

Advancing Domicology for Sustainable Construction

Venkatesh Kodur

Dept. of Civil & Environmental Engineering
Michigan State University

- **Domicology**
 - Study of **policies**, **practices** and **consequences** of structural abandonment
- **Sustainable design**
 - Should include consideration of lifetime **resources** (e.g., energy, raw materials), plus handling of **construction** and **demolition** waste
- Current practice - Not much consideration for sustainability issues arising from abandonment/restoration of structures
- Abandonment – **low probability, but high consequence event**
- Why abandonment?
 - Major attacks/terrorist incidents (9-11)
 - Wars/Economic migration – (Ex. Syria (2015), Sri Lanka (1980's))
 - Catastrophic events – Earthquakes (Ex. Taiwan, Turkey), Tornadoes, Hurricanes (Ex. New Orleans, LA)
 - Accidental events – Fire, Blast (Ex. Oklahoma, OK)
 - Economic downturn (Ex. Detroit, MI)
 - **Structures are the secondary victims**
 - **Leads to abandonment of buildings/structures**



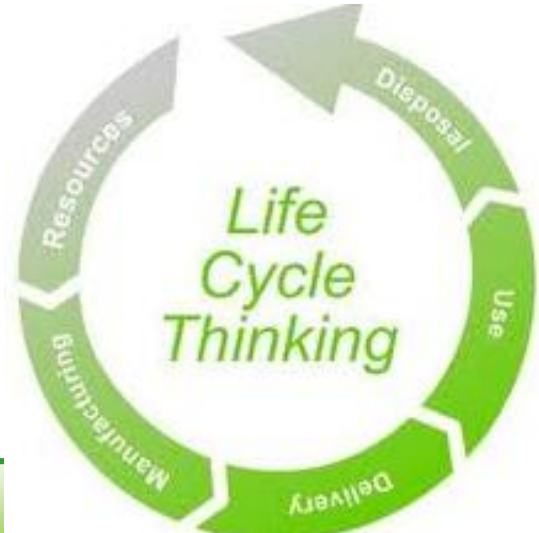
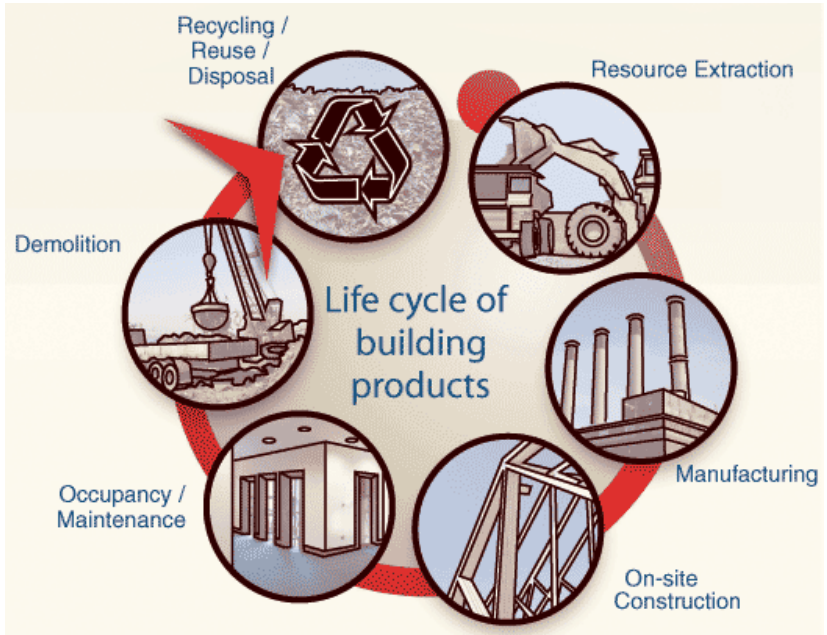
- Abandonment
 - **Current practice - Demolition of structures – the preferred solution.**

Consequences of Demolition – **Environmental, Safety, Economic**

- Waste - Land-fills
 - **25 to 40%** of the national solid waste stream is construction - related waste and only **20%** of construction waste or demolition debris (C&D) is actually **recycled (US)**
 - **40%** of landfill waste, directly attributed to building and construction (**Australia**)
 - **9/11 incidents (2 millions tons of debris in 9 months)**
- Too much resources for recycling
- Air/Water pollution from construction/demolition sites (Ex. Delhi, Beijing)
- Safety of workers, commuters during demolition
- Hazardous to health/environment
 - Asbestos, lead (ex. fire fighters health (post 9-11))
- Direct costs/time (life cycle costs) for demolition - High
- indirect costs, life cycle costs - Very high
- **Not accounted for in current design/practice**
- **Not a sustainable solution**



- Current practice – demolition is the 1st solution to abandoned structures
- **Demolition/removal should be the last resort**
- Alternative solutions
- **Refurbishing/Retrofitting** of structures possible
 - Structures can be retrofitted/refurbished for different scenarios
 - Different purposes/occupancy (ex. school to hospital)
 - Different loading conditions
- **Need to develop unique strategies/best practices for refurbishing/retrofitting abandoned structures**
 - Cost effective approaches and techniques can be viable alternative to demolition
- **Need approaches to incorporate Impact of structural demolition during initial design of project**
 - Should be part of life cycle costs`



- **Better design features/construction practices**
- Structural design
 - Should encompass techniques to deal with abandonment of structures
- **Unique solutions for different construction types/practices**
- Steel structures
 - Bolted connections vs welded connections
- Concrete structures
 - Prefabricated construction
- Masonry/wood structures
 - Standardize section sizes
- **Need best practice documents**
 - design rules & practical guidelines



- Current practice – not much research or techniques to deal with abandoned structures or process of demolition structures
- Solution – **Reusing, Refurbishing, Retrofitting & Recycling of structures, components & materials**
- Steel structures
 - Reuse of structural components
- Concrete structures
 - Recycling of materials (aggregates)
 - Dwindling of resources (ex: sand Singapore)
- Masonry
 - Recycling of materials (Bricks)
- **Need techniques and best practices documents for reuse/recycling**
- **Need machinery/tools for recycling of materials, sorting of construction waste**
 - Reuse in reconstruction, or other applications
 - Recycle for construction products
 - Recycling of materials



Need Strategies for Advancing Abandonment

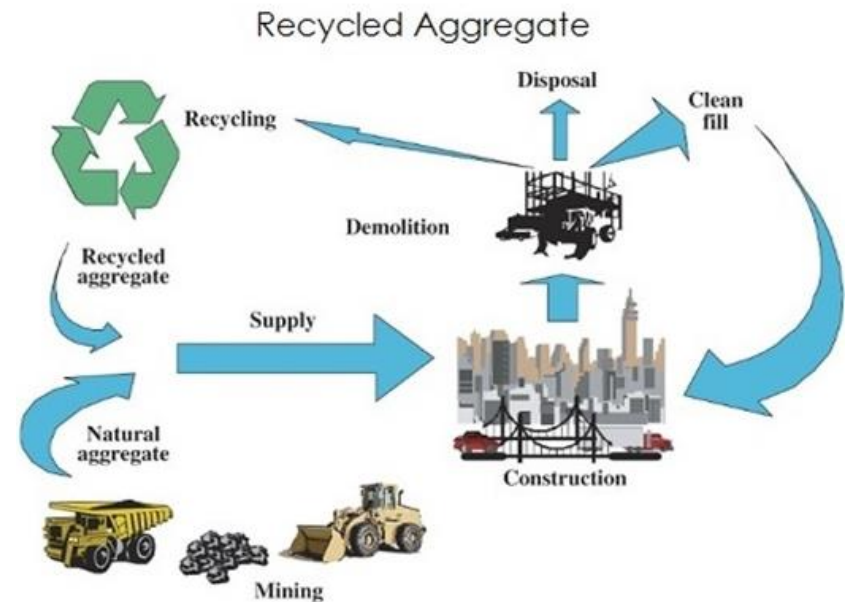
- **Advancing Domicology for Sustainable Design/Construction**
- Refurbishing/Retrofitting strategies
- Reuse of structural components
- Recycling of materials for reconstruction
- Recycling of materials for other applications
- Develop life cycle cost models
 - Impact on sustainability

R&D is the key to develop unique solutions

- **Challenges**
 1. Awareness: policy makers, public
 2. Training (policy): engineers, city/building officials
 3. Training (techniques): construction workers
 4. Funding for research
 5. Construction industry: unorganized sector

Developing solutions to abandonment is key to achieve overall sustainability

- Will have significant economic benefits



Thank You!