SEAU *NEWS*

The Newsletter of the Structural Engineers Association of Utah

Volume IX- Issue V February 2005

This newsletter is a monthly publication of the Structural Engineers Association of Utah.

Articles or advertisements appearing herein may be submitted by anyone interested in expressing a viewpoint on structural engineering.

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Salt Lake City-County Building

IN THIS ISSUE

FEBRUARY EVENT

UTAH STATE CAPITOL BASE ISOLATION & RESTORATION

Presented by:
David Hart, Parry Brown,
& Jerod Johnson

Date:
Thursday, February 17, 2005
5:30 p.m. Social Hour
6:00 p.m. Presentation

Location:
EMCB Room 101
University of Utah

MESSAGE FROM THE BOARD

YOUR PROFESSIONAL DIRECTION

By Don Barfuss
SEAU Secretary/Historian

Who are you and where are you going? We may have heard these questions in different settings, but I would like to reflect on these concepts for this article.

If you are reading this newsletter you are affiliated with structural engineering, most likely as an engineer. You have gone to school, learned scientific principles, graduated, and now offer services to benefit the community. You may work for a small to big firm. You may be just starting out or have many years under your belt. Understanding who and where we currently are helps us to know where we want to go and how to get there.

We do not all think alike nor have the exact same goal or destination, but I think the original goals of SEAU are a common ground. They are:

1. Promote acquaintance and understanding among Structural Engineers.
2. Promote technical expertise.
3. Promote legislation and codes relating to Structural Engineering.
4. Increase public awareness of Structural Engineering.

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FOCUS

Salt Lake City and the greater Wasatch Front are growing into a major metropolitan region with many interesting buildings that define our historical, business and cultural qualities. SEAU NEWS will highlight some of our most interesting and important buildings over the next several months. (If you have particular interest in a building you would like to see highlighted in this space, please contact the Newsletter Committee). This month the focus is on:

Salt Lake City-County Building

by James S. Bailey & Edmund W. Allen
Originally issued in the September 1988 issue of Civil Engineering Magazine
Edited for SEAU NEWS by Cameron Empey

At the time the Salt Lake City and County Building was designed and built (1890-1894), earthquake engineering and susceptibility to earthquake damage were not known. Over time, however, minor earthquakes produced visible cracks in walls and over doorways, loosened stonework, caused the clock tower to sway, and set decorative statues askew. Soon the structural deficiencies of the building became significant enough to warrant concern. Several studies were undertaken to determine both the current condition of the building and the feasibility of performing a full-scale rehabilitation. The studies concluded that under non-seismic conditions the building was safe but, if an earthquake were to occur, the potential for significant damage and loss of life was too great of a risk. A design was then developed to retrofit this historic structure at an estimated cost of $30 million.

The primary challenge facing the design team was to refine the initial study and explore ways of reducing the anticipated cost of seismic retrofit. Three approaches were considered: UBC, ABK, and Base Isolation. While not the least expensive solution, base isolation provided the best value by allowing the architectural fabric of the building to remain intact yet still kept costs within reason. In addition to cost effectiveness, structural integrity of the isolated structure was greatly enhanced. Expected building accelerations were reduced by about 85% thus reducing the required modifications to the existing structure. Lowering the building accelerations also significantly reduced the amount of damage expected in the sensitive non-structural elements of the building.

The key elements in the base isolation scheme are the 447 specially designed isolators installed between the structure and its foundation. The isolators consist of alternating layers of bonded metal and rubber. They are vertically stiff to transfer gravity loads but laterally flexible to allow horizontal movement. The isolators under the exterior walls are fitted with lead cores to provide inelastic viscous damping to dissipate energy during a seismic event.

A concrete structural system was added to transfer the loads from the building to the isolators. This load-transfer system consists of concrete beams and a steel grillage. The main elements of the system are described below:

- Concrete side beams cast on either side of all masonry walls, and set 4 in. into each wall, support the masonry between isolators. Post-tensioning rods, drilled through the beams and walls, are stressed to clamp the masonry material tightly between the new beams.
- Concrete cross beams cast on top of the isolators connect paired side beams, and act as double cantilevers in transferring the wall load from the

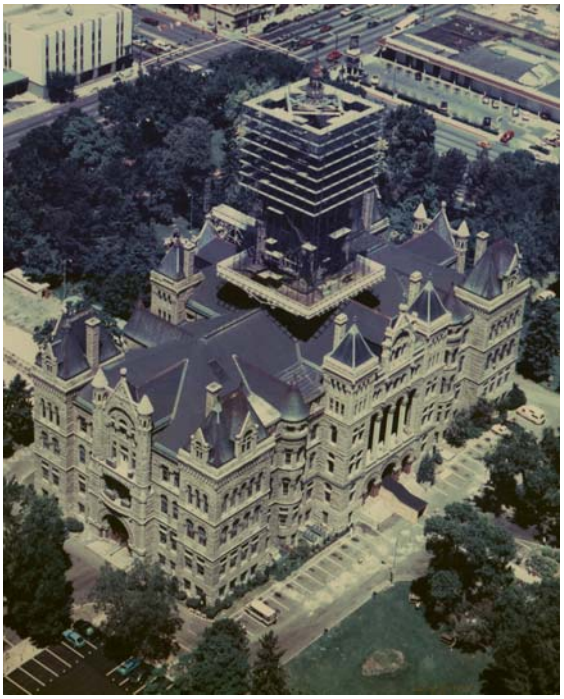
side beams onto the isolators. At isolator locations, masonry wall material is removed to accommodate isolator and cross beam height.

- A steel grillage installed beneath the isolators distributes the vertical loads evenly from isolators to the existing footing. Small wide-flange beams are welded together to form the grillage system.
- A concrete floor cast above the load-transfer grid acts as a rigid diaphragm connecting all side beams and linking all the isolators so they act in unison as a system.

For the isolators to work properly, the structure had to be isolated from the adjacent ground. A 12" moat was constructed around the building to give the building space to move. Computer analysis indicated that the maximum horizontal deflection of the building is about 5 in. 12" was used to provide a factor of safety. A bumper restraint was also used in the event expected deflections are exceeded.

In addition to isolation system, the building and tower were strengthened by the following methods:

- Erecting a Steel frame structure to brace the clock tower.
- Adding a plywood diaphragm above the 5th floor in the attic.
- Adding plywood shear walls in the attic.
- Anchoring exterior masonry walls to the floor and attic diaphragms.
- Anchoring diaphragms to interior masonry walls for shear and to provide a tension tie through the walls.
- Adding a reinforced, lightweight concrete topping on existing floor diaphragms to increase their stiffness and strength.
- Anchoring all exterior seismic hazards, such as chimneys, statues, dormers, balustrades, parapets and cornices.



The base isolator approach to seismic protection offers the possibility of preserving as much of a building's original architectural fabric as possible, while at the same time providing a greater degree of protection from nonstructural earthquake damage than conventional strengthening methods. While not the best solution for every building, base isolation proved to be very effective in mitigating much of the seismic risk to the Salt Lake City and County Building. The Salt Lake City and County Building is believed to be the first historic structure in the world to be retrofitted against possible seismic damage using base isolation.

MESSAGE FROM THE BOARD (continued from Page 1)

5. Discourage unethical and detrimental practice.
6. Promote high standards of Structural Engineering in the best interests of clients, community, public and the profession.

Past articles in this newsletter encouraged us: (Jan.) to make goals to improve ourselves, to build our own character, (Nov.) to be aware of industry trends, to appreciate mentors and others who help us look at engineering as more than a business/job, (Oct.) to learn and be more ethical, to remember we serve the public, (Sept.) to be people who make a difference. These are all worthy goals, and I encourage all to strive for them. It is easy to get caught up in the deadline-to-deadline routine and lose sight of where we want to go.

Although I dare say I could not put a majority of your names with your faces, I have appreciated the opportunity to work with you on committees, hear your questions and comments at seminars, and learn technical and non-technical concepts directly from you. All of this has made me a better engineer and a better person. Ron Dunn shared a concept from a book he was reading, and I am sure I am oversimplifying it: A lot of "average" people will have a better solution to a problem than one "brilliant" person. The message to me is that we are better off together sharing our ideas, thoughts, concerns, and examples. If a lot of "average" people are better than one "brilliant", just think what a lot of highly motivated engineers can do with common goals?

ON ETHICS by DEBORAH LONG

Red Flags of an Ethical Dilemma

If individuals reach adulthood without suffering major psychological traumas, such as child abuse, they are usually capable of determining right from wrong. Many moral problems we face require us to be able to make that determination. Most of the time, adults know right from wrong, but they may be unwilling to pay the price for doing the right thing. When we knowingly choose the wrong thing, we have succumbed to ethical temptation.

Facing ethical temptations is not the same as facing ethical dilemmas. We know it is wrong to lie; we know it is wrong to steal; we know it is wrong to cheat. Thus, it is not really a dilemma when we consider choosing wrong over right. It is merely an ethical temptation. For example, falsifying an annual report to make the company appear in good financial health is an ethical temptation. As long an individual knows that this act is wrong, then this problem is not really a dilemma.

However, choosing between two rights is a compelling ethical predicament – for example choosing between telling the truth and maintaining loyalty to a friend. Truth and loyalty are both virtues: what do you do when your friend asks you to lie, perhaps to save his marriage or his job? Choosing between the individual's needs and a community's needs or choosing between justice and mercy are two more illustrations of true ethical dilemmas. Choosing between two or more positive values requires more than ethical competence; it also requires sound ethical decision making skills.

Developing mature decision making skills involves recognizing problems when they occur. How can you tell when you are facing issues that have an ethical dimension to them? The following guidelines may help:

1. Frequent use of words such as right or wrong; conflict of interest; bottom line; ethics; and values.
2. Desire to call the state regulatory agency or professional hotline.
3. Making lists of advantages and disadvantages of an action.
4. Feeling torn between two or more values, goals, or parties.
5. Wondering how the outcome of this problem would look in the newspaper headlines.
6. Loss of sleep.
7. Use of expressions such as:
   "Well, maybe just this once..."
   "Let's keep this under our hats..."
   "We'd better look the other way..."
   "No one will ever know..."
   "Whew, we certainly dodged that bullet..."
   "Don't tell me. I don't want to know."
   "I have this friend..."
   "No one's going to get hurt..."
   "Everybody does it..."
   "They had it coming..."
   "They'll never miss it...."
   "What's in it for me?"

These red flags advise of impending ethical challenges. Rushworth Kidder, author of How Good People Make Tough Choices, suggests that ethical dilemmas, rather than temptations, will challenge us more frequently and profoundly in the near future as our society becomes increasingly diverse and complex. He cites the ethical dimensions of technological advancements such as cloning and nuclear power to make his case.

Thus, in addition to being able to recognize ethical temptations, adults will also be called upon to be able to determine "Which is the greater good?" It is a challenge to those in positions of influence to help others navigate through the difficult moral terrain which we will face in the next decade and beyond.

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STRUCTURAL ENGINEERS PRACTICE ACT

Structural Engineers Practice Act

by Kelly Calder

On November 13, 2004 the Structural Engineering Institute (SEI) sponsored a national workshop, the third in a series, to further develop a strategy for separate SE licensing. SEI strongly supports separate licensing of structural engineers in the form of a practice act and has committed to support and encourage activities to achieve this goal nationwide.

The previous SEI workshops explored strategies for ultimately achieving a uniform SE practice act for all US jurisdictions. After long debates it was concluded that while a nationwide adoption of a

licensing law is preferred it is a goal that would be very impractical to achieve given the opposition that would surely ensue from powerful special interest groups. They concluded the most viable plan for promoting and achieving separate SE licensing is to tackle the job on a state by state basis.

Utah is one of 10 states that currently have a title act. A title act simply creates the title of Structural Engineer but does not define what can or cannot be designed by a licensee. California by the way has what they call a Title Authority, but it is nevertheless a title act and not a practice act. Restrictions on the practice of structural engineering in California were achieved by administrative law. For example, all public schools and hospitals where the construction must be administered through the Division of the State Architect must be designed by an SE.

There are very few states that have a practice act or other law or statute that restricts the practice of structural engineering. That group currently includes Illinois, Oregon, Nevada, and Hawaii. It is interesting to note the range of restrictions currently enforced in these jurisdictions. Oregon requires an SE for the design of "significant structures" generally meaning the primary frame of structures. Nevada requires an SE for a building more than three stories in height or more than 45 feet from the bottom of the lowest footing. Hawaii on the other hand requires an SE for the design of just about every structure with a few exceptions. For instance, an SE is not required in Hawaii for a personal residence where the estimated cost does not exceed $50,000 (presumably one room bamboo huts are okay).

The Structural Engineering Institute is promoting the idea of selecting a particular state to be the front runner in their effort toward national licensure. They are hoping to select a state with the best prospects for success and assist that effort financially. Many factors enter into the equation and they were discussed in depth at the workshop. Utah has many of the favorable aspects and we are currently investigating the viability of Utah being the selected state.

In the meantime we have a number of avenues we can pursue to prepare the groundwork for a possible practice act in Utah or some other means of defining cases where the services of an SE should be required. It was noted during the workshop that major changes in engineering practice occur in the aftermath of a major catastrophe. One favored approach is to prepare the wording of the law for a practice act now so that should the opportunity arise, for instance after an event of some type, we are one step ahead and ready to press the issue.

Another avenue to pursue is to target institutions and other users of structural engineering services to both inform them of the SE title and to encourage these institutions to specify SE requirements for certain structures. Structures that were targeted by workshop discussions include essential facilities, public educational facilities, buildings used for assembly use, seismic upgrades, and structures over three stories in height.

While the issue of restricting the practice of structural engineering for certain types of structures is controversial amongst various engineering groups, the structural engineering organizations and societies are generally strong proponents. The Structural Licensing Committee is supportive of the goals and ideas that were promoted at the workshop and is developing a strategy for pursuing these goals to present to the SEAU Board for further action.

PRESIDENT'S MESSAGE

Are You Sure You Are Insured?

Seems like a silly question. You pay your premium and you're insured – that's all there is to it, right? Wrong! Insurance contracts are based somewhat on the principal of good faith. The insurer assumes that the insured will get reasonable fees, which the insurer takes a percentage of to cover their risk. If the insured does not get reasonable fees for the projects they undertake, then it is possible that they are not insured because they have acted in bad faith. As a ludicrous example, consider an engineer who takes a fee of $1000.00 to design a building worth $10,000,000. The engineer's insurer could claim the engineer acted in bad faith and void the policy, leaving the engineer and his/her firm open to liability.

Why do I bring this up? A number of reasons - see if you recognize any of them. First, "This one is just like the last one, so your fee should be a lot less". Second, "After the second level all the other levels have the same framing so there really isn't that much additional work to do and therefore your fee should be less". Third, "We want you to design the first one but since you're not doing any additional work for the others, you should do it for a lower fee".

Regardless of how it is requested, taking the action to reduce your fee for repeat or repetitive types of projects may leave you unintentionally holding the "liability bag".

Barry Arnold, SEAU President

BULLETIN BOARD

BULLETIN BOARD SPECIAL FEATURE

This month SEAU would like to feature:

DEEP COLUMNS IN SPECIAL STEEL MOMENT FRAMES

by Dorian Adams

"Why are those columns so huge!" screams your best client after opening your 65% review set of drawings for his new 6 story moment frame office building. Your life flashes before your eyes – at least the last two weeks of hard work delicately balancing drift requirements with steel weight. You try to explain that using deep columns would have saved thousands but current design procedures don't allow it. But your client doesn't understand because he remembers that job in 1998 that had W24 columns half the weight of those monster W14's jumping out at him in your drawings on his desk.

Similar experiences have frustrated even the most experienced structural engineers since FEMA 350 forbade using columns deeper than W14's in Special Steel Moment Frames (SMF). We find ourselves convincing clients and owners that floor plan flexibility must be sacrificed if economy is a priority. Architecturally stubborn Concentric Braced Frames are recommended instead of SMF systems creating their own set of challenges. We long for the days of deep moment frame columns.

It appears that the evolution of SMF design may come full circle very soon, at least for column sizes. The November 22, 2004 draft of ANSI/AISC 341-05, *Seismic Provisions for Structural Steel Buildings* contains language that will make it easier to specify columns deeper than W14 in SMF structures. Specifically, Part 1 section 9.2b requires that SMF connections must conform to one of the following:

a. Use of SMF connections designed in accordance with ANSI/AISC 358.
b. Use of a connection pre-qualified for SMF in accordance with Appendix P.
c. Provision of qualifying cyclic test results in accordance with appendix S. This includes tests reported in the literature, documented tests performed for other projects, or project specific testing.

The latter two options are no change from the 2002 AISC Seismic Provisions. However, the first option via the draft AISC publication, ANSI/AISC 358, "Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications", provides the ammunition we have been waiting for to specify up to W36 columns without project specific testing. What's the catch? Reduced Beam Section (RBS) is the only connection that is pre-qualified for SMF in ANSI/AISC 358. Bolted Stiffened and Unstiffened End Plate connections are prequalified for use with columns up to the beam depth in Intermediate Moment Frames and Special Moment Frames without concrete slabs. No other connection is mentioned.

So are RBS moment frames so much better than all the others? The industry believes that testing is the best way to answer that question.

Our friends at AISC recently advertised the RBS testing at Lehigh University as reported in ATLSS Report No. 04-13; *Development of Seismic Guidelines for Deep Column Steel Moment Connections*; J. Ricles, X. Zhang, L. Wu, J. Fischer; June 2004. The paper reports that testing was performed specifically to investigate the effect of floor slabs on the performance of RBS connections with deep columns. One main goal of the study was to "examine whether RBS connections to a deep column can be qualified for seismic use in accordance with the standards in Appendix S of the 2002 AISC Seismic Provisions." The testing demonstrated that 6 of 6 specimens with deep columns "were found to have exceptional ductility and good performance to 4% story drift or beyond". Additional positive conclusions are noted in the report and repeated below:

- The requirements of Appendix S of the 2002 AISC Seismic Provisions were met.
- RBS connections with a floor slab or a supplemental lateral brace will perform adequately provided weak beam strong column is satisfied.
- The only special consideration for RBS connections with deep columns and a floor slab is checking the column for torsional stresses.
- The current RBS design procedure overestimates the torsional warping stresses in the column when a floor slab is present.

Structural engineers should be able to take advantage of this research and resulting code changes very soon. The 2005 AISC Seismic Provisions just completed the third round of public review and is expected to be published later this year. ANSI/AISC 358, "Development of Seismic Guidelines for Deep Column Steel Moment Connections", December 24, 2004 is expected to follow.

The above mentioned documents can be obtained through AISC's website.

SEAU MEMBERSHIP APPLICANTS

The following individual has submitted an application for approval by the SEAU membership committee for new members:

Nathan Kelley – Associate

CLASSIFIEDS

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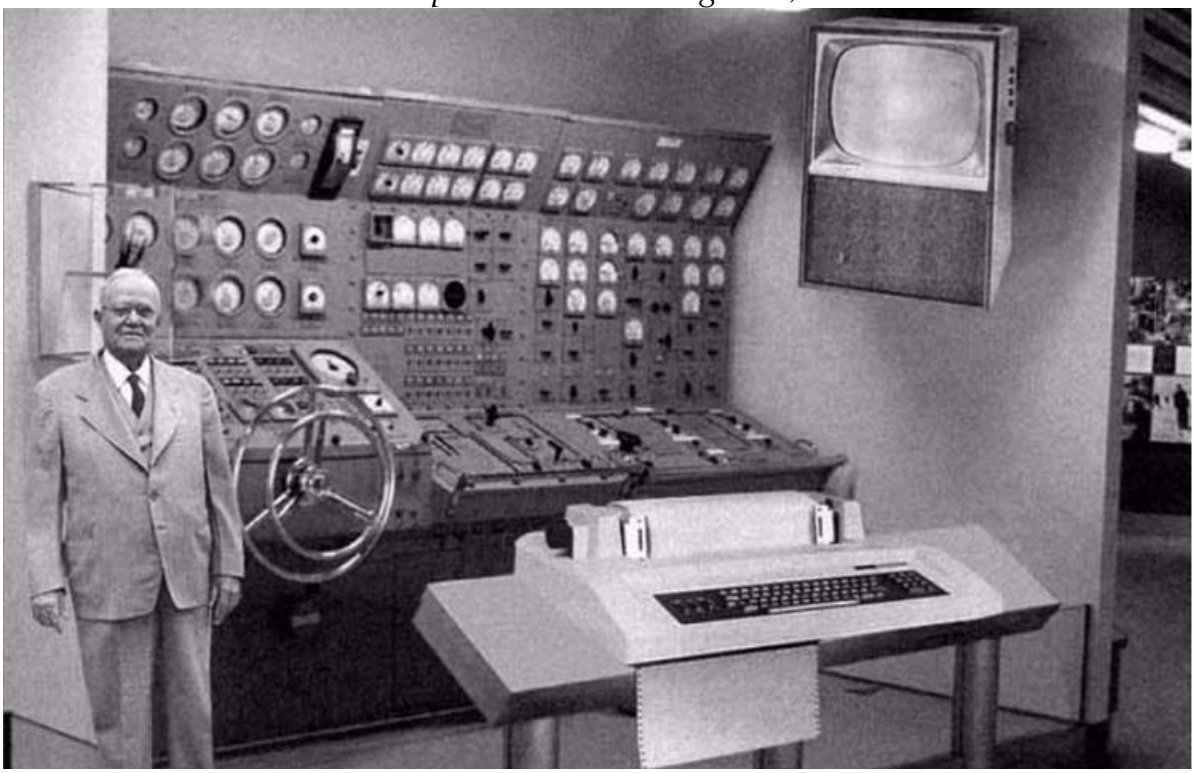
From *Popular Mechanics* Magazine, 1954



Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 50 years from now scientific progress is expected to solve these problems. With the teletype interface and the Fortran language, the computer will be easy to use.

SEAU Presents:

UTAH STATE CAPITOL BASE ISOLATION & RESTORATION

Presented by:
David Hart, Parry Brown, & Jerod Johnson

February 17, 2005
University of Utah
EMCB Room 101

5:30 p.m. Social Hour
6:00 p.m. Presentation

Presentation Topics include architectural challenges, modeling issues, load transfer concepts, securing historic ornamentation, and others.
A field trip to see isolator installation and a tour of the construction site is scheduled for sometime this summer. Watch for an announcement from SEAU in the near future.

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