SEAU *NEWS*

The Newsletter of the Structural Engineers Association of Utah

Volume VIII- Issue VI March 2004

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.

Articles for publication may be submitted to:
Mike Buehner, Editor
(801) 486-3883
mbuehner@reaveley.com
Advertisements for publication may be submitted to:
Jerod Johnson, Advertising
(801) 486-3883
jjohnson@reaveley.com

Bomb Washout System at Eglin AFB, Florida; by EASE, Inc.

IN THIS ISSUE

Message From The Board ..... p 1

Member Forum ..... p 2

Bulletin Board ..... p 5

MARCH EVENT

ADDED DAMPING & STRUCTURAL RESPONSE

Presented by:
H. Kit Miyamoto

Date:
Thursday, March 18, 2004
5:30 p.m. – Social Hour
6:00 p.m. - Presentation

Location:
EMCB Room 103,
University of Utah

MESSAGE FROM THE BOARD

TAKE ADVANTAGE OF SEAU MEMBERSHIP

By Jeff Miller,
SEAU Treasurer

As my term as SEAU Treasurer nears the end, I wanted to pass along something that has become very evident to me over the past two years. It is the simple fact that our SEAU membership dues can be some of the best money we ever spend if we take advantage of the opportunities it brings. The SEAU board is constantly looking for ways to be more efficient in our spending, and provide more bang for the buck for the membership. Electronic publication of the newsletter and distribution via e-mail has saved a significant amount of money over what it used to cost to print and distribute the newsletter. While this process has had a few problems, and has taken some getting used to by most of us, it is getting better, and in the end is more efficient than the old way.
Barry Arnold and the Newsletter Committee have spent a significant amount of time playing salesman for ads in the newsletter. Barry has even recruited his wife in the effort. Newsletter advertising revenue has increased significantly, and it appears as though revenues will continue to increase in the future. The combination of savings in the cost of distribution of the newsletter and increased ad revenue have put the newsletter in the black. The Newsletter Committee and Barry Arnold deserve credit here. Money that would otherwise be spent on the newsletter can be applied to better

CONTINUED ON PAGE 3

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:

KNIGHTON AND CROW, INC.

Knighton and Crow, Inc is a full service E/A firm located in Logan, Utah. The firm started in 1987 as Knighton Engineering, as a structural consulting firm. Gary Knighton is the principal structural engineer and received a BS degree from USU and an MS degree from Purdue. Gary is actively involved with SEAU and has served as the chairman of the Technical Committee for two years and was also a Member of the Board for several years. In 1994, Gary took on a partner, Wayne Crow (PE & RLS) and expanded to provide civil engineering and surveying services. The firm's name was changed to Knighton and Crow, (K & C) at that time. In 1996, the firm added architecture (Skyline Architects) to its list of services. Now as a competitor to other architectural firms, K & C typically only provides structural engineering on buildings designed by its own architectural staff, design build projects for contractors, and specialty structures. K & C has a staff of 18 including 5 licensed professional engineers.

360' high amusement ride structure,Cedar Point, Sandusky, Ohio

Specialty structures include projects such as a 250' high amusement ride tower on top of the Stratosphere in Las Vegas. This project required that a scale model of a portion of the tower and ride were tested in a wind tunnel to determine drag coefficients at various angles. The tower had to be designed as light weight as possible and detailed for ease of erection as it was erected by helicopter with the top of the tower at elevation 1149'. K & C has designed about 100 tower structures at various locations around the world. This requires becoming familiar with quite a variety of building codes and design standards. The firm is currently working on several amusement structures in St. Petersburg, Russia and Ningbo, China.

Ground run-up enclosure facility with blast deflector fence, Tampa, Florida

Another type of specialty structure is a ground run-up enclosure facility to test large aircraft. These projects are typically 3-sided open structures that vary in height from 40 to 60 feet. The structure is used as an acoustical barrier so that aircraft engines can be tested during late night hours without disturbing nearby residents. Some of the jet engines are placed within 50 feet of the structure. The jet engine exhaust velocity contours at take-off thrust are analyzed for various aircraft to determine critical pressures at various heights. A jet blast deflector is then designed to deflect jet blast forces away from the acoustical barrier. The design forces are typically between 50 and 100 psf. K & C has designed 5 of these facilities, 4 throughout the US and one in Europe.

Neways office, Springville, Utah

An example of recent building projects completed on a design build basis are the Neways facilities in Springville. K & C provided the design for all of the concrete on the 5-story office structure and the warehouse. The warehouse consisted of a 300,000 square-foot facility using concrete tilt walls that were 42 feet high. K & C teamed up with Golden Empire Manufacturing and C & A Construction on both of these projects.

MESSAGE FROM THE BOARD (continued from page 1)

seminars and other learning experiences.

Publication of the membership roster on CD has also saved a significant amount of money, and in my opinion, its interactive format has also increased its ease of use. Kim Robinson deserves all of our thanks for the hours she has spent on modernizing and streamlining the membership roster CD. Economics wasn't the sole reason the roster was distributed in CD format, but it was one of the major considerations. The intent was to provide a better product at a lower cost.

One of the best values the board has taken advantage of in recent years is obtaining DOPL funding to defray costs of educational seminars. Ron Dunn, Larry Reaveley, and others have spent time petitioning DOPL for educational funds. They have been able to secure a significant amount of funding that has made it possible to offer educational seminars that would otherwise cost hundreds of dollars at a much lower cost. The ACI 318-02 seminar and the recent AISC Seminar were both offered at highly discounted rates made possible by a combination of DOPL funding, wise use of funds by the board, and the cooperation of AISC and ACI. Larry Reaveley has helped us greatly in providing meeting space and other services at the University for a minimal cost. He has also been able to negotiate very favorable rates with organizations such as AISC and ACI that provide our seminars. Larry deserves our thanks.

Our Thursday evening meetings are planned with the main goal of providing a meaningful learning experience for the membership, and high value for the funds expended. Active participation in the Thursday evening meetings and the seminars held through the course of the year make it possible to obtain more CEU's than are required for license renewal at a nominal price. I get numerous mailings from seminar sponsors emphasizing that if I pay a few hundred, or even a thousand bucks, I can get the CEU's I need for license renewal. I still attend a few of these seminars, but I added up the CEU's I get from attending SEAU sponsored events, and had more than enough for only $100.00 yearly dues and a nominal fee for two or three SEAU sponsored seminars each year. The SEAU meetings and seminars are a much better value. When other benefits such as the Opening Social and Executive Business Lunches are considered, our dues become an even better value.

A related issue that should be mentioned is participation in a committee. We can all earn CEU's through committee participation, but my feeling is that the primary reason for participating on a committee should be giving something back to the organization, and helping advance the profession of structural engineering. If you you're not on a committee and would like to help out, please contact a member of the board or the committee chairman and let them know of you willingness to help. There is a lot of work to be done, and the help of all of our members is needed.

My intention in writing about this subject is not to publicize the activities of the board and my opinion of the great work that is being done. It is simply to inform the membership of something that I did not fully appreciate until I was given the responsibility to watch over SEAU funds and how they are spent. It is clear to me that the primary goal of the board is to provide the best value possible for the funds expended. I would encourage all of us to take better advantage of the benefits that come from our SEAU membership. If we do, they money we spend on SEAU activities can be one of the best investments we make.

MESSAGE FROM THE PRESIDENT

"*People who tell you that happiness, achievement, and significance will come automatically if you simply do the work you love are misguided*." Regardless of how much you care about your job, you will still feel conflicting desires – between work and home, between working forever on a problem and taking a break from it, between going for more market share today and investing in the company's needs for tomorrow. The skills you use to compete are totally different from those you employ in moments of enjoyment.

Survey after survey shows a high degree of job dissatisfaction and burnout among the general working population, even among those with plenty of options. Pursuing success is like shooting at a series of moving targets. Every time you hit one, five more pop up from another direction. Just when we've achieved one goal, we feel pressure to work harder to earn more money, exert more effort, possess more toys. Standards and examples of "making it" constantly shift, while a fast-paced world of technological and social change constantly poses new obstacles to overcome.

The preceding paragraphs were summarized from an interesting article published by the Harvard Business Review.

Success involves more than a heart-pounding race to the finish line. Oft times in our profession deadlines are one of the measures of success. We are seemingly always engaged in a pattern which ties our success to the success of others. What is this enduring success that we long for? Is it dependent upon others? Unlike an equation for a successful market strategy, no one person or company can fully embody lasting success for others. We have to find it ourselves. Fortunately, success doesn't have to be seen as a one-dimensional tug-of-war between achievement and happiness. But where is it?

Why is it that we feel we will find it (happiness) right next to someone else's misery or woe? Why is it

that human tendency is to feel ourselves successful at another's expense. I sometimes wonder if we are more interested in other people's success or lack thereof than our own individual world. Maybe this is why there is such a high degree of job dissatisfaction as noted above.

Twenty-five years ago I knew very few engineers who were not genuinely happy and enjoyable to be around. I fear that we are moving in a direction that is not consistent with why we chose this profession. According to a recently read article Architects and Engineers are now in a "high risk" group for suicide, divorce and burn out. It also mentioned that we (architects and engineers) are more likely to speed on the road than any other profession. Maybe it is our deadlines that are making us crazy!

My best friends are engineers and architects. I challenge us all to search out those things which cause enduring happiness and success. If you think about what constitutes a moment of lasting satisfaction in your own life-maybe it's your daily practice of a musical instrument, a relationship or sports activity – it may be surprisingly trivial in comparison with your major commitments at work or at home.

Ron Dunn
President, SEAU

BULLETIN BOARD

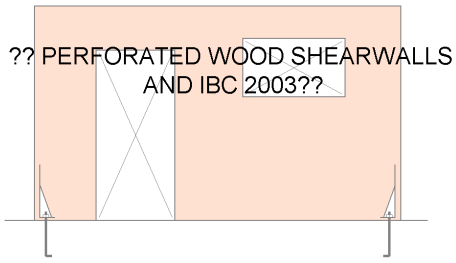
BULLETIN BOARD SPECIAL FEATURE

Each month this year SEAU will feature recent building code developments and design requirements. This month our focus is on:

IBC 2003 PERFORATED WOOD SHEAR WALL DESIGN

by Matthew Roblez S.E.

For many years structural engineers have designed plywood sheathed shearwalls as segmented full height sheathed elements between openings in a wall. With this approach, hold-downs are generally required on each end of the shear wall segment. The IBC 2000 adopted a method of analysis allows the structural engineer to design what is referred to as a "perforated shear wall". A perforated shearwall is a method of analysis that considers the walls, with openings, as one unified shearwall with one hold-down at each end of the entire perforated shearwall. This at first glance seems like a wonderful approach that will make many owners and contractors happy due to the reduced number of hold-downs that may be required. However, the IBC 2003 has very specific design and detailing requirements that cannot be overlooked and may require more design time and require more hardware than the traditional segmented shearwall approach.



The IBC 2000 was fairly vague as to the correct design and detailing procedures that are necessary for the use of Perforated Shear Walls (PSW) in light framed timber construction. The IBC 2003 goes into more detail listing a required design procedure that in turn has very specific detailing requirements. It seems that in the past that since the IBC 2000 had not specifically adopted these requirements, the proper design and detailing of PSW had been either overlooked or ignored.

Specific design issues that are now covered in the IBC 2003 are as follows:

Uniform Tension Directly Under the Shear Wall Segments:

IBC 2003 section 2305.3.7.2.6 states: "*In addition to the requirements of Section 2305.3.7.2.4, perforated shear wall bottom plates at full height sheathing shall be anchored for a uniform uplift force, t, equal to the unit shear force, v, determined in section 2305.3.7.2.5.*"

The term "*at full height sheathing*" in the above listed section indicates that this uniform tension, or uniform uplift anchorage force, is to be taken at the shear wall segments in the PSW that meet the height to width ratios listed in Table 2305.3.3. The uniform uplift anchorage force is specified for attachment of the bottom plates of the shear wall segments to the elements below. This requirement brings up several design and detailing issues that must be addressed in the calculations and detailed on the construction documents.

At PSW's at the second level, their base sole plates must be anchored to the rim joist and/or double top plate below. This force can be taken by one of the following methods: A nail through the sole plate to the rim joist which is sized for both withdrawal (tension) and shear in combination, or a metal plate connector such as a Simpson LTP4, fastening the sole plate or rim joist to the double top plate below. As stated above, the provisions of Section 2305.3.7.2.6 require that these connections be concentrated at the point of origin of the uniform uplift anchorage force **directly under the shear wall segments** and NOT distributed across the entire length of the PSW.

At the base, the requirements for the connection from the sole plate of the PSW to the foundation are the same. However, there are several important design issues that need to be addressed in the calculations and detailed in the construction documents. It is suggested in the AF & PA publication, PERFORATED SHEARWALL DESIGN, that the uniform uplift anchorage force be transferred through the sheathing to the sole plate and resisted by the uplift capacity of the anchor rods into the foundation. **As with the anchorage hardware from the second level to the first level mentioned above, the anchor rods resisting the uniform uplift anchorage force must be located directly under the shear wall segments. The construction documents must detail this requirement.**

In addition to the requirement of the anchor rods being located directly below the shear walls segments, the calculations and construction documents must address the issue of cross grain bending in the sole plate. Cross grain bending or cross grain tension is defined as tension stress perpendicular to the grain of the timber member. The National Design Specification (NDS) 1999 Edition (a reference standard in chapter 25 of the code) states, "*Designs that induce tension stress perpendicular to the grain shall be avoided whenever possible. When tension stress perpendicular to the grain cannot be avoided, mechanical reinforcement sufficient to resist all such stresses shall be considered.*" A connection that transfers the uniform uplift anchorage force through the sheathing to the sole plate and is resisted by the uplift capacity of anchor rods induces cross grain bending in the sole plate. Mechanical reinforcement is therefore required. It is even likely that the minimum required plate washer (section 2305.3.10), which is 2" x 2", is not sufficient to prevent cross grain bending. Most wood frame construction is 2 x 4 or 2 x 6. A 2" x 2" plate washer still leaves a cantilever arm past the washer. This means the uniform uplift

anchorage force must transfer through a cantilever arm to the point of resistance. This is a force times a distance that is the definition of a bending moment, thus induces cross grain tension in the sole plate. Either the calculations must address this cross grain tension, or a full width plate washer must be detailed in the construction documents.

Tension at the Ends of the Perforated Shear Wall:

Section 2305.3.7.2.4 if IBC 2003 states; "*Anchorage for uplift forces due to overturning shall be provided at each end of the perforated shear wall. The uplift anchorage shall conform to the requirements of section 2305.3.6 except that for each story the minimum tension chord uplift force, T, shall be calculated in accordance with* equation (23-3)." Section 2305.3.6 states; "*Where the dead load stabilizing moment in accordance with Chapter 16 allowable stress design load combinations is not sufficient to prevent uplift due to overturning moments on the wall, an anchoring device shall be provided."* In short, section 2305.3.7.2.4 allows the design professional to calculate an uplift force based on the principals of mechanics resisted by the appropriate dead loads per Chapter 16. But it sets a *minimum* tension force to be resisted by each PSW. Examination of equation 23-3 indicates that there will always be a positive tension force at the ends of the PSW requiring an anchoring device. **If in the construction documents, a hold down device is not specified at each end of a PSW, then it <u>does not</u> meet the provisions of this section. Therefore the PSW would not be properly detailed and is prohibited from use to resist lateral forces.**

Total Perforated Shear Wall Resistance:

In the code, section 2305.3.7.2.2 item #4, it states*; "The perforated shear wall resistance shall be equal to the adjusted shear resistance times the sum of the width of the perforated shear wall segments*." In section 2305.3.1 it defines a shear wall segment as being; "*The width of full-height sheathing adjacent to unrestrained openings in a shear wall.*" In Section 2305.3.3 it states; "*Size and shape and shape of shear wall and shear wall segments…shall be limited as set forth in Table 2305.3.3*." **This means that the width of wall that may be used to resist lateral forces shall be the sum of with widths of the shear wall segments in the PSW meeting the aspect ratios listed in Table 2305.3.3, NOT the total length of the PSW. (Note that the end result as far as the length of walls providing shear resistance is EXACTLY the same as using the traditional shear wall approach with hold downs at each end of each segment.)**

Maximum Total Shear that May Be Taken by the Perforated Shear Wall:

In the code, section 2305.3.7.2.1 item #2 states, "*The allowable shear set forth in Table 2306.4.1 shall not exceed 490 plf."* This sets a limit for the amount of shear that can be taken in a PSW system. In addition, section 2305.3.8 states, "*The shear values for material of the same type and capacity applied to both faces of the wall are cumulative,"* Thus, Table 2306.4.1 is intended to give values for each side of the shear wall where wood structural panels are applied to each face. Therefore, the limit of 490 plf is intended to mean each sheathed face and the maximum forces in a PSW system is 490 plf for a single sheathed PSW and 980 plf for a double sheathed PSW. **If a PSW system is calculated to have more than 490 plf for a single sheathed wall or 980 plf for a double sheathed wall, then it <u>does not</u> meet the provisions of this section. Therefore the PSW is not properly calculated and is prohibited from use to resist lateral forces.**

Perforated Shear Wall Deflection:

In the code, section 2305.3.2 states, "*Permissible deflection shall be that deflection up to which the shear wall and any attached distributing or resisting element will maintain its structural integrity under design load conditions."* This section follows with a formula (23-2) to calculate the deflection of a shear wall. In traditionally calculated and detailed segmented shear walls (i.e., overturning restraint at each end of each shear wall segment) deflection is not a serious concern because of the overturning restraint at the end of each segment. Additionally, the base force is not increased by any factors. Section 2305.3.7.2.9 states "*The controlling deflection of a blocked shear wall with openings uniformly nailed throughout shall be taken as the maximum individual deflection of the shear wall segments calculated in accordance with Section 2305.3.2, divided by the appropriate shear resistance adjustment factors of Table 2305.3.7.2."* This means that one can only use the full height shear wall segments to resist deflection. Additionally, the forces used to calculate deflections must be increased by dividing this force by the factors in Table 2305.3.7.2 which are all less than or equal to 1.0.

Reliability and Redundancy of the PSW:

Section 2305.3.7.2.5 establishes that the total resistance of the PSW is the sum of the resistances of the full-height shear wall segments. Section 1617.2 states in the definition of α_{max}, "*The ratio of the design story shear resisted by the single element carrying the most shear force in the story to the total story shear, for a given direction of loading."* These two provisions mean that the most heavily loaded shear wall segment of the PSW system shall be used to determine α_{max} , NOT the total length of the PSW. **Hence, the calculations shall use l_w in the determination of α_{max} equal to the most heavily loaded shear wall segment length, NOT the total PSW length.**

In summary, The IBC 2000 was fairly vague as to the correct design and detailing procedures necessary for the use of Perforated Shear Walls. Since that time, many research papers have been written and testing has been performed. As a result, the IBC 2003 goes into more detail, providing a required design procedure that in turn has very specific detailing requirements. The use of the PSW design concept requires more specific detailing than just calling out a PSW system in the construction documents. The use of the PSW design concept also requires more structural calculations than the application of traditional segmented shear wall concepts to a length of shear wall with an opening(s) and calling it a PSW.

BULLETIN BOARD

NOMINATING COMMITTEE

The following people have been nominated to be on the nominating committee:

Don Barfuss
Kim Robinson
Steve Powell
Russell Merrill
Steve Cohen
Barry Welliver
Jonathan "JR" Richards
Ron Reaveley

The general membership is encouraged to participate in the nominating process. Further information and ballots will be distributed to voting grade members later in the month. (Voting will not take place at the upcoming Membership Meeting.)

BY-LAWS BALLOT RESULTS

The proposed By-Laws change passed with 87 voting yes, and 6 voting no. Thanks to all the voting grade members who took the time to vote.

SEER COMMITTEE UPDATE

Have you completed your Rapid Evaluation Safety Assessment for the example presented in last month's newsletter? Please go through this excersise and email your answers to Blake Hoskisson at blake@suresteel.com.

CLASSIFIDES

STRUCTURAL ENGINEERS WANTED

CARTWRIGHT Consulting Engineers is seeking a **General Manager** and **Staff Engineers** for its Salt Lake Metro office. General Manager applicant must be an SE or able to obtain SE and will be responsible for management of staff, marketing, and design. Excellent salary and benefits. E-mail letter of interest/resume' to craig@caceng.com or fax to 435-753-2851.

SEAU MEMBERSHIP APPLICANTS

The following individuals have submitted applications for approval by the SEAU membership committee for new members:

Julie B. Birtcher	Associate
Jason S. Christensen	Associate
Steve Ericksen	Associate
Julito M. Ganchero	Associate
Christopher R. Handy	Associate
Jon Hansen	Associate
Desiray Larsen	Associate
Spencer R. Lee	Associate
Brian Warner	Associate
Scott H. Andersen	Professional
Mark E. Anderson	Professional
Mike Christensen	Professional
Jody M. Christensen	Professional
Steven J. Cosper	Professional
Todd Datwyler	Professional
Andrew J. Herseth	Professional
Stan G. Humpherys	Professional
Leland V. Jensen	Professional
Timothy D. Nordstrom	Professional
Scott M. Pettit	Professional
Kyle Price	Professional
Robert Rasmussen	Professional
Richard D. Seamons	Professional
Henry Shen	Professional
Brent R. Tobler	Professional
Steven D. Young	Professional

SEAU Presents:

ADDED DAMPING & STRUCTURAL RESPONSE

Date: Thursday, March 18, 2004

Place: University of Utah
EMCB Room 103

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

Presenter: H. Kit Miyamoto, M.S., S.E., President & CEO Marr Shaffer & Miyamoto

Mr. Miyamoto will discuss how adding damping to structures will reduce their response in an earthquake; related building code provisions; and give two case studies – one rehabilitation project and one new construction project.

STRUCTURAL ENGINEERS ASSOCIATION OF UTAH
P.O. Box 58628
Salt Lake City, Utah 84158-0628
www.seau.org