Senior Thesis Program
The Department of Architectural Engineering
The Pennsylvania State University
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Breadth Analysis – Structural

Ideas and suggestions for breadth analysis in Building Mechanical Systems

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Overall System Ideas

- Evaluate or redesign structural system type. Steel to Concrete etc. including impact on lateral systems.
- Alternate lateral systems.
- Refinement to structural system type. Impact of LRDF vs. ASD, non-composite to composite, change beam spacing and deck sizes
- Build up and build down concepts
- Post tension systems to improve strength, span or solve construction issues
- Design parts of all of structural system in precast concrete
- Design/evaluate building for future expansion or potential to add future expansion (usually vertical but horizontally may also be possible)
- Increase floor strength capacity in all or part of the building (for unexpected loads and overall flexibility of renting the building).

Roof Modifications

- Change roof from flat to pitched or vice versa. Include review of architectural form.
- Raise all or part of a roof area to allow clearstories to implement day lighting concepts. Redesign framing and check columns for extra height.
- Add skylights. Redesign roof framing or spacing as appropriate.
- Adding mechanical equipment of significant size or weight to a roof or penthouse. Redesign framing to take size, any roof penetrations needed, impact of snow drift etc.
- Remove or add columns or framing lines to open up floor area.
- Change roof drainage patterns. (Slope framing to get better drainage alternatively use flat framing with sloped insulation to save costs or obtain more positive drainage.

Façade Modifications

- Change façade to add windows or take out windows. Redesign wall support and backup system for wind. Review architecture impact.
- Change of wall system for architectural or energy reasons. Requires a check of the new system for loads including wind.
- Façade analysis for moisture, thermal and structural performance
- Redesign or change façade to add durability or extended life

Constructability Issues

- Erection sequence, construction loadings and intermediate stress checks for large or long span roof elements.
- Structural design of shoring, bracing, sheeting or other temporary structures necessary for construction.
- Construction issues related to renovations and modifications
- Construction issues, temporary support etc. related to historic preservation efforts or reuse of historic facades.
- Review structure for construction loads and/or compliance with new ASCE Standard on construction loadings.
- Modify framing type, connections etc. to allow an alternate framing erection sequence.

Breadth Analysis – Structural (continued)

Foundation Design or Review

- □ Sequence of foundation construction
- □ Change from shallow to deep foundation or vice versa
- □ Alternate means to deal with sinkholes or potential of sinkholes
- □ Use of a mat system in lieu of numerous large spread footings
- □ Water table problems such as bearing capacity and hydraulic pressures
- □ Design of temporary foundation or retaining walls
- □ Soil remediation

Misc. Items

- □ Design stand alone mechanical building to remove equipment from roof or because of addition of major system such as ice storage.
- □ Design underground vaults or tunnels for mechanical equipment distribution or access to outside air.
- □ You want to add a large cooling tower and put it WHERE?

Security Design

- □ Evaluate or redesign full or partial structural system to be blast resistant or blast improved
- □ Design façade to be blast resistant
- □ Redesign site access to be more secure including improving distance to potential blast events.
- □ Improve resistance to progressive collapse in case of blast or other unusual event
- □ Relocate essential and emergency mechanical equipment to a more secure location in building and redesign / check framing to carry loads.
- □ Design a safety or shelter floor for blast or fire events.