLUMBING	$	11,933.00
DIVISION 23 00 00 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)	$	-
DIVISION 25 00 00 - INTEGRATED AUTOMATION	$	-
DIVISION 26 00 00 - ELECTRICAL	$	14,308.00
DIVISION 31 00 00 - EARTHWORK	$	-
DIVISION 32 00 00 - EXTERIOR IMPROVEMENTS	$	-
DIVISION 33 00 00 - UTILITES	$	-
DIVISION 33 00 00 - TRANSPORTATION	$	-
DIVISION 35 00 00 - Waterway and Marine Construction	$	-
DIVISION 40 00 00 - Process Integration	$	-
DIVISION 41 00 00 - Material Processing and Handling Equipment	$	-
DIVISION 42 00 00 - Process Heating, Cooling, and Drying Equipment	$	-
DIVISION 43 00 00 - Process Gas and Liquid Handling, Purification, and Storage Equipment	$	-
DIVISION 44 00 00 - Pollution and Waste Control Equipment	$	-
DIVISION 45 00 00 - Industry-Specific Manufacturing Equipment	$	-
DIVISION 46 00 00 - Water and Wastewater Equipment	$	-
DIVISION 48 00 00 - Electrical Power Generation	$	-
SUB TOTAL	**$**	**249,389.31**
Design Contingency	$	5,089.58
Construction Contingency	$	13,125.75
Overhead	$	21,686.03
Fee	$	13,125.75
TOTALS	**$**	**302,416.42**

Mental Obstacles

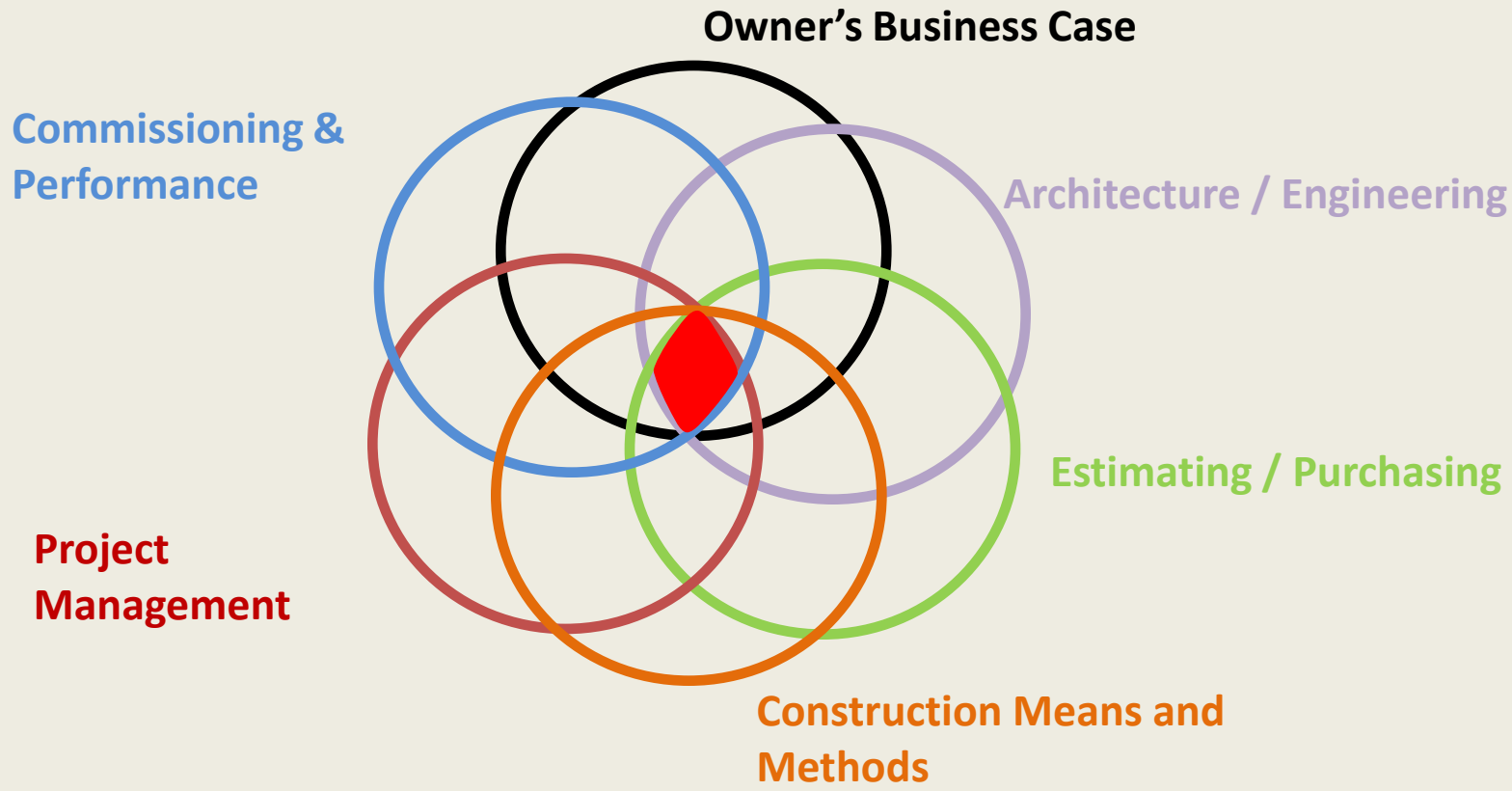
Changing the way we do business

THE BIG PICTURE

Mental Obstacles

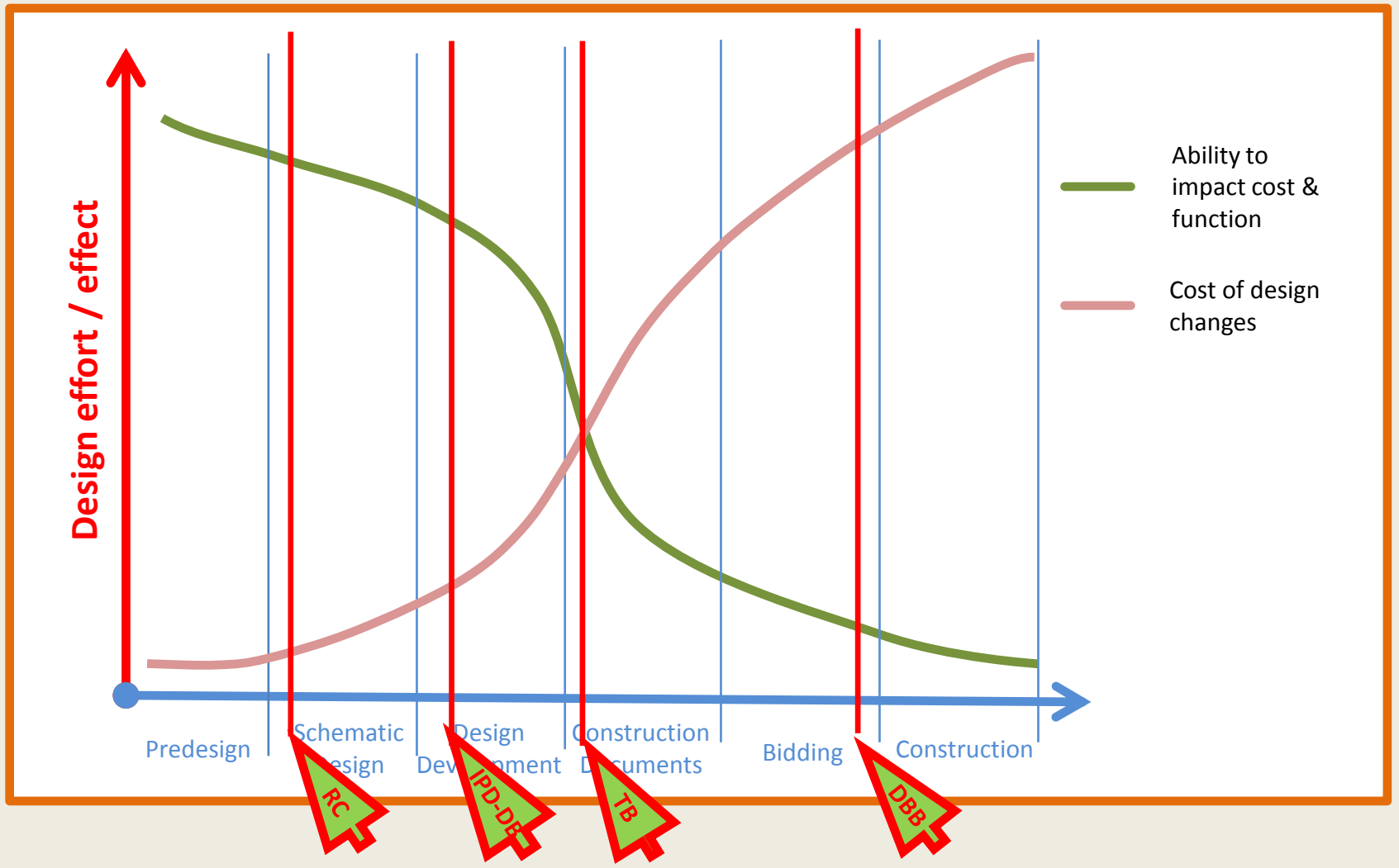
Changing the way we do business

Integrated Project Delivery
Relational Contracting



Mental Obstacles

Changing the way we do business



Mental Obstacles

Changing the way we do business

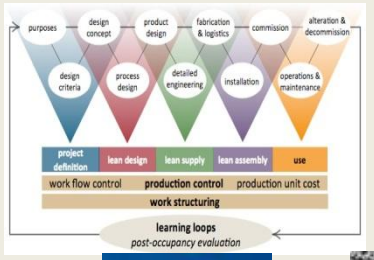
	Design/Bid/Build	Team Build	Typical Design / Build	True Design / Build – Integrated Project Delivery	Relational Contracting with Lean Construction
Contract	Owner contracts with design team (typically through architect) and contractor separately, they in turn contract with sub consultants / subcontractors	Owner contracts with design team (typically through architect) and contractor separately, they in turn contract with sub consultants / subcontractors	Owner contracts with design team (typically through Contractor), they in turn contract with designer and major sub consultants	Owner contracts with one turnkey delivery entity (typically an LLC)	**Owner, design and construction teams form one delivery entity**
Responsibility for project successes and failures	Separate individual responsibility to Owner for design team and contractor, sub consultants / subcontractors	Separate individual responsibility to Owner for design team and contractor, sub consultants / subcontractors	Individual responsibility to Owner for design builder (typically contractor), Separate individual responsibility to design builder for design team, sub consultants / subcontractors	Group responsibility to Owner	**All parties share responsibilities**
Worst case potential problem solving incentives	Individual firms protect their interests over project interests	Individual firms protect their interests over project interests	Entity contracting with owner protects their interests over project interests Subs protect their interests over project interests	Group protects its interest as a team over project interests	**All parties protect project interests above all**
Likely outcome in solving significant project problems	**Poor**	**Poor**	**Better**	**Good**	**Best**

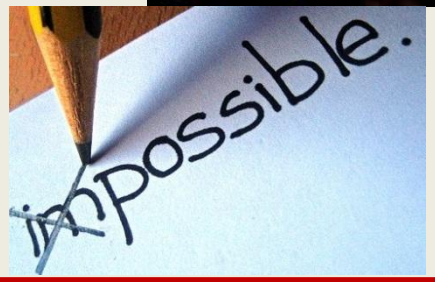
Mental Obstacles

Changing the way we do business

Delivery Method

- A no cost strategy for truly sustainable design and construction
- Integrated Project Delivery
  - Integrated team based on trust and mutually beneficial relational contracts
    - Process is not ***bid based*** but ***objective driven***
  - Fully and truly functional BIM
    - Model functions through design, construction & operations
  - Lean construction principles
    - Just in time delivery of information and materials
  - ***New Paradigm*** is really and olde way of doing what we do





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- Are you ready?

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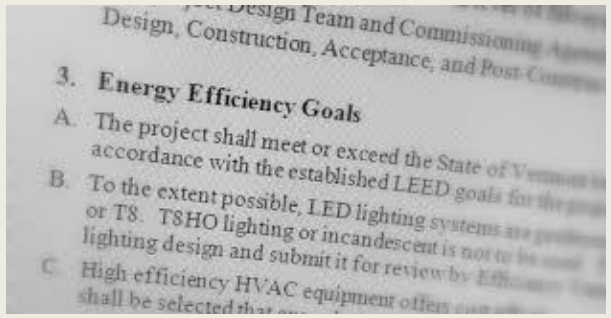
Knowledge saves power

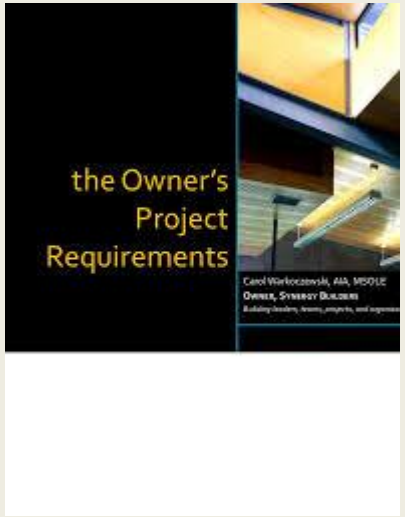
Process is not bid based but objective driven

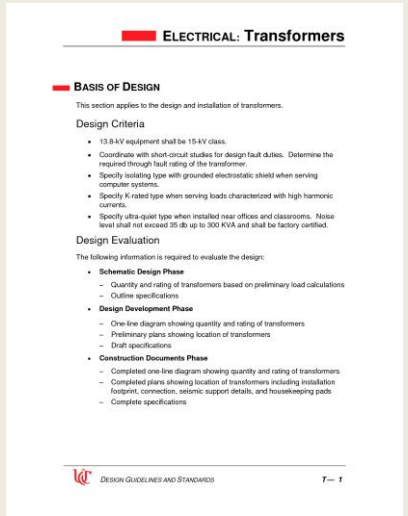
Changing the way we do business

High performance design and construction there is a generally accepted two-step documentation process of pre-planning.

- Owner's Project Requirements (OPR)
  - A written document that details the requirements of a project and the expectations of how it will be used and operated. This includes project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- Basis of Design (BOD)
  - A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.







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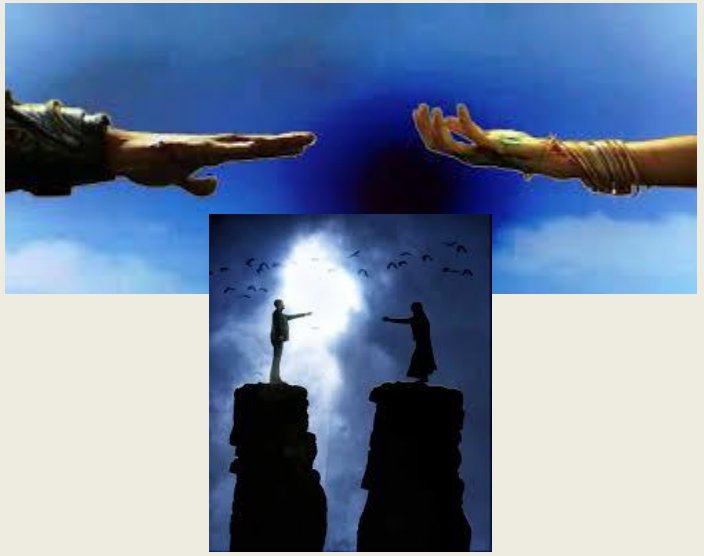
Changing the way we do business

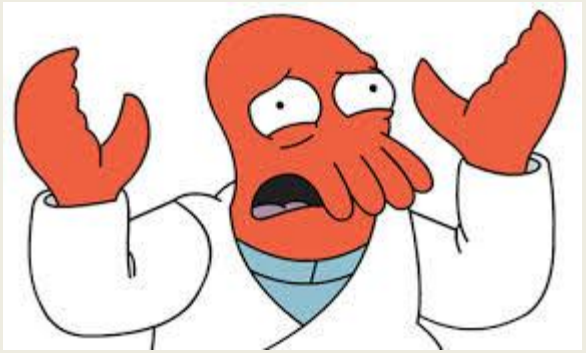
- OPD & BOD separation
  - Assumes a “siloed” process in which each discipline is contracted to perform in their area of expertise. The outcome of the project is not a jointly held responsibility, but rather an orchestrated process in which some entity, commonly the architect, construction manager or owner’s representative takes on the role of “chief cat herder”.
    - **Job Description:** Attempt to facilitate and coordinate each discipline’s additive portion of the design to achieve a well performing and cost effective high performance solution.
  - The outcome is sometimes achieved, very often the outcome is less then optimal creating either expensive solutions or cost effective projects with energy savings, comfort and air quality “left on the table”.

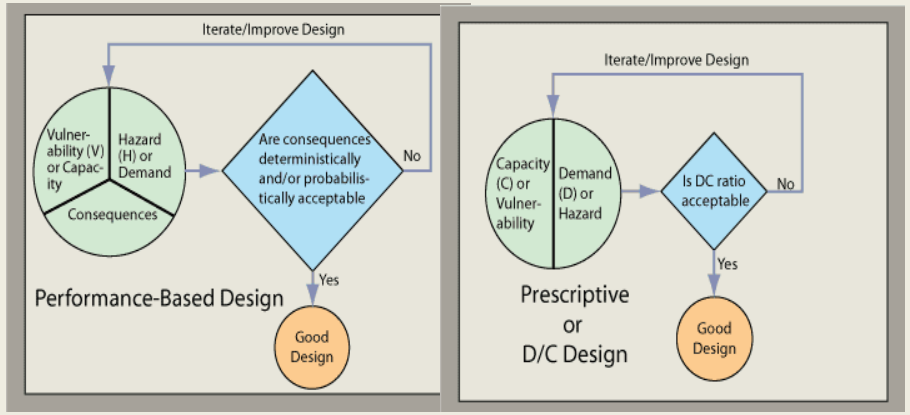


Process is not bid based but objective driven

Changing the way we do business

- Statement of Project Objectives (SPO):
  - A single document that is performance based. It starts with the business case or cost proforma of the project. To this the functional, aesthetic and performance metrics are added. There is no BOD document.
- Why??
  - When we are orchestrating IPD and/or utilizing a relational contract, we want to employ the lean technique of “pull” production or the last planner approach. We do this not only in the construction of the project but also in the design of the project.
    - We want all possible solutions on the table for all aspects of the project until the last possible moment where we can decide as an informed group which set of options produced the optimized solution for budget, function, aesthetic and performance.





Process is not bid based but objective driven

Changing the way we do business

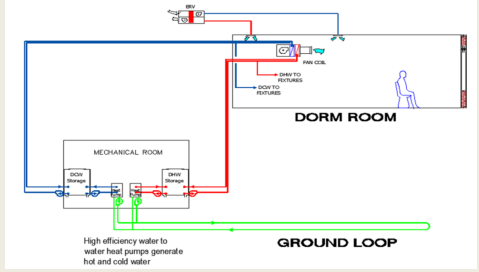
- Quick Example:
  - Dormitory project the SPO (two of many objectives)
    - Cost of the dorm had to be equal or less than a benchmark dorm built two years prior
    - Individual dorm room occupants had to have thermostatic control of their room (benchmark dorm had PTAC units)
  - How is that any different from the standard process?
    - OPR and the SPO are very similar, but the process is different. The SPO is created as a group whereas typically the OPR is created for the owner by a single entity potentially missing creative opportunity in setting objectives.
  - Real issue lies not with the OPR, but with the BOD
    - Standard pre-planning method we would have next created a BOD
      - The team initially thought before any design or analysis had been completed that a multi head mini split system was a logical choice and if the budget allowed a variable refrigerant flow system would be nice.
        - Had we entered that assumption in a BOD we may have unintentionally “locked” in this thought.




Process is not bid based but objective driven

Changing the way we do business

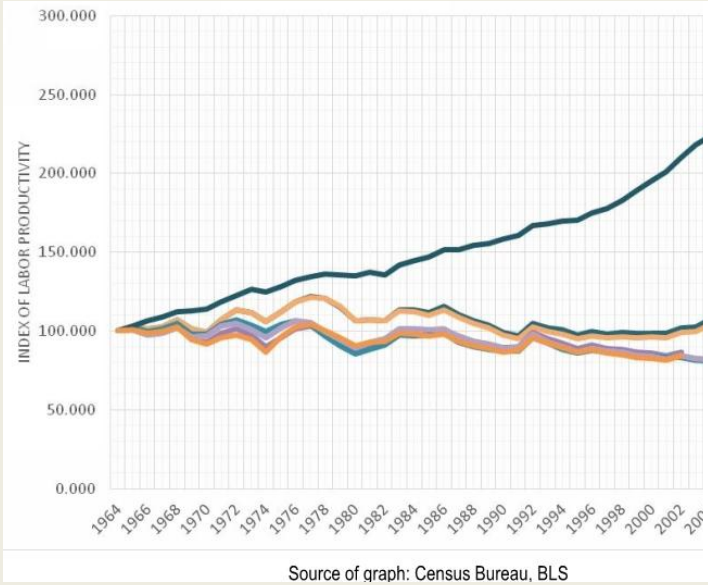
- Quick Example:
  - As we developed the design, energy and load analysis and cost figures it became clear that significant performance could achieve very inexpensively with minor envelope changes, peak loading on the individual rooms was dropping to the point where the smallest mini split heads available were 2 ½ times larger than the peak load!
    - BOD document: “That’s OK, the units will scroll down to 30% load” - done thinking about the HVAC system.
    - SPO document: Does not pre-dictate the system types only calling for the performance and control parameters, a more detailed search was undertaken to optimize the HVAC solution.
    - Many solutions were presented, but after research a small fan coil unit that was rated for potable water was found that was correctly sized for the load and because it was rated for potable water, it became just another fixture in the plumbing string in the room, making it very inexpensive to install. The dormitory already had a recirculating hot water line, so a simple buffer tank and return was added to the cold water supply and an optimized, low cost, correctly sized system was installed.
    - If your project is using standard delivery, pre-supposing through the OPR/BOD process may be fine, but you may be leaving additional performance or cost optimization on the table.



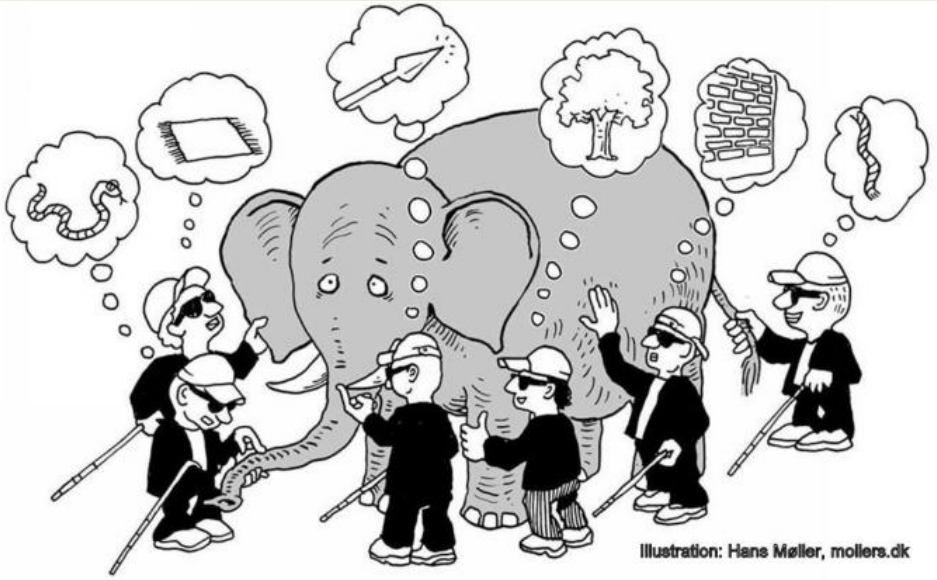
Fully and truly functional BIM (Big BIM)

Changing the way we do business

- In 1964: If a building takes 1,000 hours to build…
  - In 1998: the building should take 552 hours to build
    - If productivity gains = to other industries
      - In 1998: Building actually takes 1,185 hours to build
        - Meanwhile….
          - In the same 30 years, auto manufacturers reduced the Concept to Production Cycle from 6 Years to 14 Months (Center for Integrated Facility Engineering –Stanford)



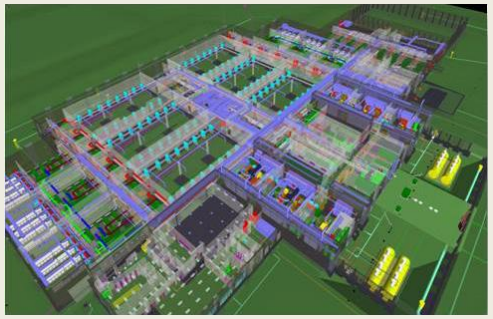
Source of graph: Census Bureau, BLS

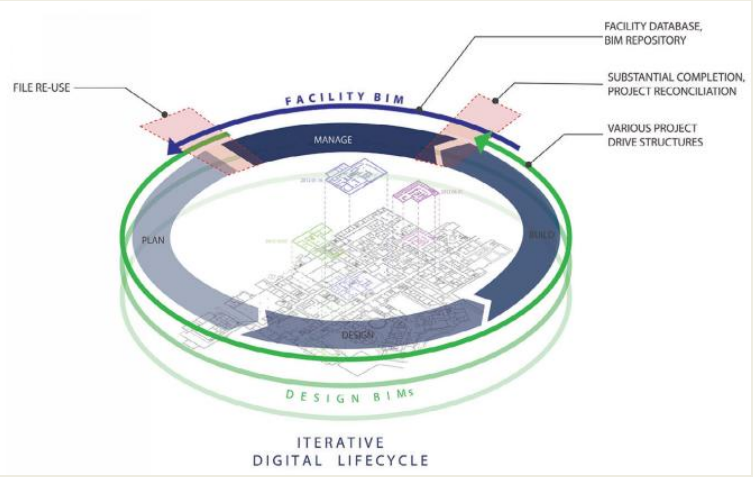


Fully and truly functional BIM (Big BIM)

Changing the way we do business

- Model functions:
  - Design
  - Construction
  - Operations





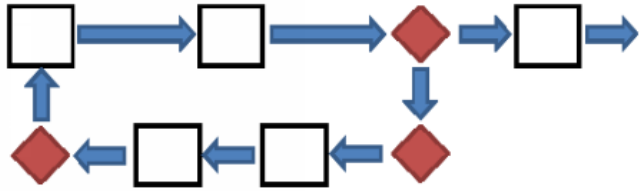
Independent review by each discipline

Design Iteration – team coordination

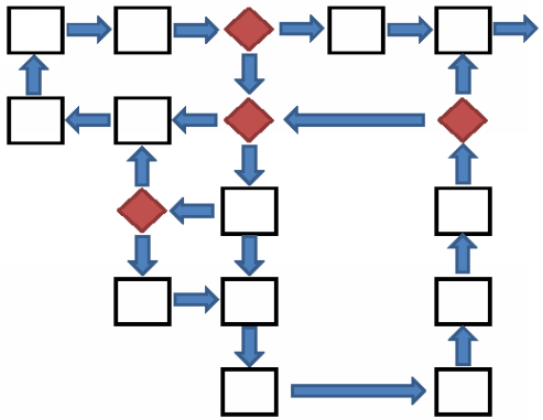
Comments Returned Resolution Through email

Follow up or lack there of keeps issues hidden

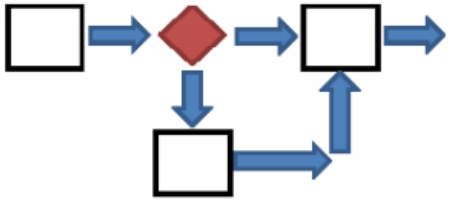
What the manual "says" we are doing



What we are actually doing



What we should be doing



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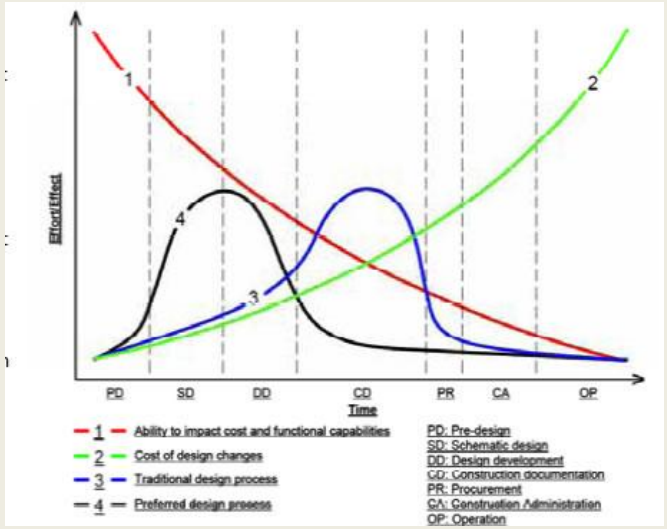
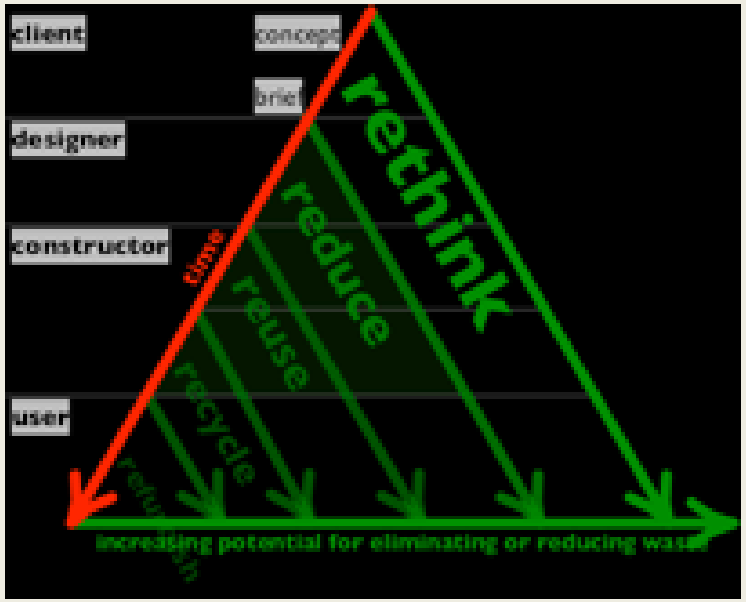
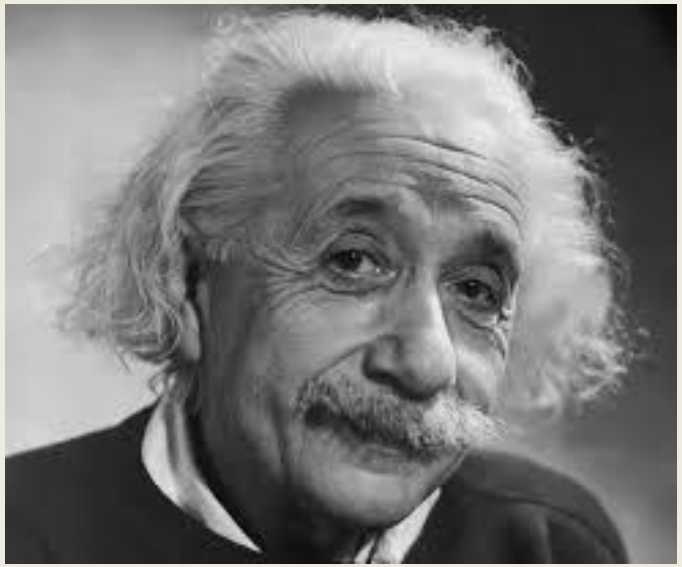
Lean principles - Just in time delivery of information and materials

Changing the way we do business

- Lean is a method of facilitating information flow
  - Team alignment
  - Expectations
  - Promises kept
- When asked how he would spend his time if he was given an hour to solve a thorny problem, Einstein said he'd "spend 55 minutes defining the problem and alternatives, and 5 minutes solving it."







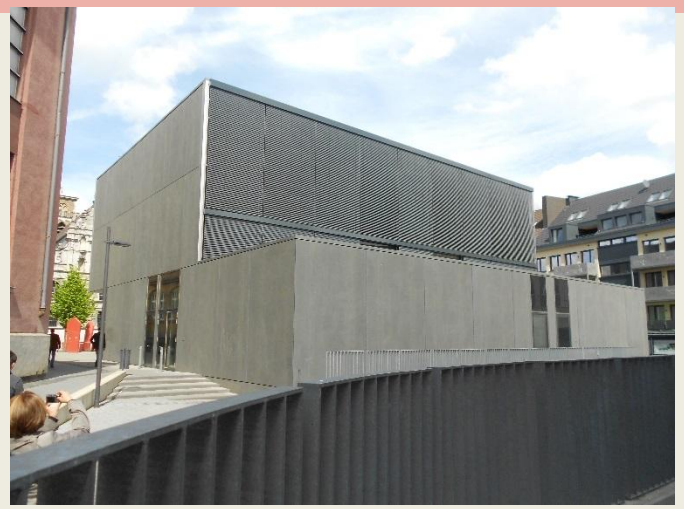
Solutions

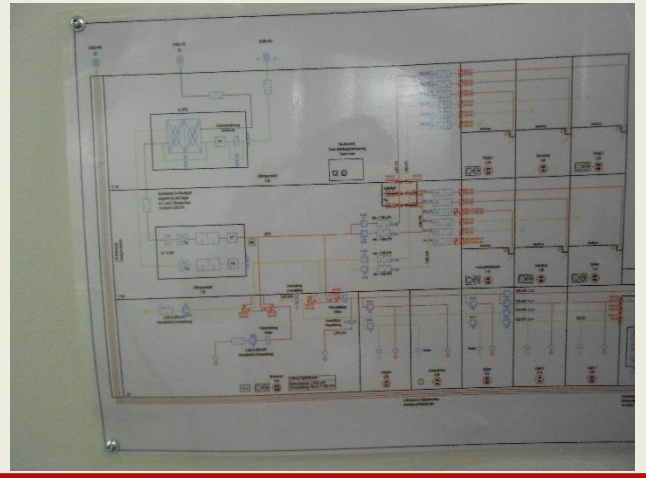
Understanding the Problem

- What is holding us back?
  - Understanding the basic physics ☑
  - Understand how to use this knowledge ☑
  - Understand the implications of the use of this knowledge ☑
  - Understanding the obstacles ☑

Education & Civic Center

- 42,000 sq ft– Passiv
- PH ventilation w/ simple controls
- Concrete Construction
- Hydronic heat (district)



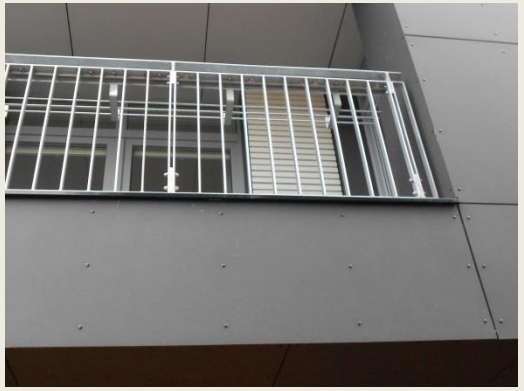
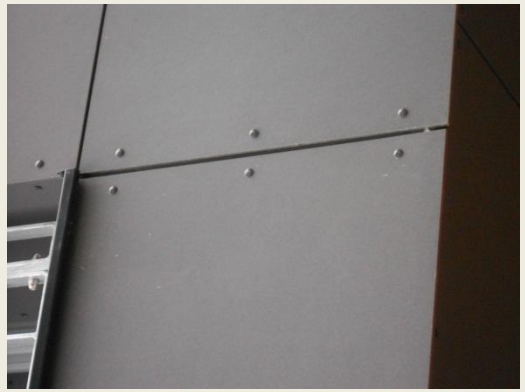
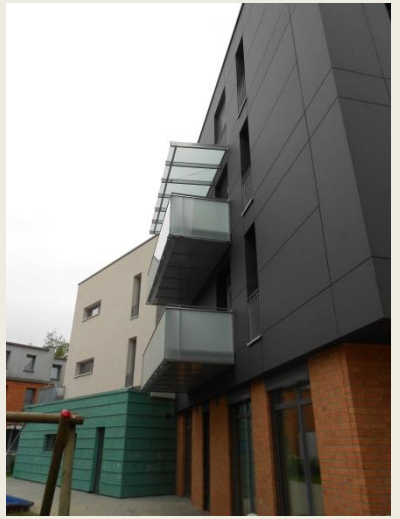


Child Care Center & 5 Apartments

- 9,106 sq ft– Passiv
- PH ventilation w/ simple controls
- Masonry Construction
- Hydronic heat (district)



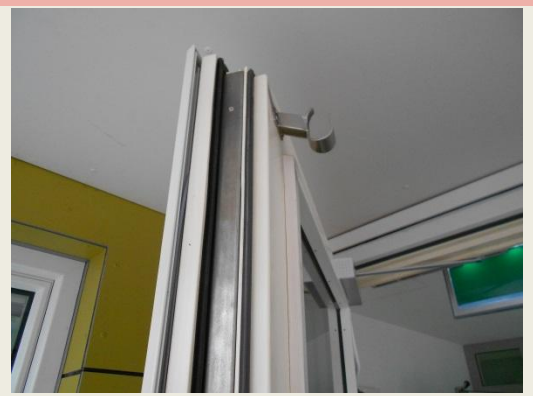



Primary School

- 11,915 sq ft– Passiv
- PH ventilation w/ simple controls
- Masonry & Steel Construction
- Hydronic heat



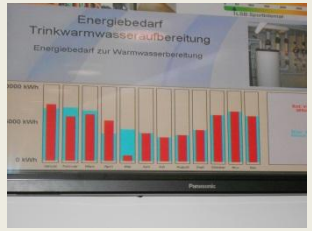







Sports school and Sports hall

- 71.418 sq ft– Passiv
- PH ventilation w/ simple controls regenerative ERV
- Masonry Construction
- Concrete core, hydronic and air heating



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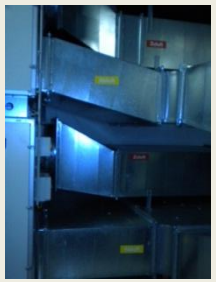
Primary School Refurbishment

- 68,000 sq ft– Passiv
- PH ventilation w/ simple controls
- Masonry & Timber Construction
- District heat fin tube supplemental heat

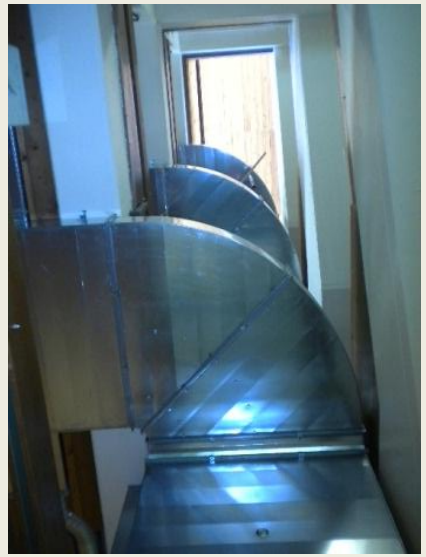


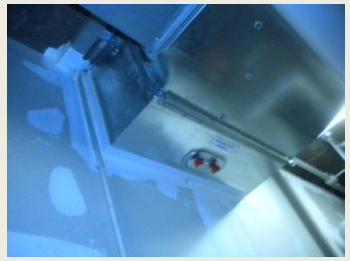






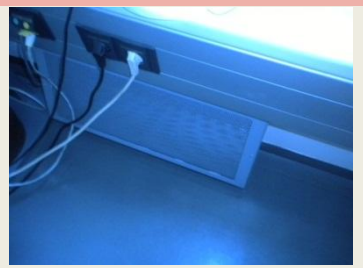




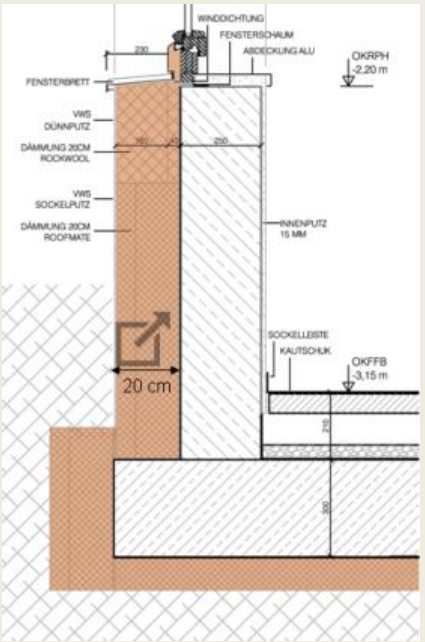


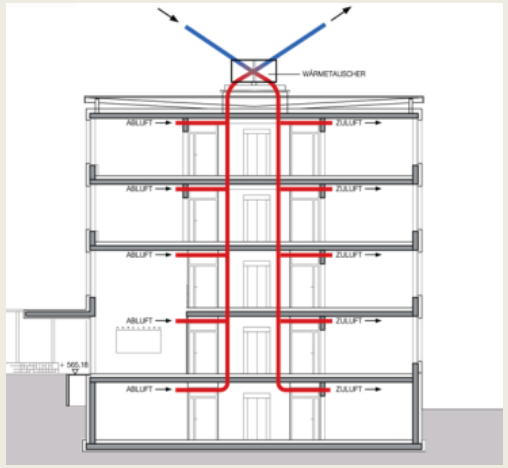
Office

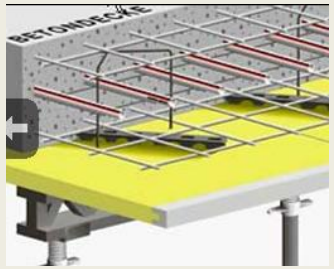
- 20,000 sq ft(orig) + 18,000 (add) – Passiv
- Thermally active concrete surfaces
- Masonry Construction
- PH ventilation w/ simple controls

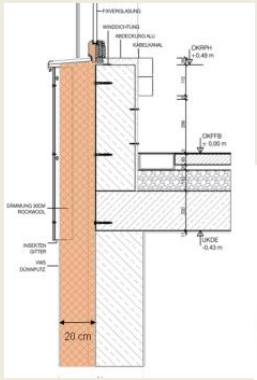



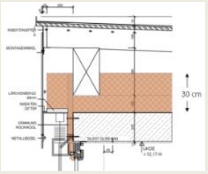


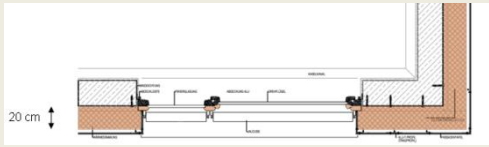



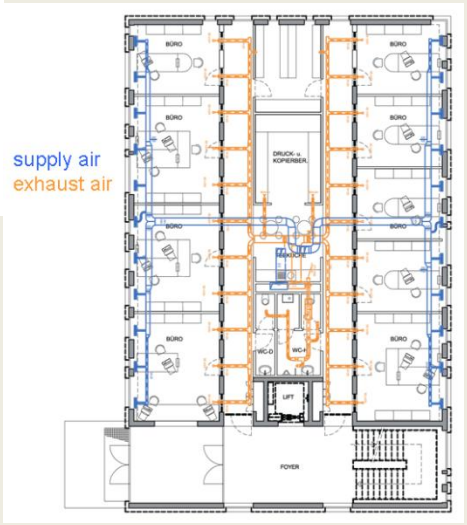


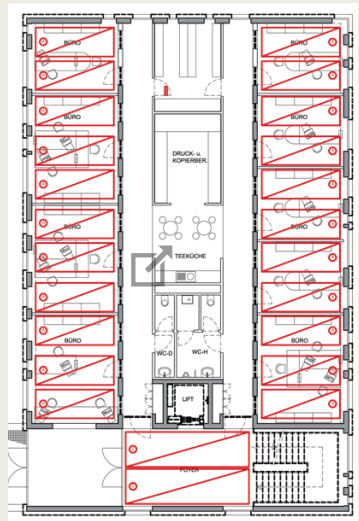










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Multi-Family

- 11,500 sq ft, 12 units (67 total) – Passiv
- PH ventilation w/ simple controls
- Timber Construction
- Solar w/ boiler supplemental heat
- Preheat incoming air to main unit







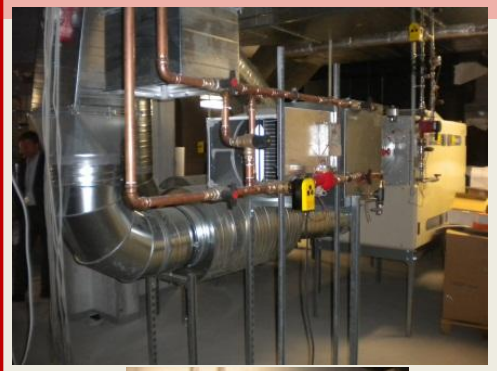
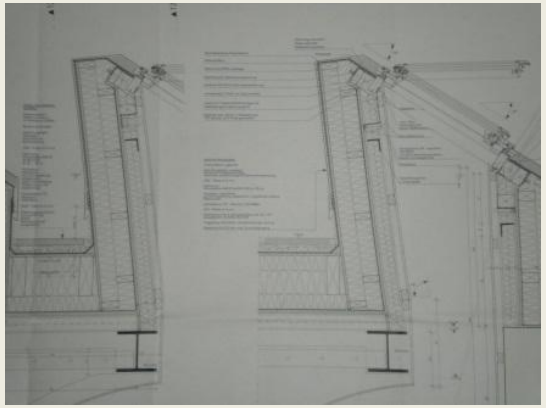






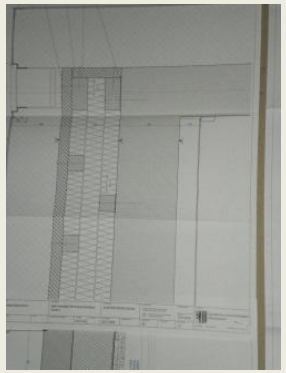
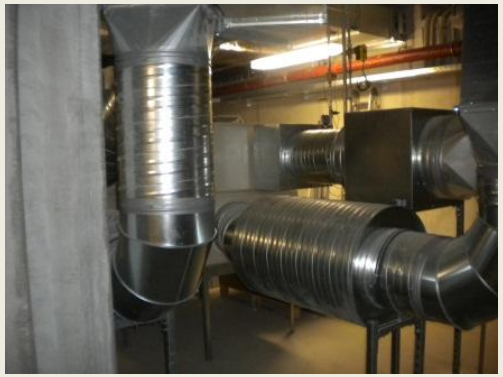
High School

- 27,000 sq ft – Passiv
- PH ventilation w/ simple controls
- Steel & Timber Construction
- Passiv ground loop
- GSHP w/ boiler supplemental heat





Kindergarten

- 7,000 sq ft – Passiv
- Timber Construction
- PH ventilation w/ simple controls
- Low temp boiler supplemental heat











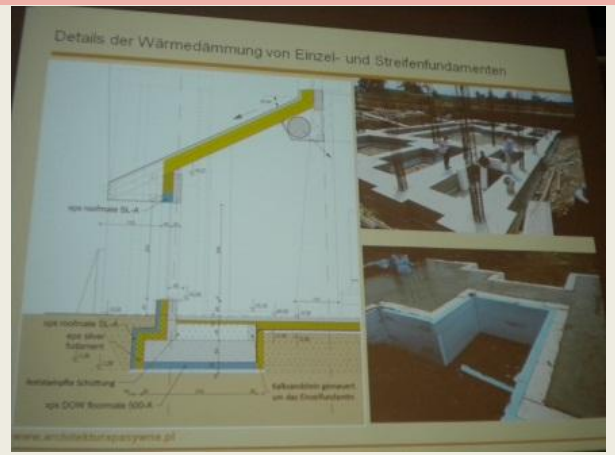


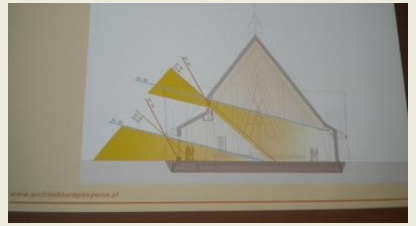


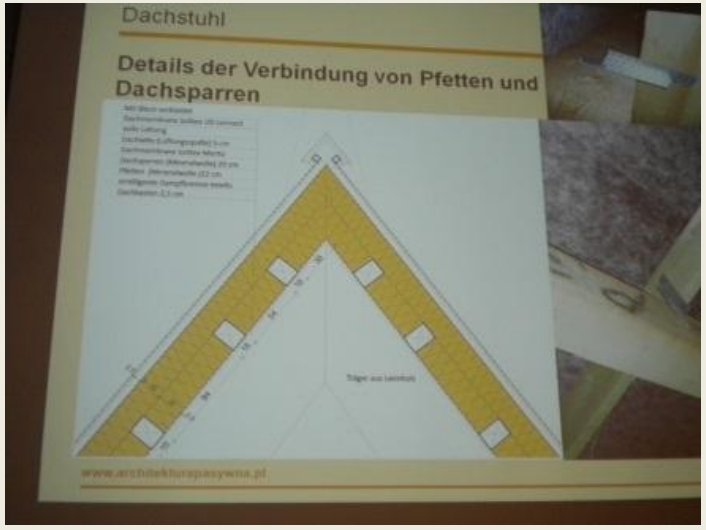


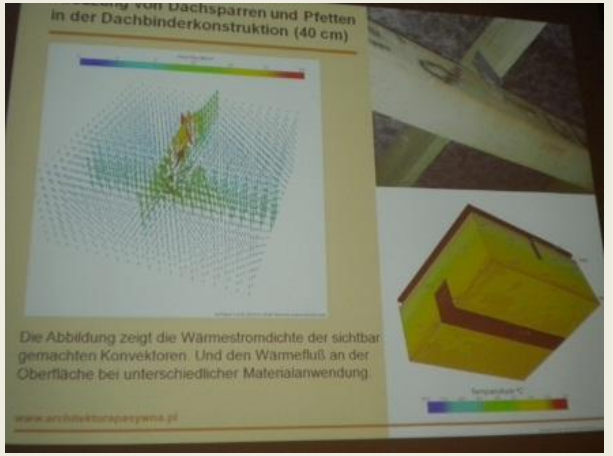

Church of the Equal Szaflarski

- 19,000 sq ft – Passiv
- Timber Construction
- PH ventilation
- GSHP low temp in floor heating



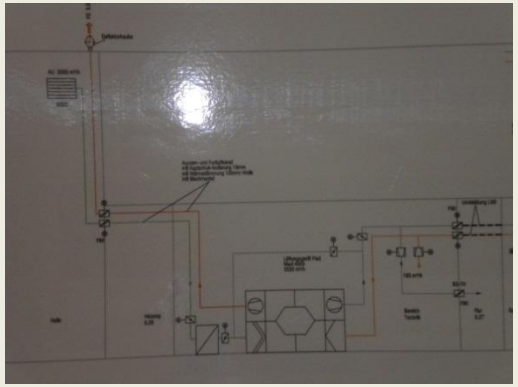


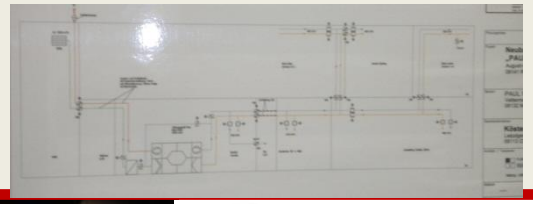




Office & Manufacturing

- 10,000 sq ft office – Passiv
- 70,000 sq ft factory – Low energy
- GSHP (heating & cooling)
- Hot water heat supplement

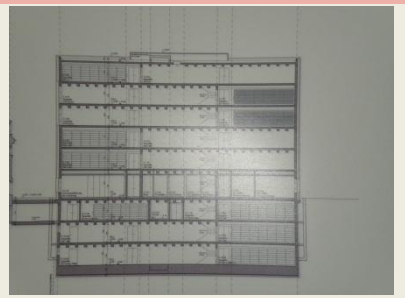


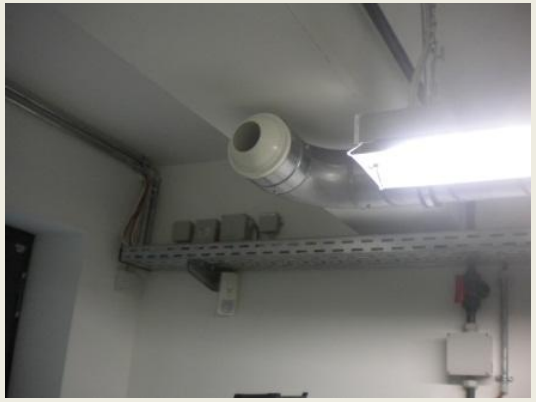


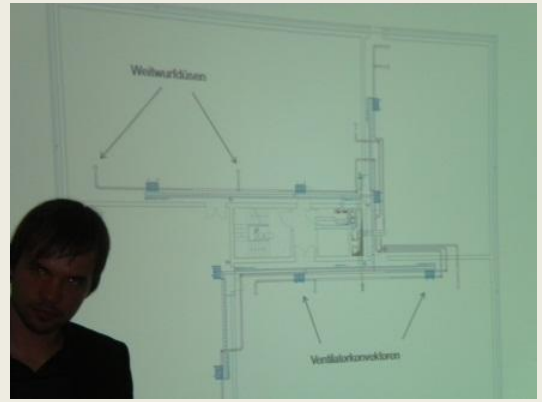
Archive

- 69,556 sq ft – Passiv
- Passive ground loop cooling
- Each floor (4) zones PH ventilation
- Simple fan coil units











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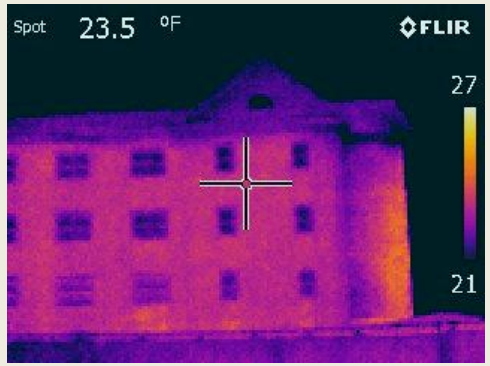
Dental Clinic

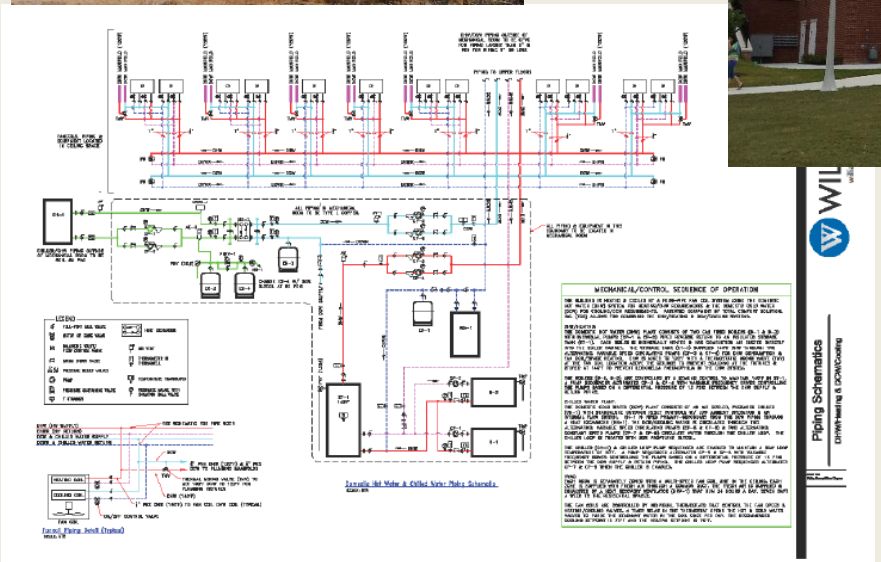
- 5,000 sq ft – Passiv
- PH ventilation w/ simple controls
- $155 per sq ft (low market rate)

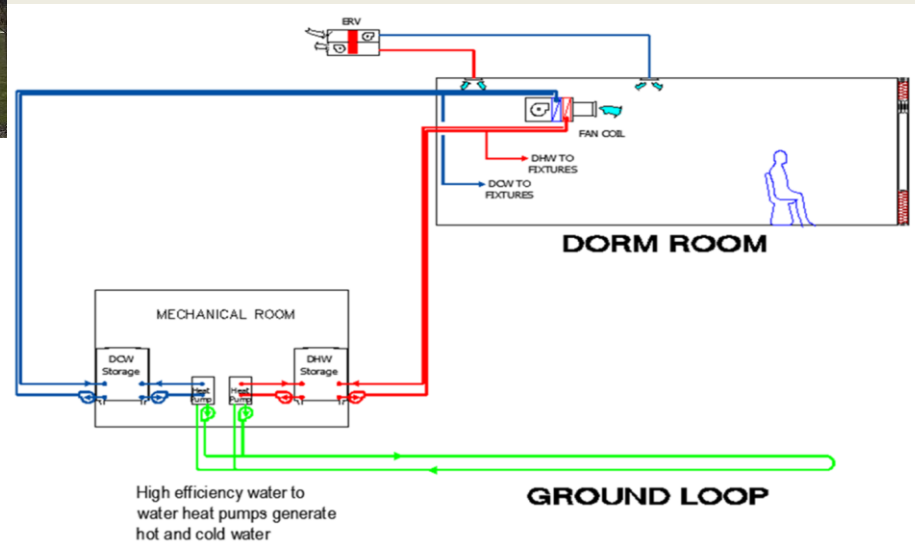
- Timber Construction
- Passiv ground loop
- ASHP

Dormitory

- 40,000 sq ft – Passiv
- PH ventilation w/ simple controls
- $118 per sq ft (low market rate)
- Timber Construction
- GSHP with Integrated Piping System (IPS)







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Assembly Building

- 8,000 sq ft – Passiv
- PH ventilation w/ on demand controls
- $135 per sq ft (low market rate)
- Timber Construction
- Passiv ground loop
- ASHP

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Public School

- 3,600 sq ft – Passiv
- PH ventilation w/ on demand controls
- Energy Positive 3 years running
- Timber Construction
- Passiv ground loop
- GSHP

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Conclusion

And now a message from Dr. Feist

“Investing in value instead of energy consumption requires little financial efforts but rather creativity and intelligent solutions”

~ Wolfgang Feist

Questions & Contact

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540.774.4800

This concludes The American Institute of Architects
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