SEAU *NEWS*

The Newsletter of the Structural Engineers Association of Utah

Volume VI- Issue VI March 2002

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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The Gateway Project – structural steel fabricated and erected by SME Steel.

IN THIS ISSUE

MARCH EVENT

SEMINAR:
Steel Connections: Seismic Applications Using FEMA 350 & 353 Guidelines, AISC & AWS Specifications

Thursday March 21, 2002
8:00 a.m. – 4:30 p.m.
Presented by:
Robert E. Shaw Jr., P.E.
Location:
Salt Lake International Holiday Inn
Cost:
$125.00 - SEAU Members
(This meeting is a change from the announcement in the February issue of SEAU *News*.)

MESSAGE FROM THE BOARD

MORE THAN A MERIT BADGE

By Wm. Chris Barker,
SEAU Secretary/Treasurer

I recently learned that I am the merit badge counselor for Engineering Merit Badge for the Boys Scouts in the area in which I live. This was a big surprise to me since hardly anyone in the area in which I live knows that I am a Structural Engineer. It probably has something to do with a rumor I may have started; something to do with me being a spy for another country. Anyway, my introduction to these boy scouts was very interesting. They showed up at my doorstep with their leaders a few weeks ago to get started on the work they needed to do to earn the merit badge. One of their requirements was that they talk with an engineer and have the engineer tell them about the work that he does. As I opened the door, the mouth of one of the boys dropped down to his feet while another, with bulging wide eyes, shouted, "Run, it's the spy guy!" Fortunately, the leaders were able to grab them before they got very far and to drag them into my home. This was quickly becoming an opportunity to dispel some nasty rumors and to let them know more about structural engineering.

It must have been an ambush that the leaders set for the boys. We all sat down at the kitchen table and we all introduced ourselves. As I

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MEMBER FORUM

FOCUS

Utah Structural Engineers provide a significant contribution to a wide variety of projects for commercial, government, industrial, and residential clients. Each month, SEAU would like to focus attention on the accomplishments, successes, and hard work of our Utah Structural Engineering firms. This month the focus is on:

Thomas Engineering Company

Thomas Engineering Company (TEC) was founded in Oct 1991 and is a woman owned business. TEC experience includes structural design for highway and pedestrian bridges, petrochemical, process, mining and power generation facilities, as well as airports, commercial buildings and liquid storage tanks. TEC's primary focus is the industrial market.

TEC has provided structural services in over thirty different states throughout the United States as well as in the countries of China, Guam, Mexico, Bolivia, Argentina and Saudi Arabia.

Recent projects include the following:

- MSCC Structure at Flying J, Inc.'s Refinery in North Salt Lake, UT

TEC provided structural consulting services to Flying J for the design and fabrication of the MSCC structure. This structure surrounds a new Catalytic Cracker which is currently being installed at the refinery and should be in operation in Apr 2002.

The structure is approximately 200 feet tall and has sixteen different platform levels. These platform levels contain equipment, valves and various instrumentation as well as provide maintenance access.

- TCC Gas Plant at Flying J, Inc.'s Refinery in North Salt Lake, UT

TEC provided structural design services to Flying J for the TCC Gas Plant expansion which is currently in construction and is scheduled to be completed in Mar 2002. Design services were for multi-level pipe racks, pipe support foundations and equipment foundations for both vertical and horizontal vessels.

- Green Springs Mass in Washington, UT

TEC was responsible for all of the design scope of work services associated with this mall complex which consists of a new Albertson's Store and 30,000 square feet of additional retail space. The structures have masonry exterior walls with open web roof joists supported by interior steel columns. Floors were concrete slab-on-grade.

- Hurst Retail Center in Washington, UT

TEC was responsible for all of the design scope of work services associated with this 30,000 square-foot retail center.

This structure has masonry exterior walls with open web roof joists, supported by interior steel columns on individual spread footings. The main floor level is a concrete slab-on-grade. The upper level/Administration area is metal stud walls with timber joists supported by metal stud bearing walls.

- Bountiful City Light and Power Generating Facility - Phase 1

TEC was responsible for all of the design scope of work associated with this power generating facility. This facility includes a new masonry generating building which houses a gas turbine, switch gear, Motor Control Center, as well as ancillary equipment associated with electrical, fire suppression, etc.

This project was constructed in approximately eleven weeks. Change Orders amounted to approximately one-half of one percent. All Change Orders were Owner requested.

Phase 2 of this project is anticipated to consist of an additional gas turbine placed in a new addition that would be constructed along the north side of the current building (the current generating building was designed to have the north wall removed for Phase 2 expansion).

Phase 3 of this project is anticipated to consist of the waste heat recovery for the two gas turbines and the installation of a steam condensing turbine along with associated ancillary equipment.

MESSAGE FROM THE BOARD (continued from page 1)

introduced myself as a Structural Engineer and that we would first review the requirements for the Engineering Merit Badge one of the boys, with bulging eyes, shouted, "Run, it's the spy guy!" This group of boys was not looking forward to working on the Engineering Merit Badge or earning it. It was clear that they thought engineers were smart idiots. Thinking fast, something an engineer gets used to doing, I changed strategies. I put a full set of contract drawings on the table and turned to an architectural floor plan. I noticed a lot of eyes rolling in their heads with that silent gesture stating their displeasure. Then something happened. As I explained what an architect does (in my dreams anyway), first one and then another scout started listening. By the time I got to the structural plans, they were all leaning forward listening intently and having a good time. The questions started flying. "Is it hard?" "Have you done a big building?" "Do you get paid?" "Are you really a spy?" I was having a good time too. It was fun telling them about my profession, about my trade. It was fun telling them how much responsibility we have and how important our profession is to society. I couldn't resist telling them that the consequence of a poorly designed structure could lead to the deaths of our friends and neighbors. By the time they left, they all wanted to become engineers instead of firemen.

By the time we met again, they had already forgotten how "cool" engineers are. It was time to think fast again. We went to Lowes, which is always a good place to take a bunch of guys, and we did some work on the electrical engineering requirements. This involved using a calculator to determining how much "juice" the different appliances use in a year and how much it would cost to run those appliances. When we were done, they again seemed to be excited about engineering. It didn't even bother me that they wanted to be electrical engineers. They were figuring that electrical engineering would be easier than structural engineering.

We do have some work to do to improve the perception that folks have of us. Perhaps it is true that engineers are a little eccentric but I don't believe so. I do believe, as Richard Weingardt editorialized in a recent magazine, that we need to be more involved in our neighborhoods and in our communities. I can assure you that I am not a very good example of that belief. Maybe we are shy about letting people know what we do because we perceive that much is expected of us. Maybe we are shy because of some of the dumb things we've done. It is okay to have done dumb things. It is not okay to have done dumb things deliberately. Everything that we do individually reflects on us all collectively. If we don't provide a good set of structural plans or if we do not act responsibly and professionally, that lowers the expectations, and respect, that our clients have for our profession. Enough of that preaching.

This has been a good year with many significant changes to codes and construction techniques. This is good. It keeps us from getting "stale". I am looking forward to continuing my career as a structural engineer alongside of you. There are roughly 200 members of us registered with SEAU. Although that is not very many of us, we do have a huge impact on society – including boy scouts.

REPORT ON THE BSSC ANNUAL MEETING

By A. Parry Brown, SEAU delegate to the BSSC.

I would like to report on the Building Seismic Safety Council (BSSC) annual meeting, January 22 - 24 in Charleston, South Carolina.

The BSSC is comprised primarily of structural engineers and geologists from across the country and is responsible for developing and maintaining the "NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures", FEMA 368, also referred to as the *Provisions,* and *Commentary*, FEMA 369. The *Provisions* are used to formulate seismic code requirements for the IBC, NFPA, ASCE and other codes. The *Commentary* is a great resource for seismic design issues providing a wealth of information and explanations for the seismic design code requirements.

The BSSC is federally funded with officers and committee chairmen committed to three-year cycles. A new version of the NEHRP *Provisions* is published at the end of each cycle and allows a three-year review and verification period before being incorporated into the building codes. The IBC 2000 uses the 1997 version of NEHRP *Provisions* with only minor revisions required to resolve formatting issues. Seismic requirements of future NFPA and ASCE 7 codes will also be based on the NEHRP *Provisions*.

The structural engineers associations from each state can participate by selecting one delegate (Parry Brown) and one alternate (Dave Pierson) to the BSSC. Through representation of the delegate, SEAU can propose revisions, suggest changes to proposals made by others and vote whether to accept or reject proposed revisions. The BSSC is an important organization where SEAU can have a real impact on the development of the seismic design requirements in our building codes. The 2003 cycle is just starting its second year. Although SEAU has a committee to review and analyze proposed revisions, Dave Pierson

and I have mostly divided the stack of proposals by chapters and waded through them due to time constraints.

The seismic design forces of the NEHRP *Provisions* and the IBC 2000 code are based on accelerations obtained from the Mapped 0.2 and 1.0 Second MCE Seismic Response values adjusted for site soil conditions by multiplying by appropriate Fa and Fv factors. These values are then reduced by 2/3 and divided by R (value as high as 8) to get to a strength level design force. Strength level design forces can be reduced again by dividing by 1.4 to produce ASD design forces. ASD design level accelerations are less than one-sixteenth of the mapped MCE accelerations for a SMF system. On top of that, the allowable stresses of the ASD procedure may be increased by 33%. How can this be possible?

We all know that the structures we design in high seismic areas of Utah are expected to exceed specified yield stresses during a large magnitude seismic event. We also know that we rely on ductility in our structures to dissipate seismic energy to keep our carefully designed structures from falling down. The greater the ductility of the structural system is, the lower the required design level force (higher R).

But how are the R, Omega, and Cd factors determined and who decides what values to use? The members of the BSSC decide the values for R and Omega for each system and publish them in the NEHRP *Provisions*. The directors for each building code can accept these values directly or modify them as they see fit. The current IBC 2000 has incorporated the R and Omega factors from the 1997 *Provisions* without change.

Are the R, Omega, and Cd factors based on rational scientific analyses and extensive testing, or have they simply evolved from previous code values that just seem to work some how? The truth is somewhere in-between, probably closer to the latter. It is my understanding that there has never been a systematic, analytical study to determine what these values should really be and very little testing has actually been performed on some systems such as concentric braced frames. One of the primary goals of the 2003 BSSC will be to undertake such a study and make recommendations to update these design factors.

There are currently 73 different seismic force resisting systems and combinations listed in the IBC 2000. Each system has its own set of R, Omega, and Cd factors, as well as, limitations on height and seismic design categories. An effort will be made to simplify the code by reducing the number of seismic systems and possibly eliminating the height restrictions. The rationale is that if the R, Omega, and Cd values truly represent the performance of the structural system, then height limitations are unnecessary. We may also see limited ductility systems such as un-reinforced masonry and concrete allowed in high seismic areas with R and Omega equal to 1. We will probably see significant changes in some of these values in the 2006 codes.

Another major, on-going effort is to completely reformat the *Provisions* to make it more consistent and seem less complicated. This task is a major undertaking and has been in progress for over a year. Preliminary ballot versions seem to be making good progress.

The evolution of our seismic design codes is in a cycle of rapid and substantial change based on a rapidly growing knowledge of geo-seismology, improved analysis methods and faster computers. With these new tools, we are able to more accurately predict the performance of various structural systems during seismic events. Seismic design codes will eventually stabilize to a point where changes are relatively minor from code edition to code edition and the BSSC will no longer be needed; but probably not in my lifetime or yours.

STANDARD PRACTICE GUIDELINES PRELIMINARY OUTLINE

The following is a Preliminary outline of the Standard Practice Guidelines for Structural Plans & Calculations which was prepared by the PP&E committee. This document will help establish an acceptable level of practice for submitting structural plans and calculations. It is also intended to provide the Building Official with "ammunition" in determining and reporting substandard practice. This document will be discussed at the March meeting and the PP&E Committee encourages any comments or suggestions by the membership prior to finalizing and distributing to the building departments.

STANDARD PRACTICE GUIDELINES FOR STRUCTURAL PLANS & CALCULATIONS

I. Introduction

a) The Standard Practice Guidelines contained in this outline were prepared by The Structural Engineers Association of Utah, (SEAU). These Guidelines are intended for use as a reference for design professionals, plan check reviewers, and building officials for the submittal and review of structural plans and calculations for permit.

b) The provisions set forth below document what SEAU as a professional organization considers a minimum standard of care for the Profession, as it relates to Structural Engineering of projects, (primarily commercial projects).

c) As a general requirement, the Design Professional shall be:
- Familiar with the current laws and governing professional requirements necessary to provide Professional Engineering services in the State of Utah.
- Competent in the understanding of the proposed design for which the design professional's stamp and signature is affixed.

d) It is SEAU's position that structural plan reviews must be performed on all commercial and large residential projects prior to issuing a building permit. A thorough review should be performed by an ICBO certified plans examiner or by a Licensed Professional Engineer employed or subcontracted by the local municipality.. General Submittal RequirementsStructural Drawings and Calculations must be submitted with the Structural Engineer of Record's wet stamp seal affixed to the cover sheet of the calculations and on each structural drawing.

II. General Submittal Requirements

a) Only those documents, which are complete, shall be stamped and submitted for approval. Partially complete placeholder sets shall not be accepted.

b) A complete set of calculations must accompany "Footing & Foundation Permit" submittals. Major changes to the Footing & Foundation packages if noted in subsequent package submittals shall require additional plan check review.

c) When manufacturer designed structures such as metal buildings are included in the project, complete structural calculations and drawings must be submitted with the project documents and must bear the seal of the Responsible Engineer, registered in Utah.

d) Deferred submittals must also be clearly defined on the documents submitted for permit review.

e) As a minimum 2 sets of calculations and drawings should be submitted (or more depending on the jurisdiction). Soils report and project Specifications are also advised.

III. Minimum Structural Design/Calculation Requirements

a) Design criteria should be clearly stated on the cover sheet and should include at least the following:
1. The current Building Code used in design.
2. Dead & live loads used in design.
3. Seismic design criteria.
4. Wind loading criteria.
5. Reference to the Geotechnical Report and values used in design.

b) Gravity design should include the following:
1. Design of major load carrying structural elements shall be addressed. This design should document the location, tributary area, span, loading, and controlling condition for each member designed.
2. Calculations should note the final member size used and as shown on plan.
3. Calculations for design of critical connections.

c) Lateral design should include the following:
1. Documented seismic design category, design coefficients, and factors used in determining seismic base shear.
2. Documented wind speed, exposure, and other factors used in determining overall wind load.
3. Comparison between wind load vs. seismic load for controlling design.
4. Clearly define the type of lateral force resisting system used and which elements are part of the system.
5. Computer analysis and design results should be submitted with input criteria showing geometry, loading, boundary conditions, etc.
6. Design of secondary elements such as, diaphragms, collectors, drag struts, out-of-plane anchorage, and connection design.
7. Code compliance for specific provisions should be documented.

d) Footing/Foundation design should include:
1. Clearly documented loading conditions and locations.
2. Affects of lateral loading in the design such as uplift, overturning, and shear.
3. A formal Geotechnical Report is strongly advised for all commercial projects.
4. If compacted fill or other specific placement criteria is required, these conditions should be noted in the calculations and plans.
5. Field verification of assumed bearing pressure is acceptable for small projects. However, the field report should be submitted to the building department (similar to a deferred submittal).

IV. Minimum Structural Drawing Requirements

a) Structural Notes should be included and document the following:
1. Loading and other basic design criteria.
2. Material allowable stresses.
3. Special inspection requirements.
4. Deferred submittal information.
5. General structural requirements.

b) Structural Plans should include:

1. Complete structural layout of foundation system, floor framing plans, and roof framing plan.
2. The foundation plan and/or footing schedule shall document the criteria used in design such as the bearing pressure and engineered fill requirements.
3. Sizes of all framing members and structural elements for the primary building structure.
4. Sufficient detail cuts, references to schedules, and specific information on critical areas.
5. As a minimum, overall and/or general layout dimensions should be included on the foundation plan or the architectural dimensioned plan). Critical structural dimensions should be shown.

c) Structural Detailing:
1. Critical gravity load connections required to transfer load from roof to floor to foundation should be detailed. These connections would include, joist to beam or wall, beam-to-beam, beam to column, column to foundation.
2. Details must be shown for all lateral load resisting connections. These types of connections are; diaphragm shear transfer, out of plane anchorage, bracing connections, moment frame connections, and force transfer to foundations.
3. Structural schedules should also be included when applicable.
4. Structural detailing should be provided on commercial projects with the exception of connections for non-primary building elements such as parapets, fascias, and canopies.
5. On simpler projects such as small warehouses and offices, structural detailing can be incorporated into the architectural sections.

d) Non-Structural Drawings:
1. It is not permissible for an Engineer to stamp Architectural, Mechanical, Electrical, or other sheets in which the design professional is not intending to be responsible for nor has expertise with.

V. Examples of Substandard Design

a) Incorrect use of basic snow, drift, wind, and seismic loading.
b) Lack of or improper application of building codes and local ordinances.
c) Incorrect use of building structure type in developing seismic loads.
d) Incorrect application or misuse of basic engineering principles.
e) Misuse or improper interpretation of computer analysis and design output.
f) Structural and/or seismic designs provided and stamped by the Architect.

VI. Examples of Substandard Practice

a) Failure to provide complete engineering plans, details, and calculations.
b) Re-issuing numerous submittal drawings and calculations during the permit process for projects not considered fast-track projects.
c) Submitting structural drawings without an Engineer's Seal or with only an Architect's stamp.
d) Submitting drawings and calculations that require numerous re-checks, handholding, and communications with plan reviewer in order to obtain a permit.
e) Making substantial structural changes (not affected by architectural considerations), during the permit process.

VII. Recommendations on Dealing with Substandard Practice

Provide a copy of the attached condensed checklist of Sections II. thru IV. to an engineer submitting substandard designs. Make note of which items the design or drawings are deficient. (Checklist is under development)

a) Establish an open dialogue with the design professional individual in question. This may occur when providing review of submitted plans and questions arise. It may also be appropriate when observing a potential problem or having some concern with a project under construction.
b) During the permit process, request a second opinion from an independent structural engineer if an issue cannot be resolved in a timely manner.
c) The subcontracting structural plan reviewers should alert the local Building Official of individuals that have shown ongoing and repetitive misconduct and/or substandard practice.
d) The Building Official should report any misconduct that is brought to their attention to the Department of Professional Licensing (DOPL). This can be done by filing a brief report through DOPL's website, www.dopl.utah.gov .

The Structural Engineers Association of Utah (SEAU) is another excellent resource in reporting problems and pursuing action. The organization is committed to maintaining public safety and upholding the standard of care for the profession. To contact SEAU, see their website, www.seau.org .

BULLETIN BOARD

BULLETIN BOARD EDUCATOR FEATURE

Each month for the next three months SEAU News is featuring the structural engineering activities of the Civil Engineering Department from one of Utah's three largest universities, highlighting their areas of research and expertise and research projects they are pursuing. This month's focus is on:

BRIGHAM YOUNG UNIVERSITY

There are 18 full-time faculty in the Civil and Environmental Engineering Department at Brigham Young University. They have a broad spectrum of experience in industry and government, and most are professionally registered. The department has developed a strong research base that is currently funded at about $1 million per year. Over half of the faculty presently holds externally supported research grants and contracts, and several are also funded through the Engineering Computer Graphics Laboratory.

Areas of instruction include engineering mechanics, hydraulics, environmental engineering, soil mechanics, structures, structural composites, transportation, and water resources. Most department research is associated with one or more of these areas plus applications for engineering computer graphics.

Department research varies with many projects related to water resources--quality, remote sensing, distribution systems, and as part of environmental hazardous waste studies. In the geotechnical area, the department has several active research grants for exploring soil mechanics, earthquake liquefaction, and geologic modeling. Faculty expertise encompasses structures, structural mechanics (including research into structures made of modern composite materials), applications of computer graphics to structural analysis, construction of high-strength dome structures, and improvement of optimization techniques. In recent years there has been a significant increase in the amount of transportation engineering research in the department, much of which is associated with the Utah Department of Transportation.

NOMINATING COMMITTEE FOR SEAU OFFICER ELECTIONS

The following SEAU members have been nominated for election to the Nominating Committee:

- Barry Arnold
- Jim Bailey
- Parry Brown
- Kelley Calder
- Steve Markham
- Steven Powell
- Ken Willmore

Other voting grade members may be nominated at the March meeting. 4 members from all nominees will be elected by paper ballot during the March meeting. Larry Reaveley is the Chairman of the Nominating Committee by virtue of his present office as Vice President/President Elect.

UEC ACTIVITY

Science Fair judges are needed for the *Salt Lake Regional Science and Engineering Fair* on Thursday, April 4 from 1-5pm at the Huntsman Center at the U of U. If you are interested please contact Ken Randle at (801) 485-9165.

SEAU MEMBERSHIP APPLICANTS

The following individuals ave submitted an applications for approval by the SEAU membership committee for new members or upgrade of membership level:

Donald Barfuss – Professional
Frank T. Smith – Professional

SEAU PRESENTS:

STEEL CONNECTIONS: SEISMIC APPLICATIONS SEMINAR

Presented by:
Robert E. Shaw Jr., P.E.
President
Steel Structures Technology Center

Thursday March 21, 2002
8:00 a.m. – 4:30 p.m.

Salt Lake International Holiday Inn
5575 West Amelia Earhart Drive
Salt Lake City, UT

Cost: $125.00 per person for SEAU members.
This is a discounted rate from the normal fee for attendees. If you have not received registration information in a separate mailer, call the SEAU office at (801)321-0259 to register.

STRUCTURAL ENGINEERS ASSOCIATION OF UTAH

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