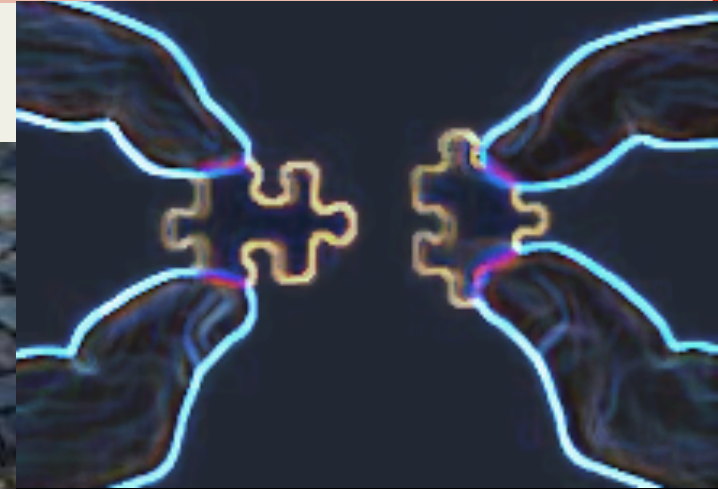


Large buildings + Cold Climates + Passive Building = recipe for cost efficient low energy

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



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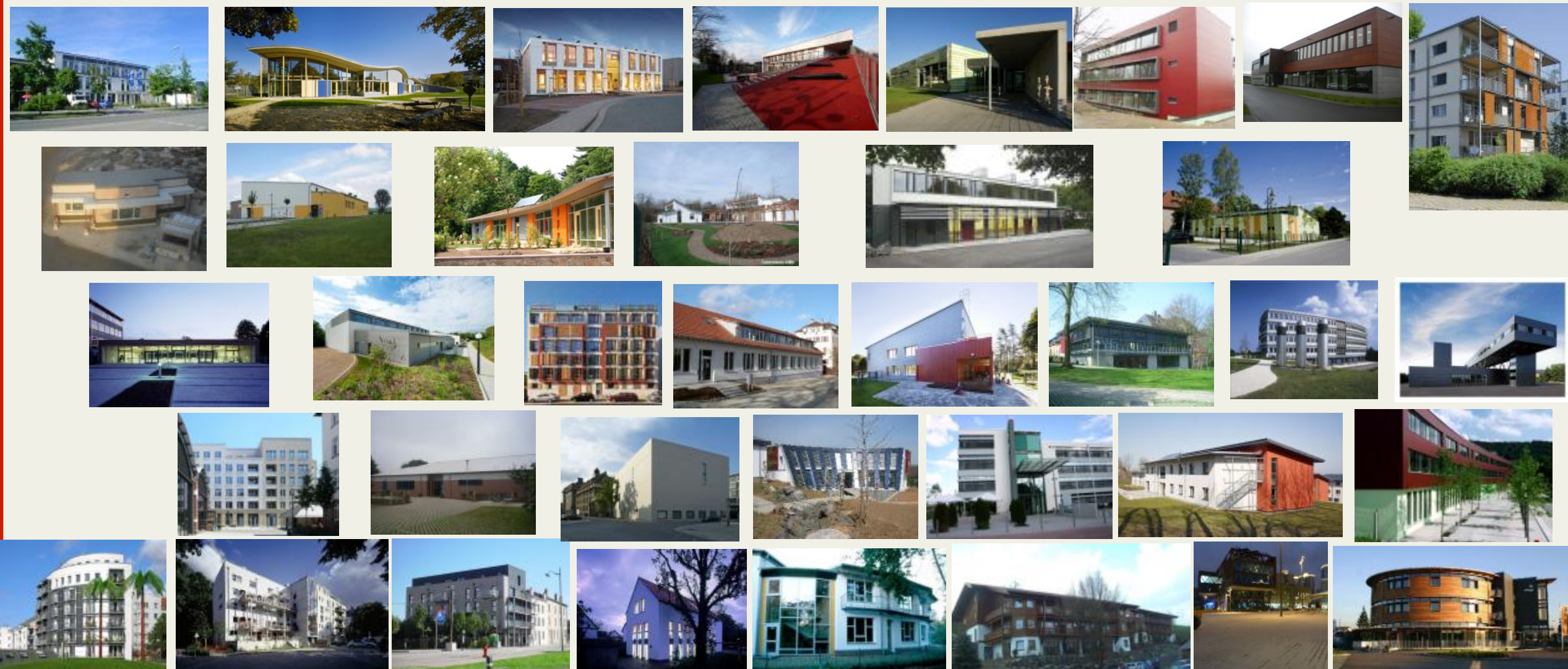


Large buildings + Cold Climates +
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efficient low energy



Commercial Passivhaus

European Examples



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efficient low energy



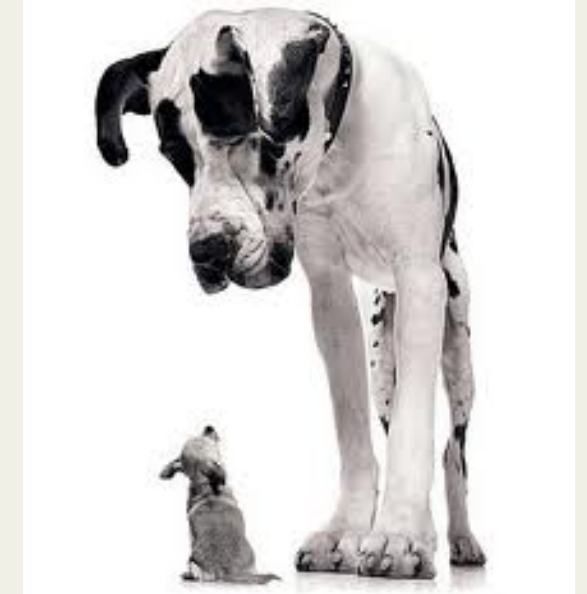
What Makes it So Attractive?



Passivhaus Principles



COLD



Scale



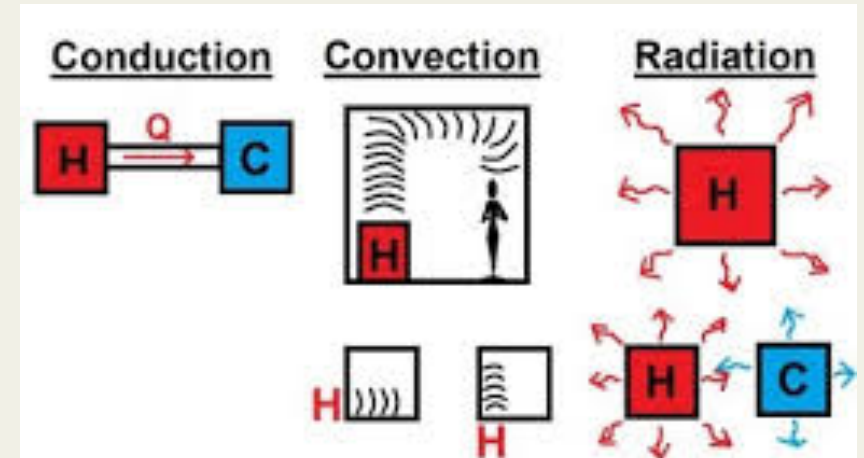
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First Step

Understanding the Problem

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



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

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



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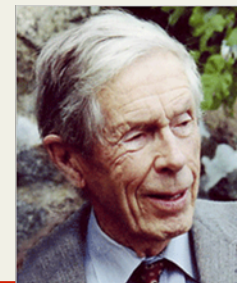
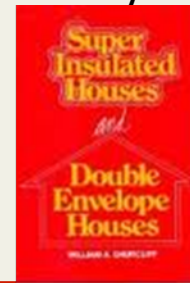
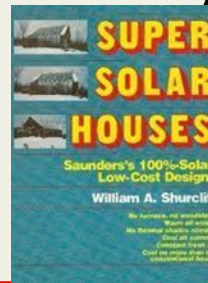
Large buildings + Cold Climates +
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efficient low energy



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.



Large buildings + Cold Climates +
Passive Building = recipe for cost
efficient low energy



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)



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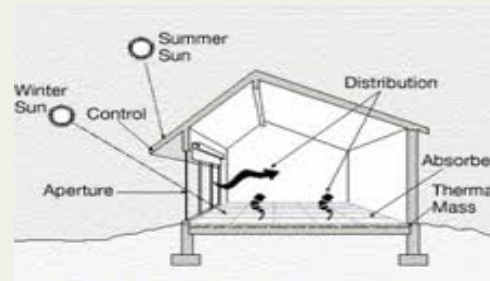
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Passivhaus Principles

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.)



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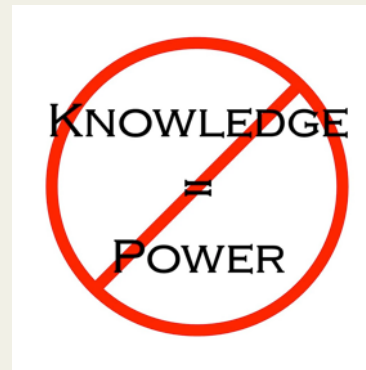
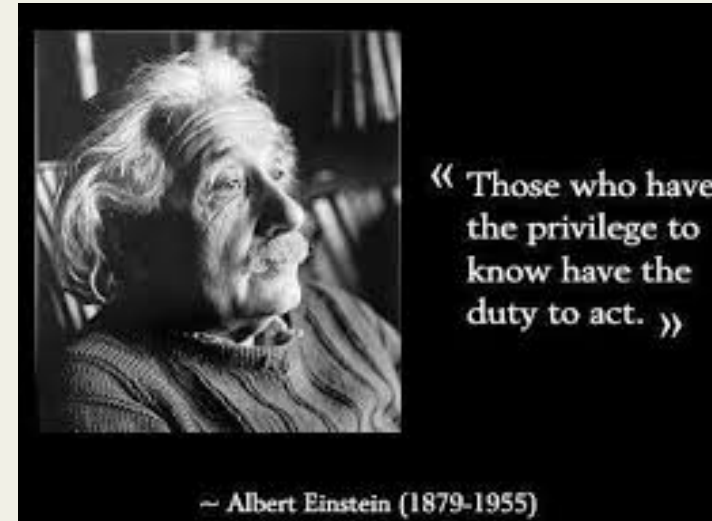
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Step Two

Understanding the Problem

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



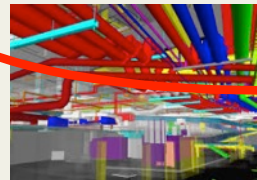
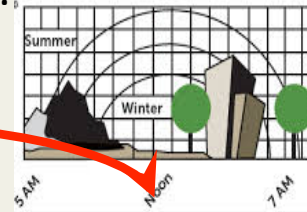
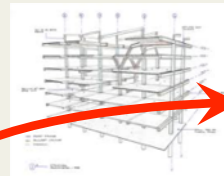
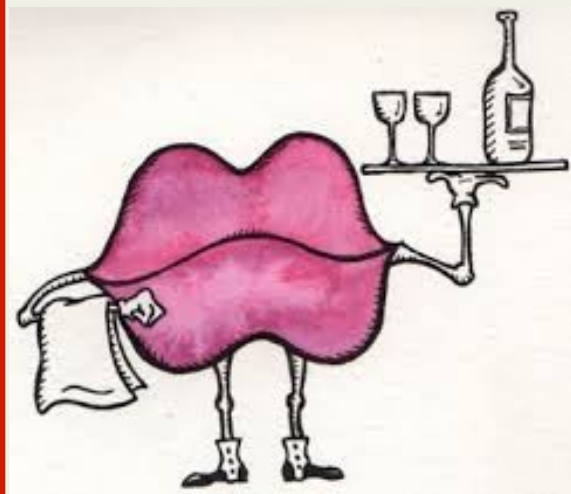
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Synergy & Leverage

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.



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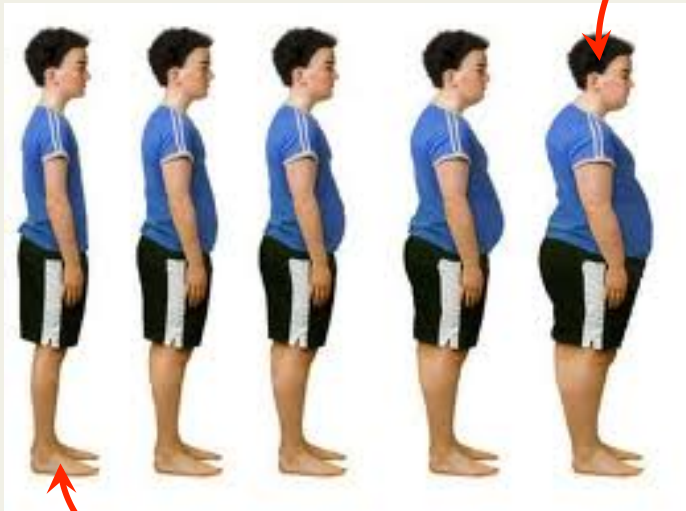


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Scale

Skin to Volume Ratio (Form & Function)



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Scale

Shape (Form)



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Scale

Interior Heat Gain (Function)



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QUANTUM
ARCHITECTS
— HIGH PERFORMANCE DESIGN —



BUILDSMART
Energy efficiency made simple

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efficient low energy



PASSIVSCIENCE
Knowledge saves power

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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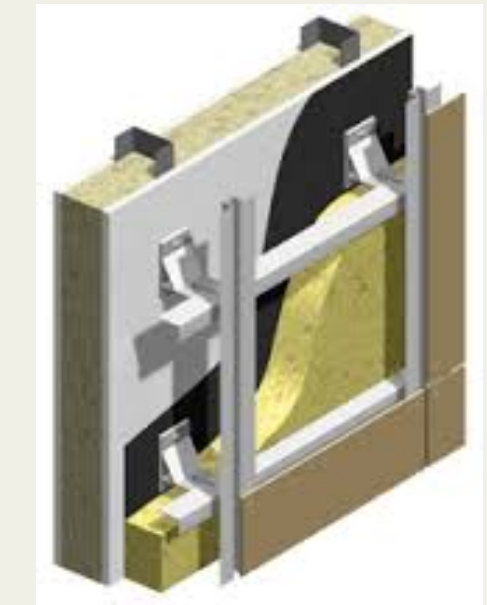
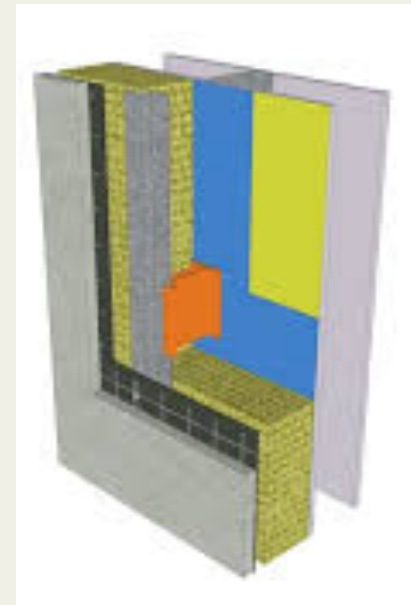
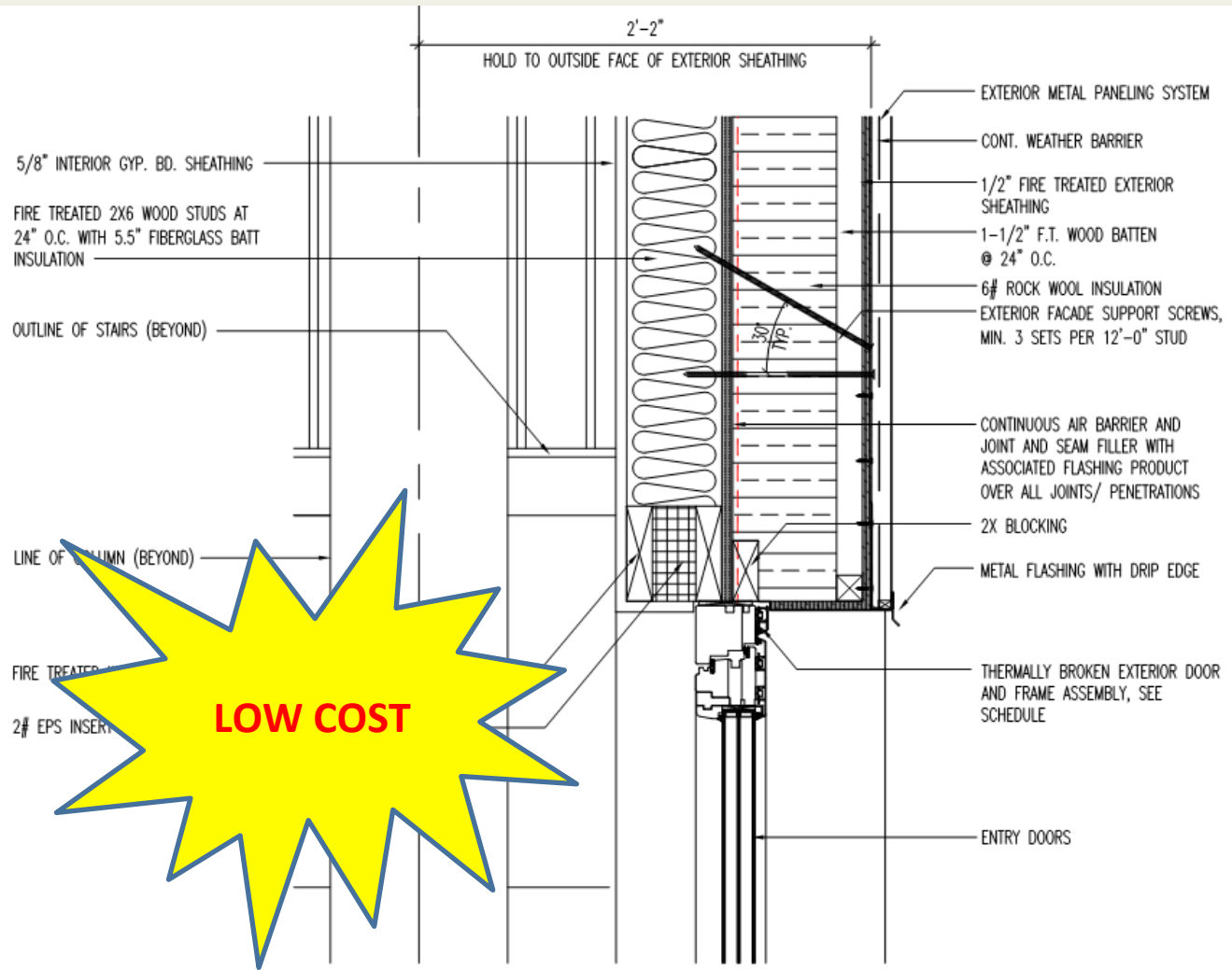


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Scale

Commercial Construction – *We are so close already*



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Scale

Commercial Construction – *We are so close already*



THINK QUALITY!
**DO IT RIGHT
THE FIRST TIME**
The first one is on me, all
the others are all you!



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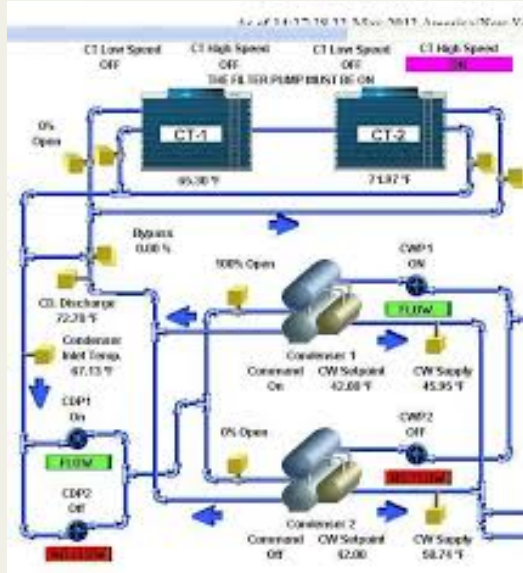


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Scale

Commercial Construction – *We are so close already*



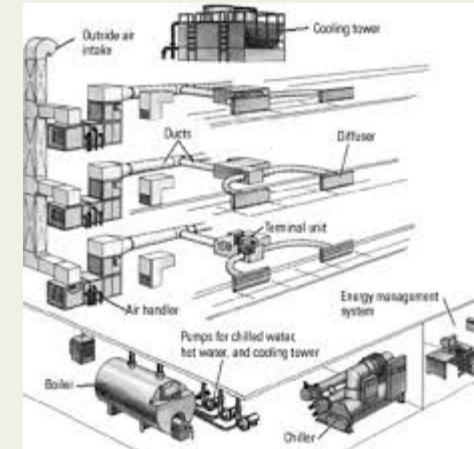
simple is beautiful.

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

Albert Einstein



THE PERFECT FIT



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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



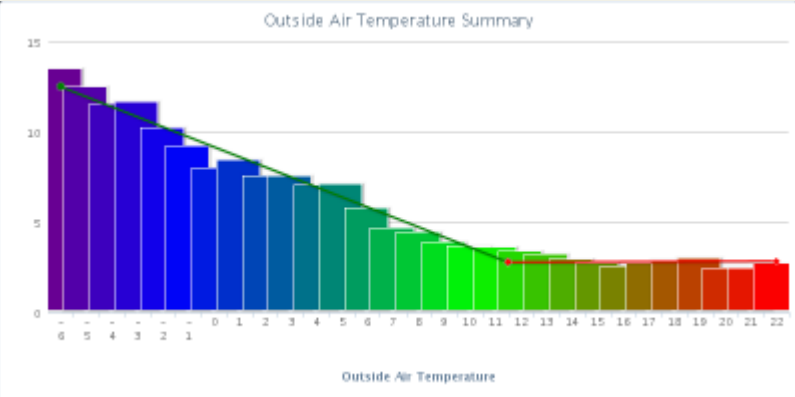
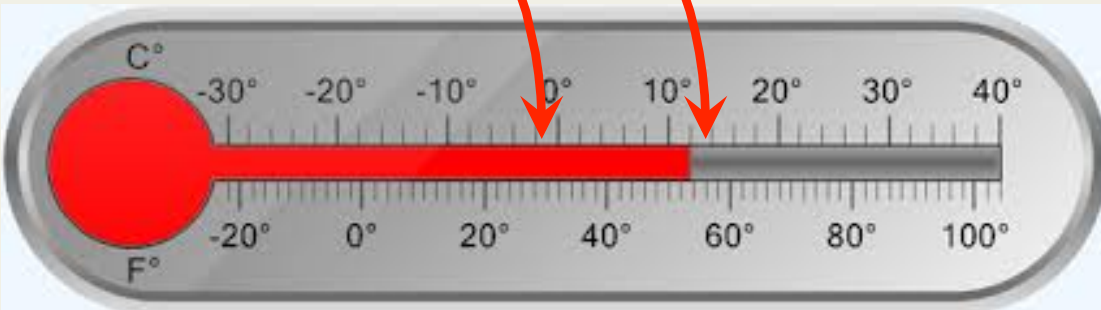
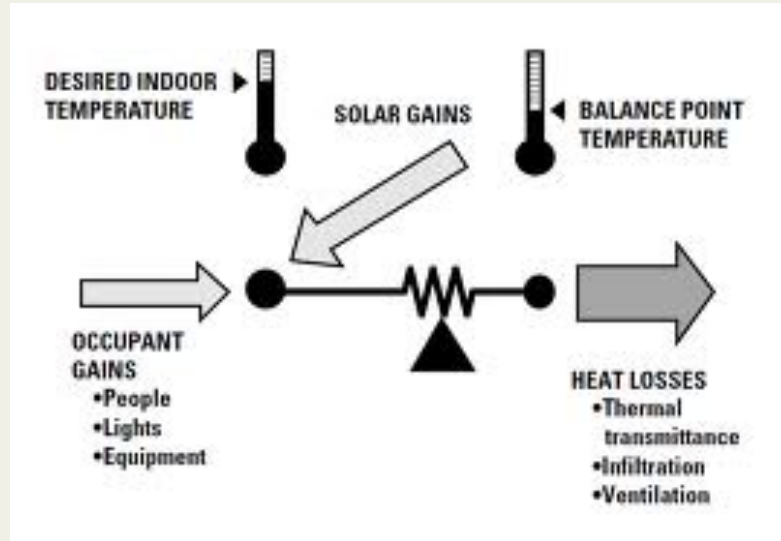
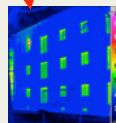
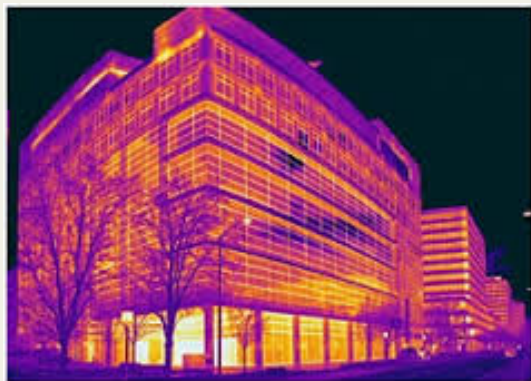
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Passivhaus Principles

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



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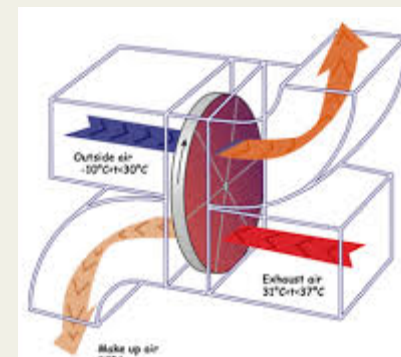
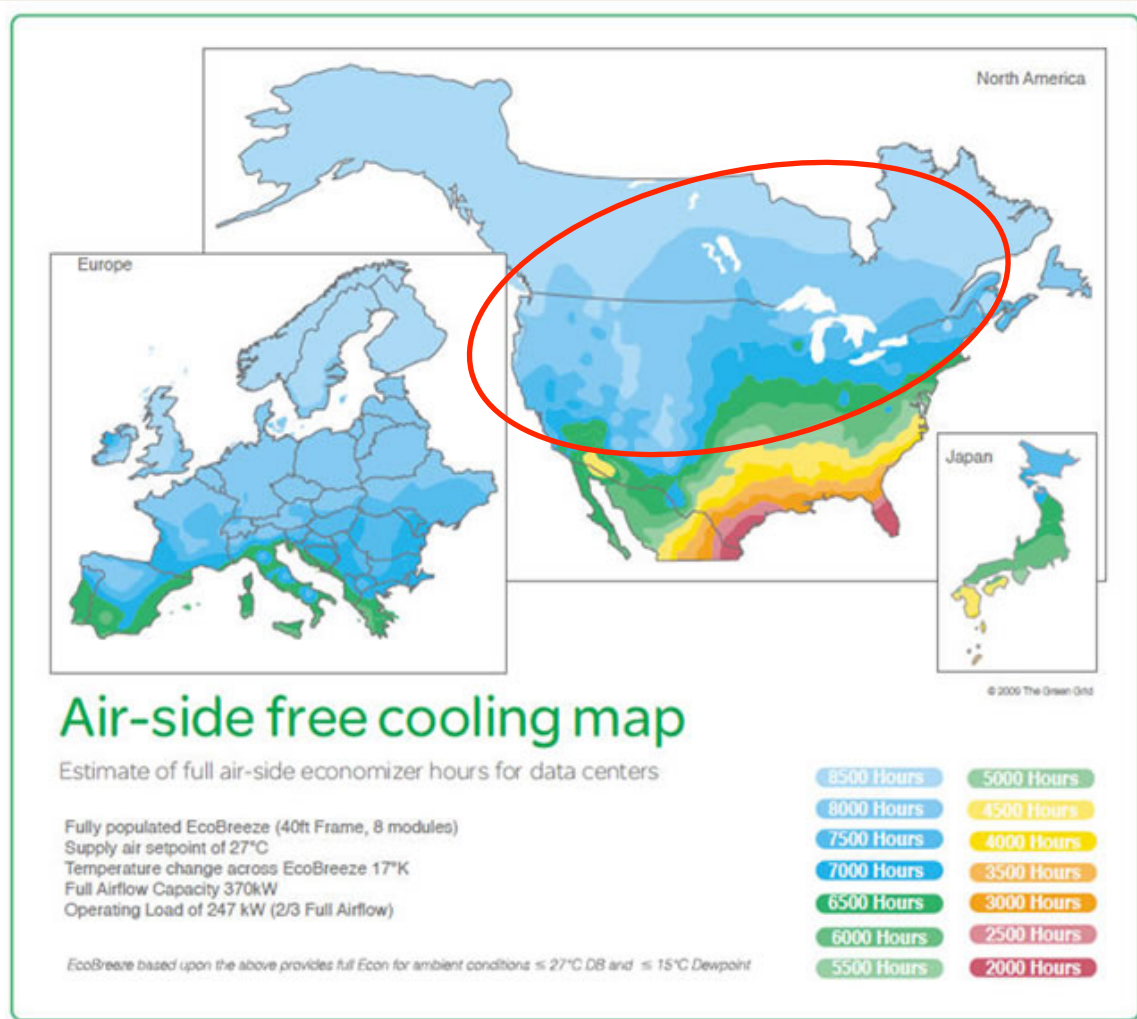


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Passivhaus + Large Buildings + Cold Climate

Free cooling



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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

A CHALLENGE
ONLY BECOMES AN
OBSTACLE WHEN
YOU BOW TO IT.



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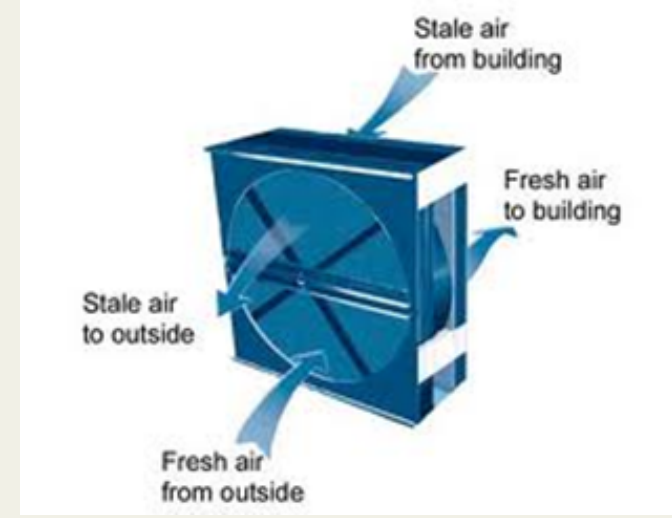
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Physical Obstacles

Materials & Systems

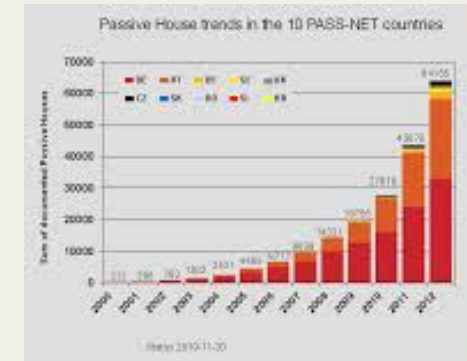
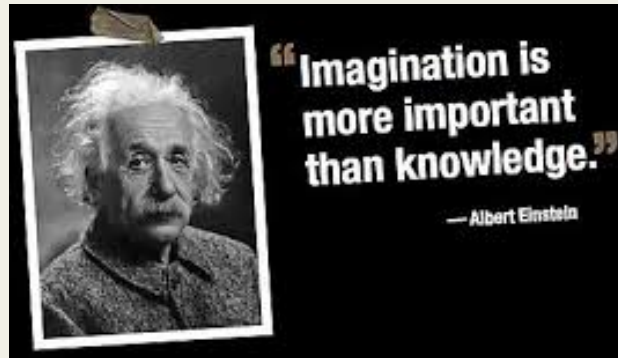
- North American Obstacles
 - Curtain wall
 - Handicapped compliant doors
 - Fire rated doors
 - Mechanical systems
 - Fresh air
 - Integrated
 - Correctly sized
 - Standard monitoring & control



Physical Obstacles

Materials & Systems

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



Large buildings + Cold Climates + Passive Building = recipe for cost efficient low energy

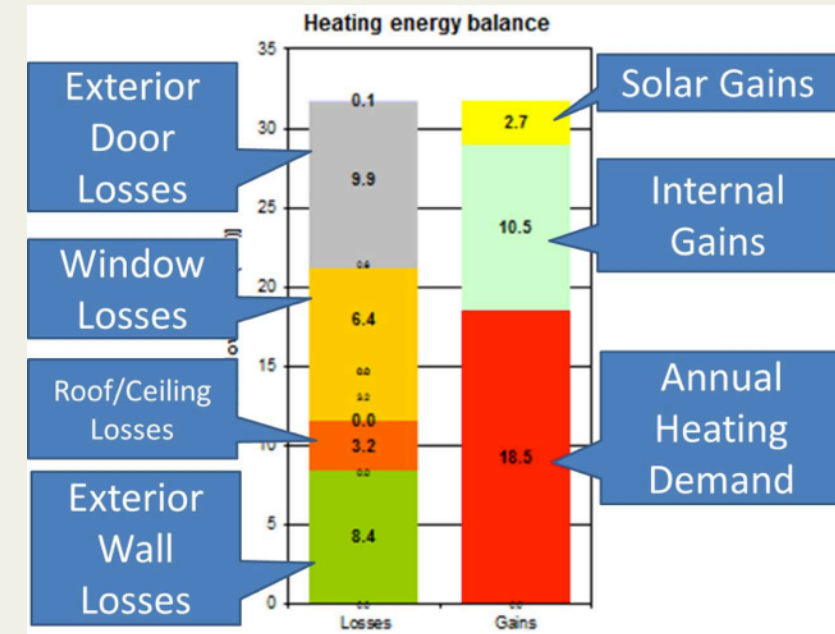
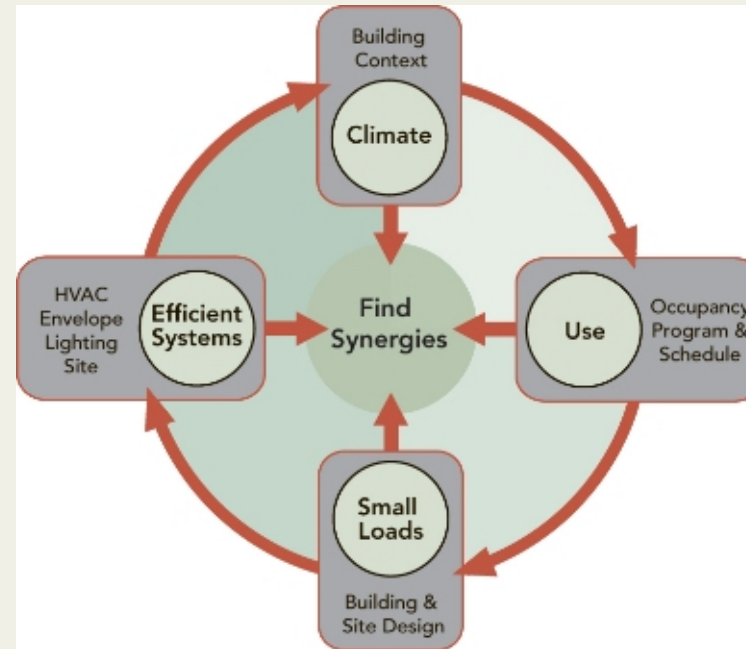


Mental Obstacles

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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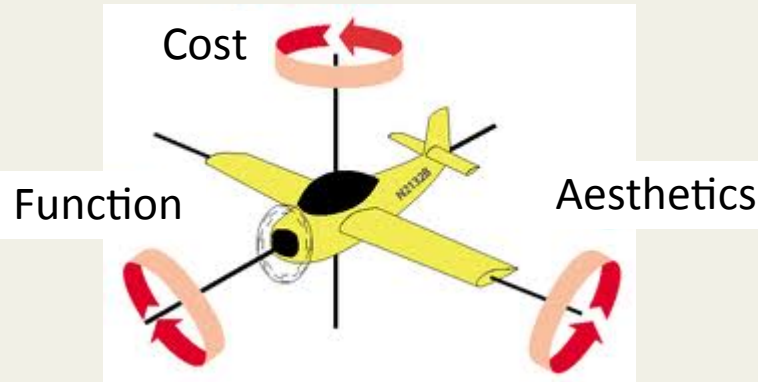


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Mental Obstacles

Changing the way we do business



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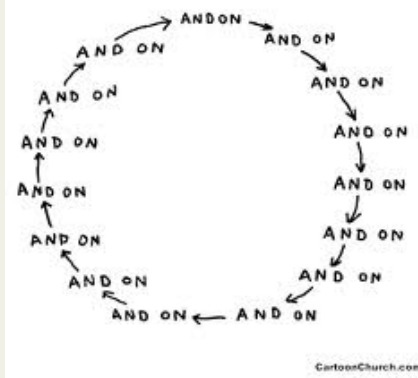


Mental Obstacles

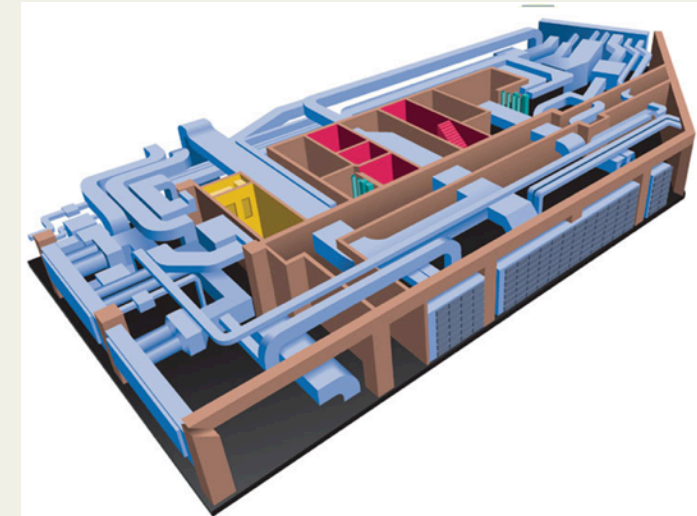
Changing the way we do business

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



Large buildings + Cold Climates +
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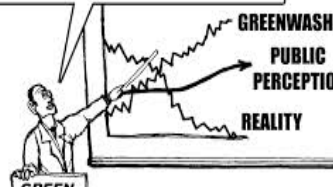
Mental Obstacles

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.

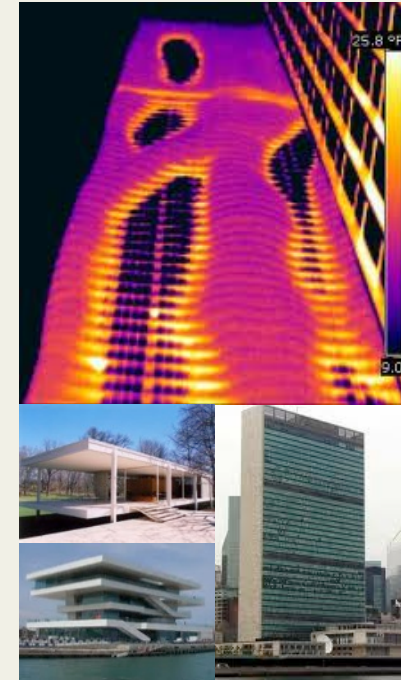
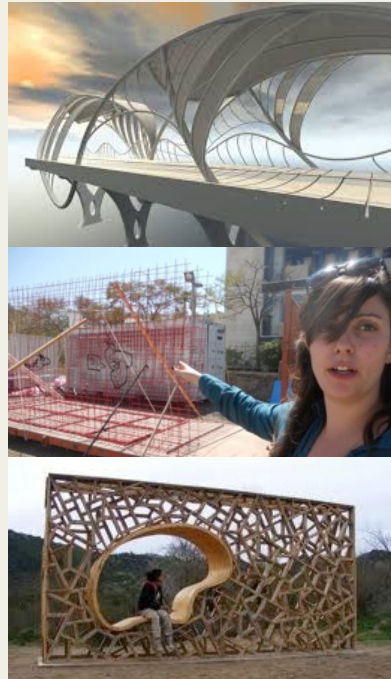
- Design takes precedence over sustainability and adaptability
- Architects become less master builder and more artist
- Reflected in the North American architectural education system until recently
- Even now sustainability is discussed without truly being understood and thus implemented in both education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

YOU CAN IMPROVE PUBLIC PERCEPTION BY OFFSETTING THE REALITY OF YOUR PROJECT WITH MORE INVESTMENT IN GREENWASH INC



GREENWASH
PUBLIC PERCEPTION
REALITY

HAHAHA!
Wait, i don't
get it.



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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



Waste in the building industry is estimated at over **50%**

-Diane Davis, Building SMART Alliance



| 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 | \$ - |
| DIVISION 08 00 00 - OPENINGS | \$ 51,654.00 |
| DIVISION 09 00 00 - FINISHES | \$ 7,230.00 |
| DIVISION 10 00 00 - SPECIALTIES | \$ 14,194.00 |
| DIVISION 11 00 00 - EQUIPMENT | \$ 490.00 |
| DIVISION 12 00 00 - FURNISHINGS | \$ - |
| DIVISION 13 00 00 - SPECIAL CONSTRUCTION | \$ 6,850.00 |
| DIVISION 14 00 00 - CONVEYING EQUIPMENT | \$ - |
| DIVISION 21 00 00 - FIRE SUPPRESSION | \$ - |
| 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 - UTILITIES | \$ - |
| 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 |



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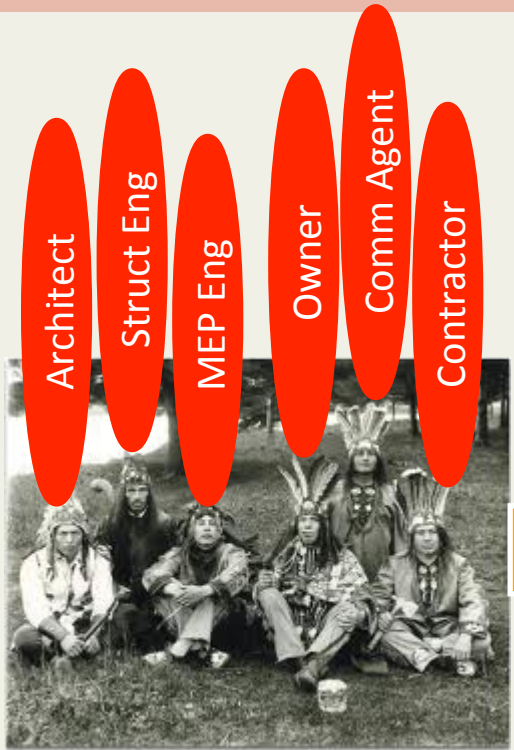


Large buildings + Cold Climates + Passive Building = recipe for cost efficient low energy



Mental Obstacles

Changing the way we do business



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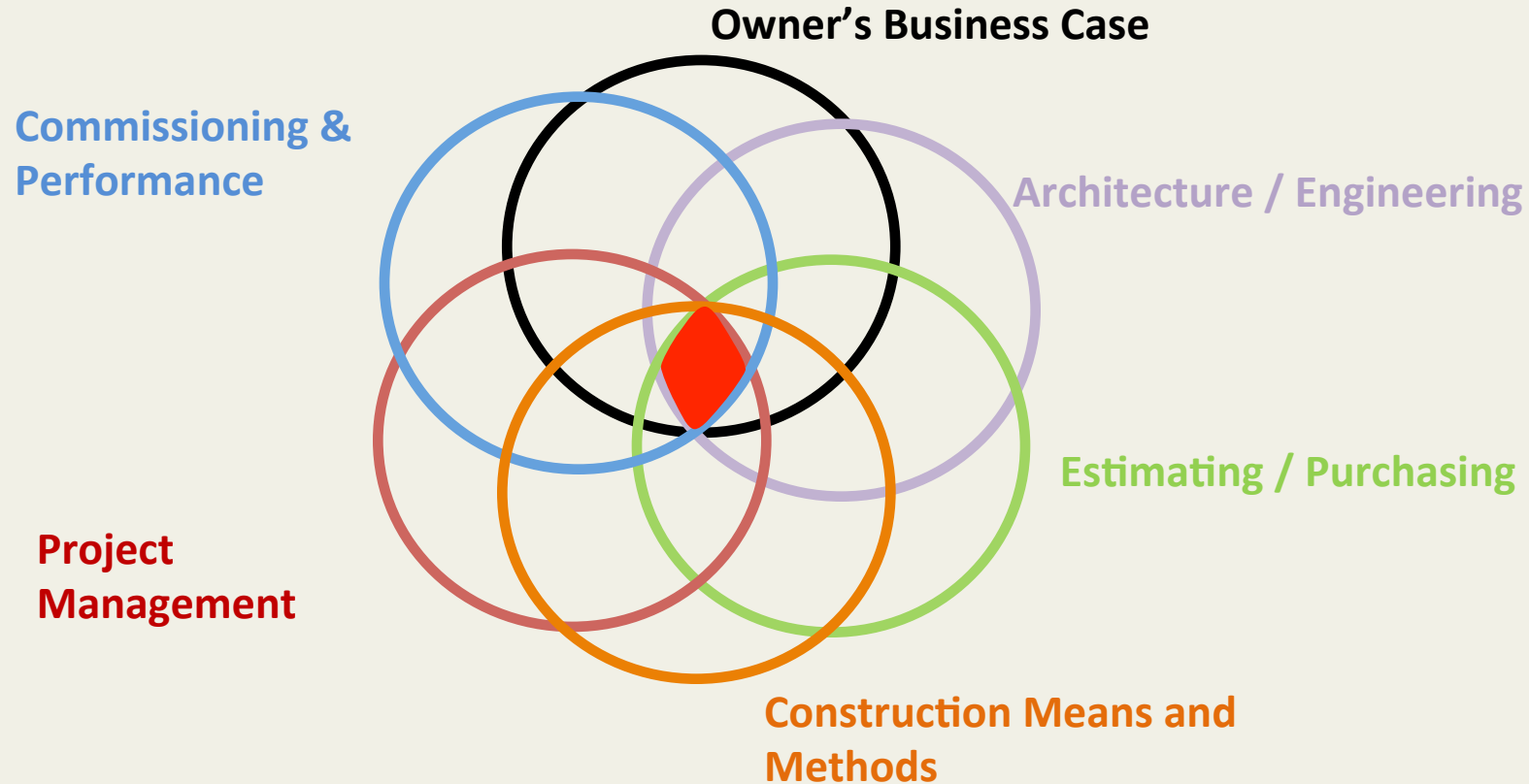
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Mental Obstacles

Changing the way we do business

Integrated Project Delivery



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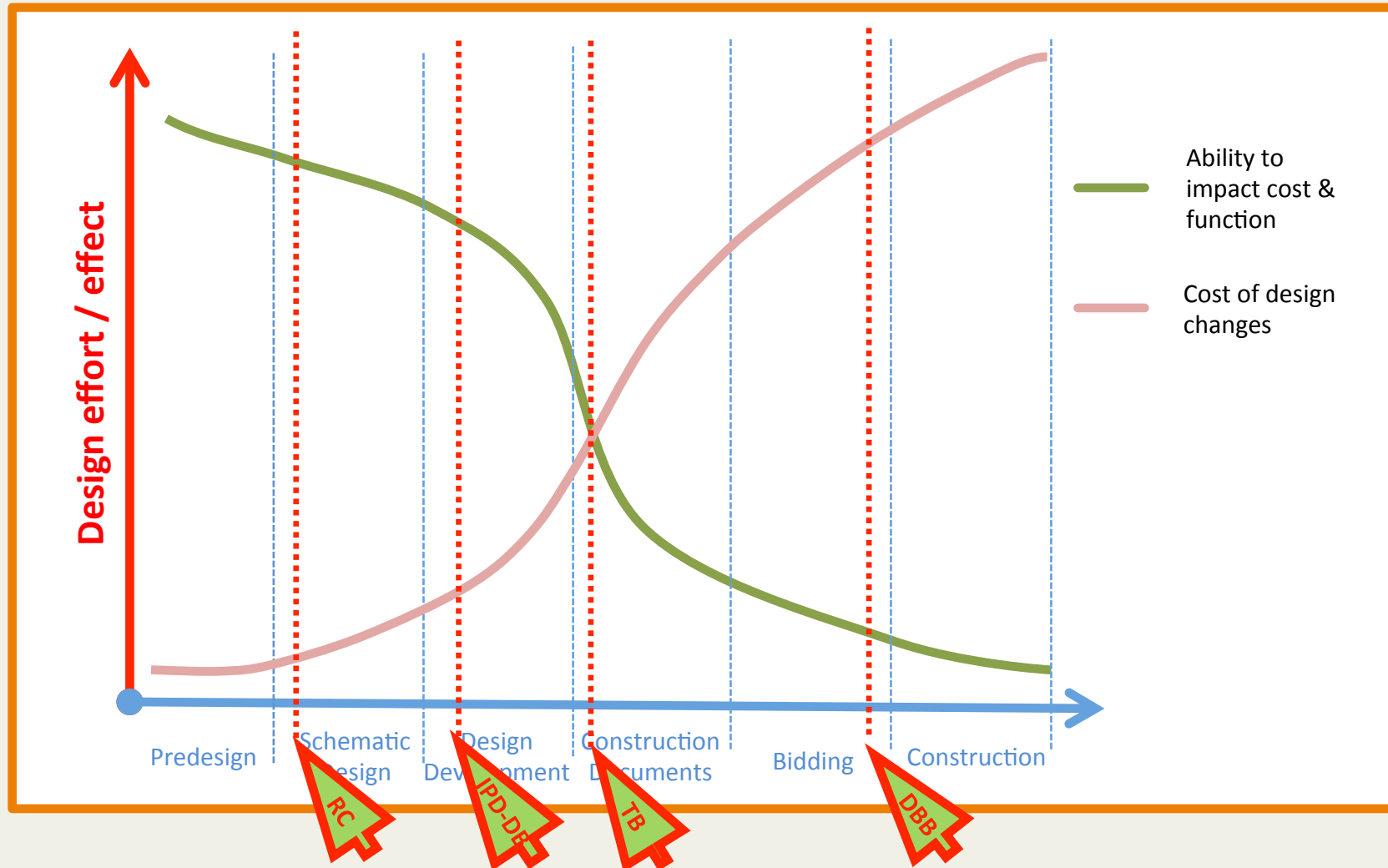


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Why is Integrated Project Delivery Different?

Integrated information flow leads to Fiscal Control



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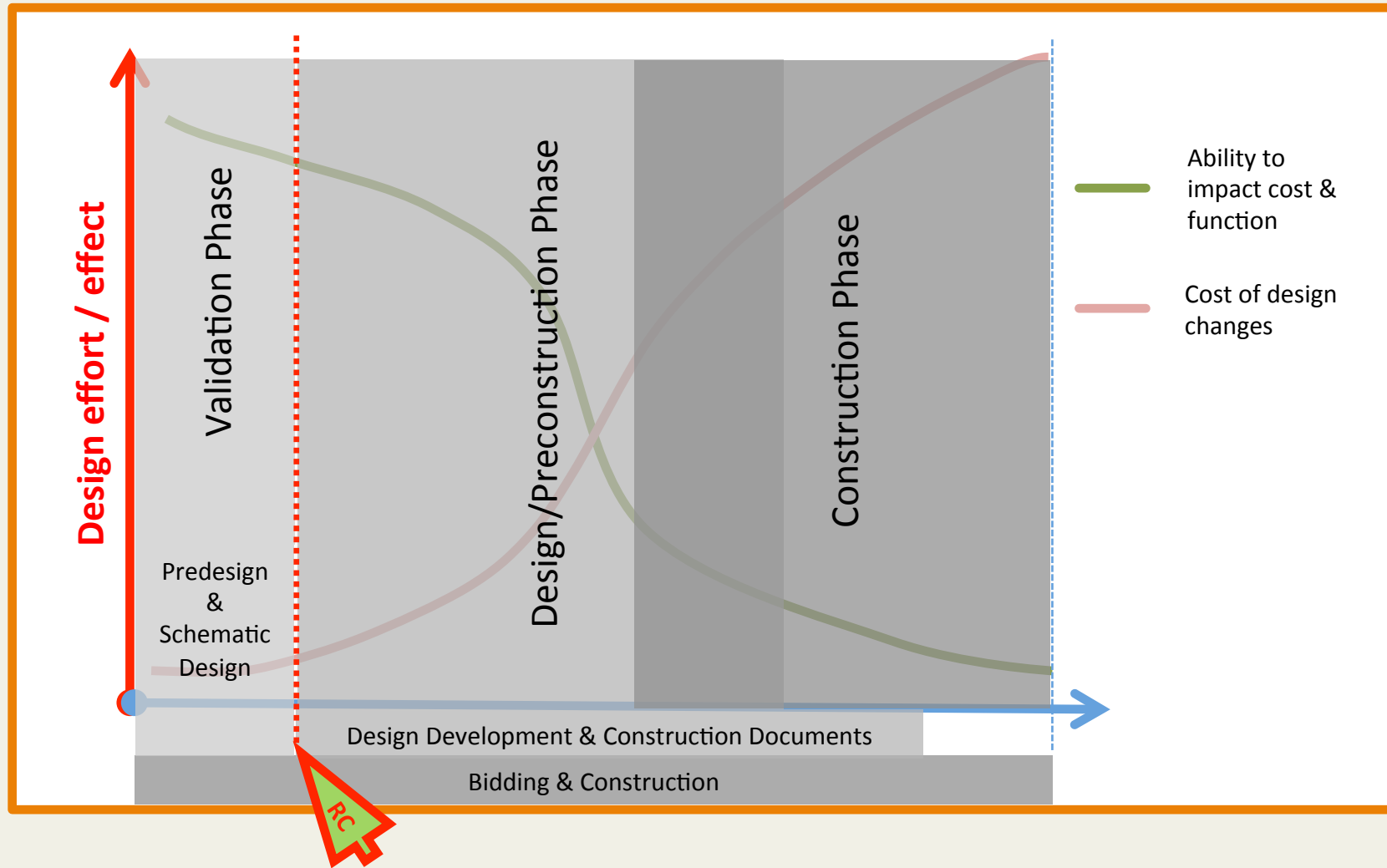


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Why is Integrated Project Delivery Different?

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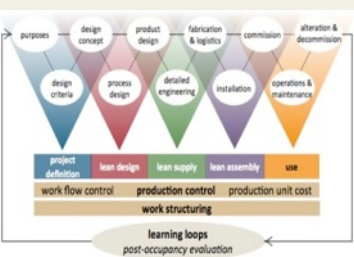


Mental Obstacles

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



OLD
is the new
NEW



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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



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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



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efficient low energy



Questions & Contact



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Large buildings + Cold Climates +
Passive Building = recipe for cost
efficient low energy

