POTENTIAL TOPICS FOR ISSUE TEAM STUDIES STEEL (AND COMPOSITE) BUILDINGS

LIST OF TS6 RESEARCH TOPICS, MAY 2009

- 23 Items Presented
- Focus Areas Included:
  - Systems – (N) such as Staggered Trusses, and (E) such as OCBF and OMF, Self-centering, Fuse Based, Rocking, R=3 (composite?), Pre-fabricated
  - Materials – 65 ksi steel applications
  - Members – composite diaphragms, encased and CFT columns, Non-WF members in SMF, multi-story columns w/o lateral bracing, beam lateral bracing

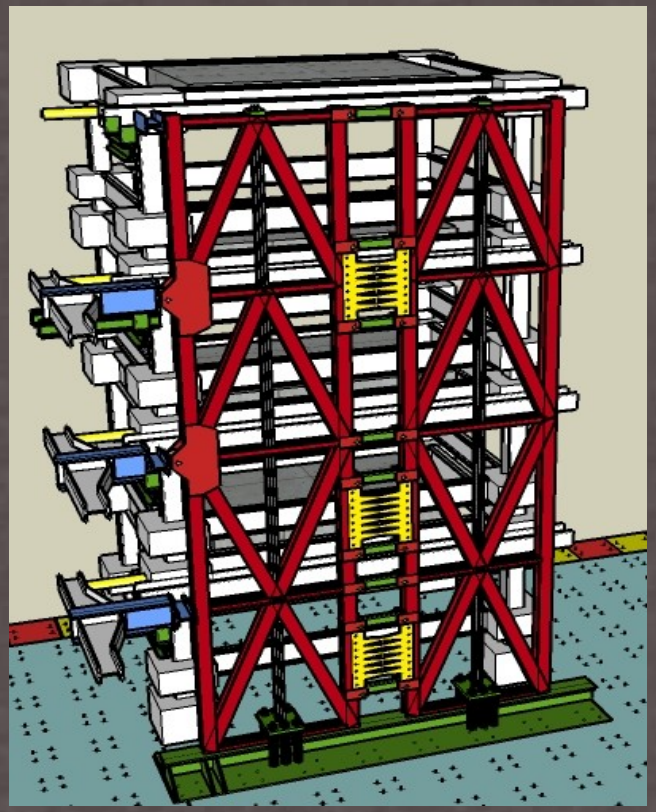
LIST OF TS6 RESEARCH TOPICS (CONT.)

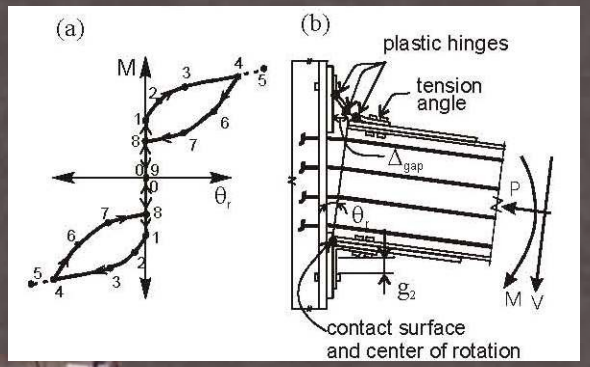
- Focus Areas (Cont.)
  - Linear Analysis – How can we improve ductility demands on deformation controlled elements and forces on force demand elements?
  - Connections – HSS details, Protected Zone disturbances, cyclic effects on steel anchors, column splice demands
  - Building Period – Impact of AISC Direct Design Method, P-Δ, etc.

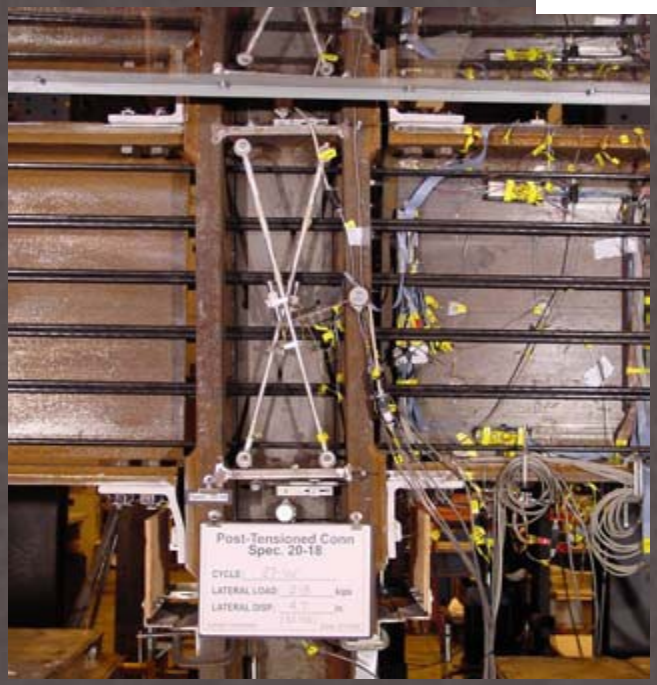
IDEA FOR POTENTIAL ISSUE TEAM – SELF CENTERING SYSTEMS

- NEES presently funding multiple research efforts
  - Lehigh and Stanford/U of Illinois, e.g.
  - Both moment frames and braced frames
- Many existing systems have some limited capacity to self-center, but it is not considered in design
  - Gravity frames with column continuity (AISC splice reqt.
  - But, may not always be present
- Does having some self-centering capacity justify modifying (increasing) R factors?
- Should residual displacements start to enter our criteria?

APPLICATIONS OF SELF CENTERING SYSTEMS





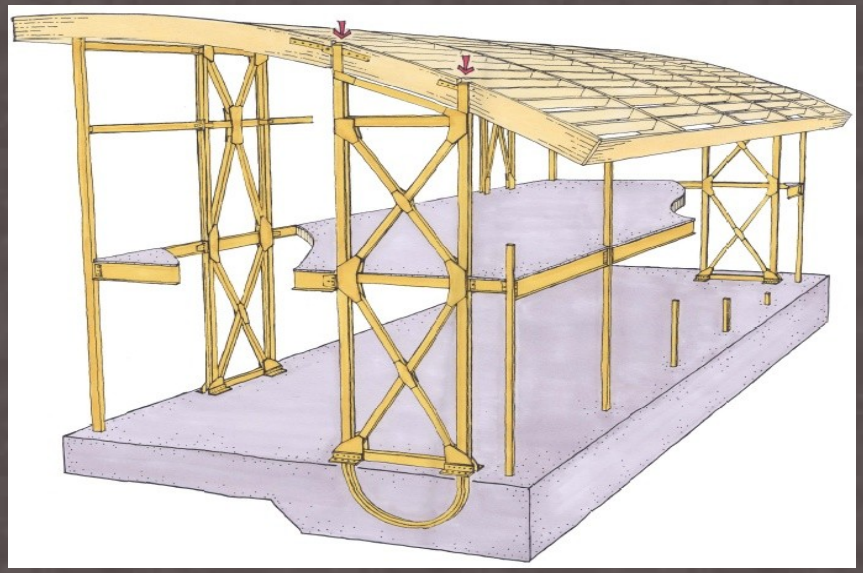


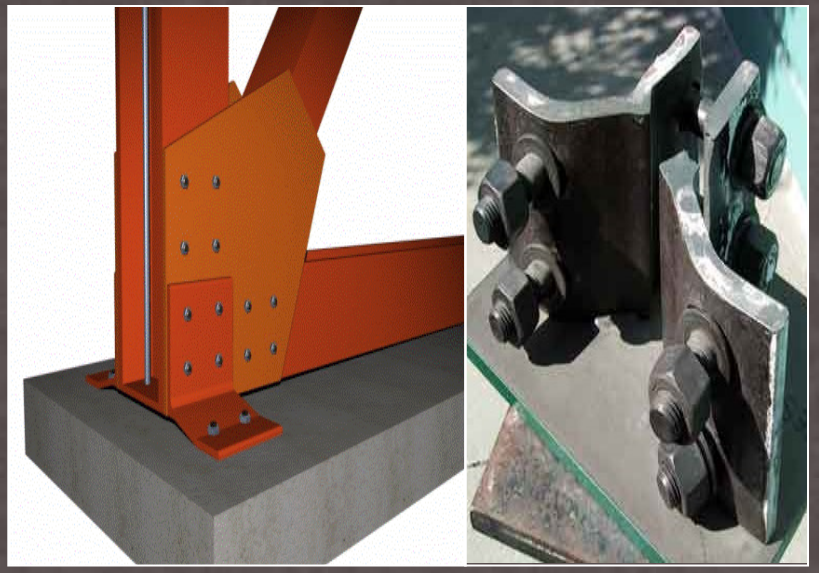
- Photos: Lehigh &
- Stanford/U IUC

IDEA FOR POTENTIAL ISSUE TEAM – ROCKING SYSTEMS

- Some applications in practice
- NEES Studies also underway (Stanford/UIUC)
- What requirements should there be for design of elements that "control" the rocking (force, deformation, cumulative ductility, etc.)?
- How should we define R for system above?
- How strict should the detailing requirements for the system above be?
- Impact on adjacent gravity systems is somewhat unique

EXAMPLE OF ROCKING FRAME APPLICATION





- Photos: Tipping Mar + Associates

IDEA FOR POTENTIAL ISSUE TEAM – REPLACEABLE FUSE SYSTEMS

- Conceptually in place with many existing systems (EBF, BRBF, e.g.)
  - A few applications have made these truly replaceable
- New elements being developed, such as slit shear walls
  - Age old question, damper or primary SLRS member?
- If truly expected to be replaced, can rest of the SLRS be given a "break" (reduced forces, detailing, e.g.)
- Would this system have more need for re-centering?

IDEA FOR POTENTIAL ISSUE TEAM – R=3…

- AISC presently funding some work by Hines, et. al.
  - Looking at Reserve Capacity Approach (akin to dual system)
- Studies to date show it's not far off, but you need to have a high fidelity model to get there (gravity system, e.g.)
  - But, certainly not all R=3 buildings are "created equal"
- Would some limited rules greatly improve the reliability?
- Extension to composite systems?

IDEA FOR POTENTIAL ISSUE TEAM – "MIX AND MATCH" SYSTEMS

- Presently, all system definitions require same level of ductility/detailing over height of building in all frames
  - Unlikely that all joints need the same level of ductility
  - May not result in optimally economical structure
- Can we define believe our analysis enough that we can use SMF, IMF and/or OMF (or BRBF, SCBF, and/or OCBF) scattered throughout frames?
  - Charney studies suggest this is viable
  - Only for NLRH analysis?

IDEA FOR POTENTIAL ISSUE TEAM – CORRELATING DUCTILITY DEMANDS WITH DETAILING REQUIREMENTS

- Present linkage between element ductility demands and detailing requirements (lateral bracing, b/t, etc.) is indirect, if not qualitative
- A more direct linkage result in more efficient construction
  - Not unique to steel
- While each material group would need to develop the details for their systems, it might be helpful for BSSC to set the ground rules for how to make this happen

IDEA FOR POTENTIAL ISSUE TEAM - CAPACITY DESIGN OF "FORCE CONTROLLED" ELEMENTS

- AISC uses the term "maximum force that can be delivered by the system" for a number of elements
  - Akin to "force controlled elements" ASCE 41
- What margins are need to ensure that the maximum force is not exceeded? How can these margins be made consistent
  - AISC study underway for steel
  - Consistent approach for all elements would be helpful

IDEA FOR POTENTIAL ISSUE TEAM – (N) SYSTEMS OR MAJOR MODIFICATIONS TO (E)

- MBMA embarking on major ATC 63 style study
  - Who will play "Solomon"?
    - Previously TS through to PUC
  - Who Now?
    - ASCE 7 Seismic?
    - BSSC Standing Panel for all systems then to PUC?
    - New Panel for each system then to PUC?
    - Someone else?

IDEA FOR POTENTIAL ISSUE TEAM – AISC DIRECT ANALYSIS METHOD, ASCE 7 P-Δ

- 2005 AISC Specification established Direct Analysis Method
  - Modifies member stiffness and prescribes minimum lateral load
- Integration with seismic analysis/design not widely published
  - Use with ASCE 7 Section 12.8.7 (P-Δ)?
    - Can 12.8.7 be improved for all systems?
  - Use with modal analysis also unclear
- AISC May approach ATC for steel

IDEA FOR POTENTIAL ISSUE TEAM – COMPOSITE SHEAR WALL, EBF AND OTHER SYSTEMS

- Present AISC approach for all composite systems has been to default to either steel or concrete provisions whenever data is lacking
  - Composite Shear Walls and EBF's are systems where the default is most widely used
  - A joint effort between the steel and concrete interests could help to make these systems more rational and efficient