



13TH NORTH AMERICAN MASONRY CONFERENCE

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Innovation in Masonry Today

Peter Roberts

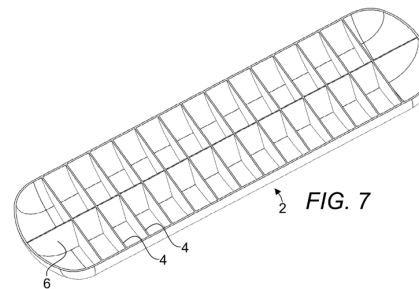
Spherical Block LLC

Innovations already underway

- Concrete Block to make roofs
 - Arches, domes, flying buttresses



- Concrete Block to make boats
 - Vessels, ships, barges



- Concrete Block to make Spheres



Outline

- What is Innovation?
 - Speak to both:
 - innovators
 - Users of Innovation
- Revolutionary vs. Incremental
- Sources of Innovation
- Personal Experience
- History and Results
- Future of Innovation in Masonry
- Conclusions and Recommendations
- Q&A



What is Innovation?

- Something NEW
- Does not exist yet
- Must be imagined first
- Occurs in the prefrontal cortex
- Based on what is known



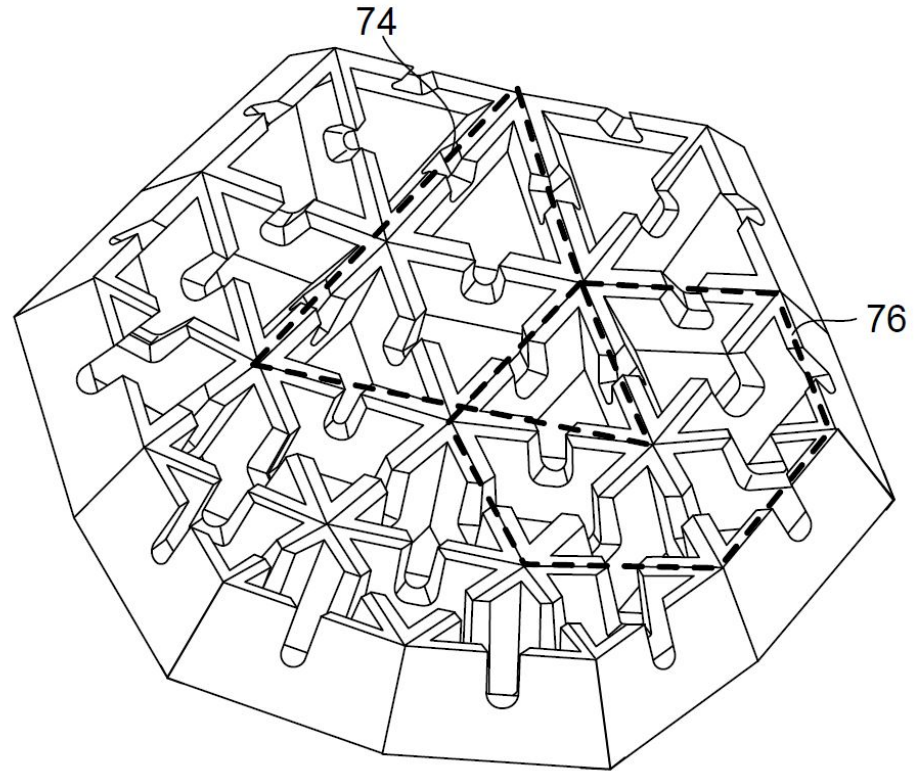
Innovation is based on what is known

- Broad base of knowledge
- Open to new experiences
- New to a field
 - Free from preconceptions
- Willingness to be wrong



Gradual innovation

- Incremental
- Occurs in small steps
- Adjustments
- Optimization
 - Example: Typical CMU



Revolutionary Innovation

- Major change
- Fundamentally different
- Disruptive
 - Creates a new model
 - New paradigm
 - Example: CMU to make arches



Innovation requires BOTH

- Revolutionary Idea
 - New concept introduced
- Incremental changes
 - Optimize a better way
 - Development



Large teams develop and small teams disrupt science and technology

- *Nature* 566, pp. 378-382 February, 2019
- Authors: Lingfei Wu, Dashun Wang & James A. Evans
- Universal trend in science and technology today
- Growth of large teams in all areas
- Solitary researchers and small teams diminish in prevalence

Analyzed more than 65 million

- papers, patents and software products 1954–2014
- smaller teams have tended to disrupt science and technology with new ideas and opportunities
- larger teams have tended to develop existing ones

Time span of Innovation

- Work from larger teams builds on more-recent and popular developments, and attention to their work comes immediately.
 - Example: Increasing computer speeds & capacity
- Contributions by smaller teams search more deeply into the past, are viewed as disruptive to science and technology and succeed further into the future—if at all.
 - Example: Creation of internet

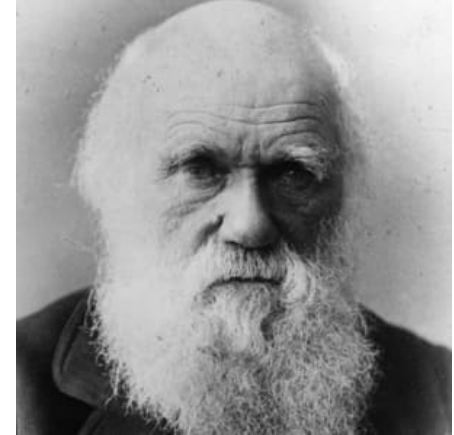
Both large and small teams are necessary for success

- small teams known for disruptive work
- large teams for developing work
- Together create a flourishing ecology for innovation

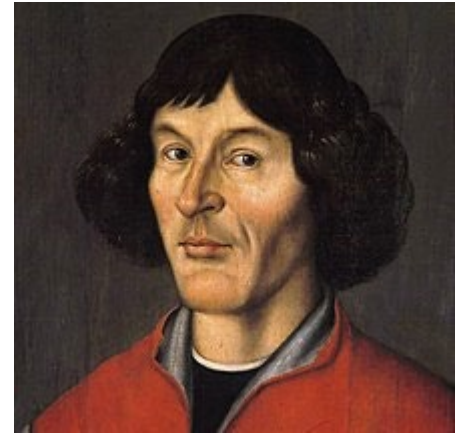


Psychology of Innovation

- Born to Rebel
- Author Frank Sulloway, 1996
- Birth order and revolutionary ideas
- Youngest (last born) source of revolutionary ideas
- Oldest (first born)
 - Conservative, power figures
 - Example: Darwin himself
- Darwinian mechanism
 - Getting parents attention



Paradigm Shift



- The Structure of Scientific Revolutions
- Thomas Kuhn, 1962
- Previously “normal scientific progress”
 - Viewed as “development by accumulation”
 - Incremental changes
- Kuhn’s idea: New Model introduced
 - Paradigm shift
 - Revolutionary
 - Example: Copernicus
- Huge resistance to new ideas by established science

Sources of Innovation

- Active research
 - Focused, linear
 - Typically performed by larger teams
 - Example: Seismic Design for Masonry
- Interdisciplinary
 - Other fields, new perspectives
 - Example: Francis Straub, Cinderblock
- Biomimicry
 - Look to nature
 - Example: turtle/tortoise shell, ceramic dome; Velcro™
- “Out of Nowhere”
 - Unexpected, a door opens
 - Informed by what is known
 - Microwave ovens
- Uncovering Something vs. Pure Invention
 - Catenary arch, Robert Hooke

My Own Experience

- Cathedrals of Europe
 - As a child: huge impression
- This was masonry!
- What happened? “Cinder block architecture”
 - Wal-Mart vs. Notre Dame
- This was modern architecture
- Can’t we do better?



My Own Experience

- Informed by art
 - Curious
 - Read books
- Worked as a potter
- Went on to study ceramic engineering
- Large scale facilities to make things
 - Alfred University
 - NYS College of Ceramics



My Own Experience

- Gained knowledge about ceramics
 - Inorganic
 - Non-metallic
 - Crystalline
 - Heat treated
- Concrete is ceramic
- A ceramic house?



A Ceramic House?

- An outlandish idea
- “Quantity has a quality all its own”
 - Very big vs. very small
- Began on the Potter’s wheel
- An engineering challenge
- Instantly mocked



NO

- Get used to it.
- No
- No
- No
- “You can’t do that”
- Echoes of:
 - Copernicus
 - Darwin



NO. NO. NO.

- Academics
 - Physics Teacher, John Stull
- Business leaders
- Architects
- Investors
- Friends



Evolution of the idea

- Began as big pot
- Ram press
 - Clay bricks
 - Time consuming
- How else?
- Concrete?
- Concrete Block?



Research

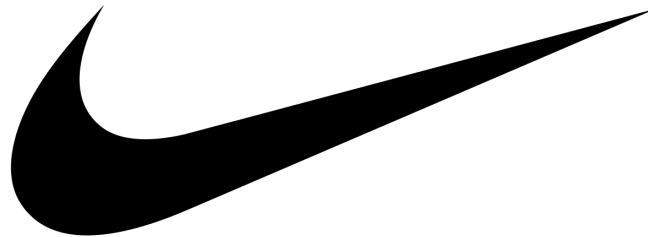
- Go to first sources
- What if there are none?
- Keep asking
- “No” (get used to it)
- Think:
 - Basic Principles
 - Fundamental
- Go back into time
 - Deep time, archaeological



Do it

- Make the thing
- Experiment
- You can do it

YUKON
YUKON
YUKON



How to get support for innovation?

- Believe in yourself
- Make yourself expert
- Obtain credentials
- Learn
 - Do research
- Talk to others in the field
- Evangelize
 - Convert others



How to get support?

- Establish Technical Standard
- Obtain Critical Mass
- Network
 - Social Media
 - Blog
 - Vlog



Where to go for support?

- Your own resources
- Friends and Family
- Trade Groups
- Government agencies
 - NYSERDA
 - State
 - National Science Foundation
 - Federal



New York State Energy Research & Development Authority

- NYSERDA
- Funded Kiln & Furnace research
- Gained much experience
- Learned a lot



National Science Foundation (NSF)

- World's largest seed fund
- Invest in disruptive technology
- Want:
 - Inherent risk
 - Revolutionary ideas
 - Disruptive technology
- Don't want:
 - Incremental change
 - "Safe bet" technology



NSF: Benefits

- Prestige
- Other Innovators
- Culture of encouragement
- Learn about Business side
 - Investors
 - Financial Projections
- “Shark Tank”
 - Real world examples
- High Standards



Spherical Block LLC

- Use of manufactured block to make roofs
 - Arches
 - Domes
 - Flying buttresses
 - Complete Spheres
 - Storage tanks
 - Septic tanks
 - Bridges
 - Ships, vessels, barges



Spherical Block LLC

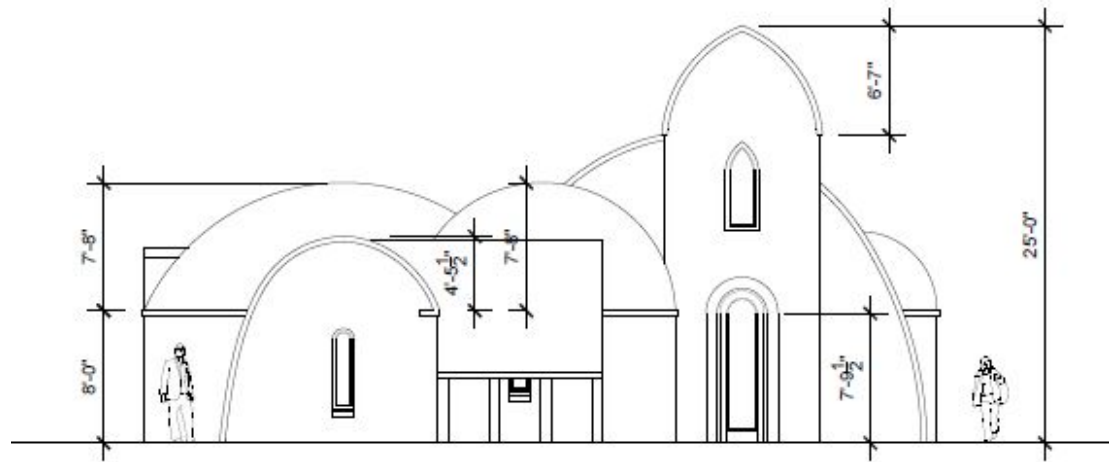
- ICC-ES

- Evaluation

- Worked with:

- P.E.

- R.D.P.



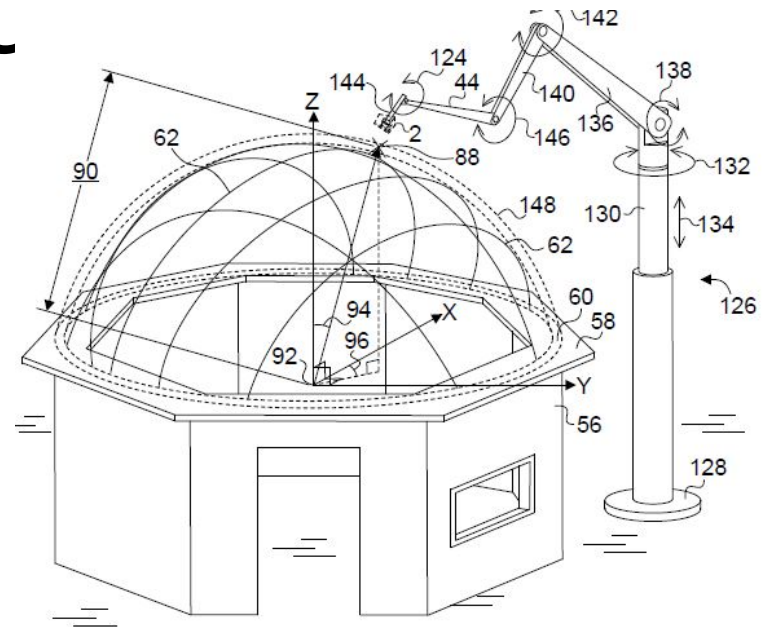
- Designed “Test” or “Sample” Building

- Show all calculations

- Establish Design Methodology

Spherical Block LLC

- Current work
 - Automated Assembly
 - Semi-Automated Assembly
- Robotics
 - Proposal submitted to NSF
- Patent Filed on Robotic Masonry Assembly
 - Roofs: domes, arches, flying buttresses. Etc.



What is Future of Innovation in Masonry?

- Look back at this question:
- Why Are There So Few Innovations in Masonry?
- Clayford T. Grimm, 1988
- This Q was posed to a steering committee
 - Workshop on Masonry
 - Sponsored by NSF
- Committee Members Included:
 - NCMA
 - Masonry Institute of America
 - Clemson University

Why Are There So Few Innovations in Masonry? (1988)

1. Tort Law
2. Bureaucratic Building Code Process
3. Unfunded Process of Writing Consensus Standards
4. Industry Fragmentation “Economic pressures for fast construction time leave little time for the learning curve required by new ideas. The construction industry mind-set supports the status quo.”
5. Research Fragmentation
6. Educators teach what they know (few know masonry)
7. Designers are reluctant to use masonry structurally because of poor jobsite quality control
8. Academics who dream up new names for old ideas and make a career out of it.
9. Designers who don’t care about mason productivity.
10. Lack of financial incentive.

Why Are There So Few Innovations in Masonry?

- The Question Persists
 - 31 years later
- “It is a mature technology”
 - No room for any improvement, after so long
- Much contemporary research looks back in time
 - Understanding previous achievements
 - Jacques Heyman, for example.
- Old ideas re-introduced as “new”
 - Catalan arches, 14th century Valencia, Spain
 - Guastavino Arches, 19th Century
 - Current work at M.I.T.

What is Future of Innovation in Masonry?

- No Crystal ball
- Educated guesses
 - Informed by technology development
- BIM, Masonry
 - Expected to shape the future of design
 - Automated, semi-automated
- Governed –in part- by economics
- Masonry will win on ***price***

Future of Innovation in Masonry

- Additive Manufacturing
 - The Future
- 3D Printing
 - In its infancy
 - Not attractive, unappealing
 - Creates opportunity for masonry
- Using CMU as an element in additive manufacturing
- Deposition of mortar using 3D techniques



Future of Innovation in Masonry

- Sensitivity to Climate Change
- Create fewer GHG's
- Able to withstand severe weather events
 - Resulting from Climate Change
 - Tornadoes
 - Hurricanes
 - Drought, wildfires
- Self-healing concrete
 - biocements

Future of Innovation in Masonry

- Entirely new applications
 - Water Storage
 - Septic tanks
- Boats, Vessels, Barges
- Bridges
 - FRP rebar, rust proof
 - Infrastructure (culverts, etc.)
- Seawalls, levees
 - Flood protection



Future of Innovation in Masonry

- New Companies are setting the example:
 - Construction Robotics
 - S.A.M.
 - MULE
 - Fastbrick Robotics
 - Hadrian X
 - bioMASON
 - Biocements
 - EConcrete
 - Italcementi
 - i.light

Future of Innovation in Masonry

- Blast and Ballistic Applications
- Defense
- Hardened Structures
- Seismic
- Severe Weather Events
- Air as support for masonry
- Thermal insulation inserts



Courtesy: ProtectiFlex LLC

Future of Innovation in Masonry

- Prediction: Masonry will become central to additive manufacturing
- Economical
- Attractive
- Builds on ***what is known***
- Long Productive future for the Industry

Future of Innovation in Masonry

- Successful Innovation will occur when creative ideas exist in a balance between the *familiar* and the *new*.

Presentation on My Company's Technology

- Learn More
- Specific examples
- Innovative Technology Session

Questions?

- My information:

Peter Roberts

President, Spherical Block LLC

1718 Moland Rd., Alfred Station, NY 14803

Email: Roberts.peter01@gmail.com

Cell: (585) 466-6046

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