SEAU *NEWS*

The Newsletter of the Structural Engineers Association of Utah

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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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Intermountain Health Care – Intermountain Murray Center
Utah's Newest State-of-the-Art Medical Facility

IN THIS ISSUE

NOVEMBER EVENT

SEAU MEETING
November 15, 2007
5:30 pm
WEB at the University of Utah
(Formally the EMCB)

LRFD Masonry Design

Presented by
Chris Pantlides, PhD, P. E.

See page 8

MESSAGE FROM THE BOARD

280 SEAU MEMBERS

By Russell Merrill,
SEAU Treasurer

The current membership count for the 2007 / 2008 SEAU year is 280. That is a lot of people showing concern and care for their profession. We have a lot to be proud of. In a summary of the recent NCSEA conference, which Barry Arnold wrote to the SEAU board, we were congratulated for having the highest percent enrollment in the country. We were also highlighted as having one of the highest numbers of active committees. It was pointed out however, that some engineers (and building professionals) submit code change proposals and other items of business on a national level without endorsement, or acknowledgment by SEAU or NCSEA. They asked us to help address this issue by reiterating the value of presenting a united front. Having little or no knowledge about a proposal can make it difficult to endorse. Furthermore, don't want to be asked for a comment on an issue and have it be a surprise, there is a danger that it could short circuit or

CONTINUED ON PAGE 3

FOCUS

SEAU NEWS intends to highlight some of our most interesting and important buildings in Utah, highlight some of the local firms, and provide biographies of famous structural engineers.

If you have a particular interest in a building or person you would like to see highlighted in this space or want your firm highlighted in this section, please contact newsletter committee member Jerod Johnson at (801) 486-3883 or jjohnson@reaveley.com.

Intermountain Health Care

Murray Medical Center

Changing Icons, Murray Smokestack is Replaced by 16-Story Medical Tower

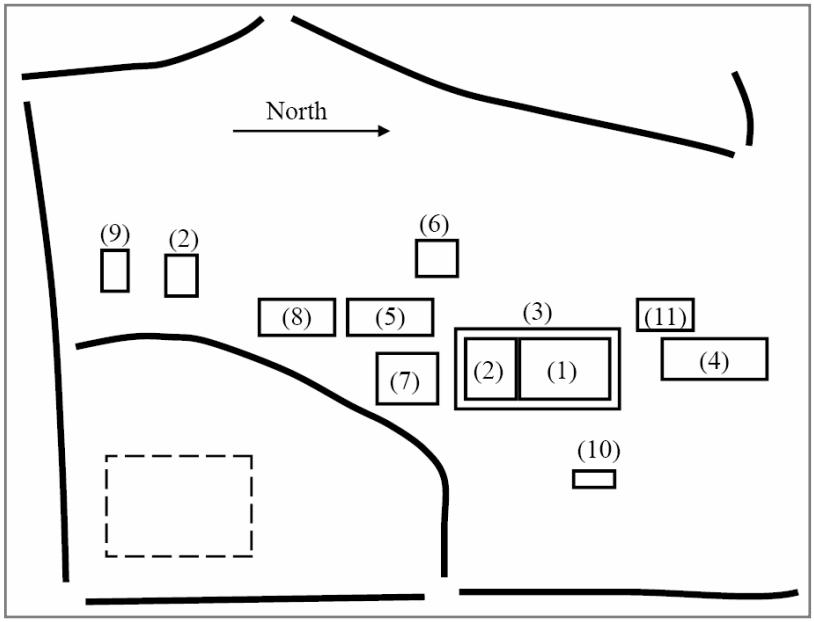
On September 25, 2007 the Intermountain Medical Center in Murray was officially dedicated, thus marking the completion of the massive +400 million dollar facility which now serves as the flagship of all IHC hospitals. An enormous blue bow atop the 16 story-patient tower announced the event and officially marked the replacement of the Old Murray Smokestack icon with a new icon drawing perhaps even more attention.

The center is comprised of several individual buildings including the hallmark 16-story patient tower (1) visible from nearly every location in the Salt Lake Valley, not unlike the smokestack that was demolished several years ago in preparation for construction. Other buildings include an 8-story heart research center (2), a 4-story principal hospital facility (3), a women's center (4), an outpatient pavilion (5), a cancer treatment center (6), a parking garage (7) and a 9-story medical office building (8) (currently under construction). Other peripheral structures include a central plant, a 3-story core lab building, a plant operations center and an education center (see site plan).

Clearly a defining characteristic of a project of this nature is the size. This required many logistical challenges for both the design and construction teams. The structural design for most of the buildings was completed in a period of approximately 6 months and required an estimated 15,000 man hours of engineering analysis, design and drafting. This effort was preceded by years of schematic design efforts and untold hours of coordination between, IHC, the project architects and the project engineers.

The foundation of the 16-story tower is comprised of a massive mat foundation, typically 5 feet thick with thickened zones up to 7 feet thick and a required compressive strength of 5,000 psi. This required over 8,000 cubic yards of concrete in one monolithic casting lasting approximately 13 hours. This translates to roughly one concrete truck arriving every 52 seconds! The heat build-up and dissipation in such a mass volume of concrete also required special attention to the concrete mix design. By using a high volume fly ash mix and allowing 56 days to reach the required strength, the heat build-up was kept in check. This precluded the need for specialty concrete mixtures and enabled a savings in excess of $60,000.

Aside from the shear size of the project, what other aspects make this project unique?



FOCUS ARTICLE (cont.)

The primary lateral force resisting system of the larger buildings consist of buckling restrained braced frames (BRBF). After a lengthy period of preliminary research and evaluation, the BRBF was selected as the system most consistent with IHC's objectives for seismic performance. After a large earthquake, this facility is expected to serve as the valley's primary treatment center for servicing the injured. BRBF's offered the most promising advantages in terms of up-front cost and the expected seismic performance to enable the facility get quickly back online after a seismic event. With the optimal nonlinear performance characteristics, the BRBF systems are expected to limit excessive motion and nonstructural damage.

Over 648 buckling restrained braces have been used on the project. The braces themselves are capable of sustaining large loads through repeated tension and compression cycles without buckling laterally or suffering tensile rupture. Nonlinear yielding of the braces' cores enables a safe and controlled method for dissipating seismic energy which might otherwise manifest itself as damage to either structural or nonstructural elements and components. To enable such performance, the frame beams and columns were designed to remain elastic thereby concentrating nonlinearity in the braces themselves. To ensure elastic behavior, braced frame columns became particularly heavy, the largest being a W14x730 with 2-1/2" side plates to improve weak axis strength.

As a relatively new technology, many of the buckling restrained braced frame sizes and configurations did not fall within the annals of previously tested assemblies. Many of the braces, connections and geometrical configurations required full scale testing to verify properties and performance. The University of Utah Structures Lab provided the required testing thereby validating the system and enabling the project's progression.

Other challenges were overcome with interesting innovations that eased the construction effort and reduced construction costs. One of these was the use of a Geofoam backfill against 34 foot foundation walls. Lateral pressures due to earth backfill would have imposed significant flexural and shear demands on the wall, requiring a total foundation wall thickness of roughly 36 inches. The use of Geofoam dramatically reduced these pressures and enabled an 18 inch thick wall as part of the design solution.

MESSAGE FROM THE BOARD (continued from page 1)

undermine more methodical efforts of other states working on issues in a more formal process of going through channels.

I'll explain what I mean. If you happen to have a hot button issue that affects our profession, we are encouraged to gain an SEAU "consensus" by having the issue studied by one of our committees. If you have an issue you would like studied please have an SEAU board member help you find the appropriate committee. Perhaps you would even like to join the committee. Once the committee has reached agreement (usually including soliciting comments from members in general), they make a written recommendation to the SEAU board. The board will then study the issue and upon reaching a consensus we can as a united SEAU endorse the item to NCSEA. This can then be formally presented to the NCSEA board, or one of their many committees depending on the situation. Then if NCSEA reaches a consensus on an issue, such as maybe a proposed code change, or a legislative issue, it has become a much broader based endorsement. If a code change is not known about, and NCSEA is solicited for comment, the hesitation may be enough to kill the proposal.

If that sounds like one heck of a long time to get through those channels, and the issue seems more time sensitive, there are short circuit alternatives that still leave SEAU and NCSEA informed. If an SEAU member feels strongly that an issue is important and time sensitive, he or she is welcome to come directly to the board, and the board will help them get in touch with NCSEA.

If a person feels strongly that an issue should still be submitted before there is time to get studies accomplished they always have that right to proceed on their own. It would be appropriate however, to keep organizations informed who are likely to be affected.

SEAU MEMBERSHIP APPLICANT

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

Travis Thurgood ..... Associate
Dallan Affleck ..... Associate
Lukas Balling ..... Associate
Michael Goodman ..... Student

SEAU NEWS SUBMITTAL DEADLINE

January SEAU News deadline is **Dec 13th**.

We expect updates from the following:

Board Member – Board Member (Senior)
Legislative Committee
Existing Buildings Committee
USSS Representative

TECHNICAL ARTICLE by JESSE MALAN

Concrete Cantilevered Retaining Walls Part III

This month's article is the third part of a three part installment on the design of cantilevered concrete retaining walls. Part I discussed the basic static forces and loads on retaining walls and briefly looked at various stability issues and factors of safety. Part II focused on the loads and safety factors for the effects of seismic excitation on the wall. This article will address the design of the structural reinforcement.

The cantilevered retaining wall design example, found by the newsletter committee to best describe the design of individual wall elements and their reinforcement and development lengths, is the design procedure in the Concrete Reinforcing Steel Institute (CRSI) 2002 Design Handbook[a]. If any SEAU member is aware of other equivalent or comparable design references, please contact the newsletter editor so that the body of SEAU as a whole may be informed of the alternate references. The 2002 CRSI Handbook was developed under American Concrete Institute (ACI) 318-99. For purposes of this article, the load factors were changed to reflect the most up to date ACI 318-05 load factors.

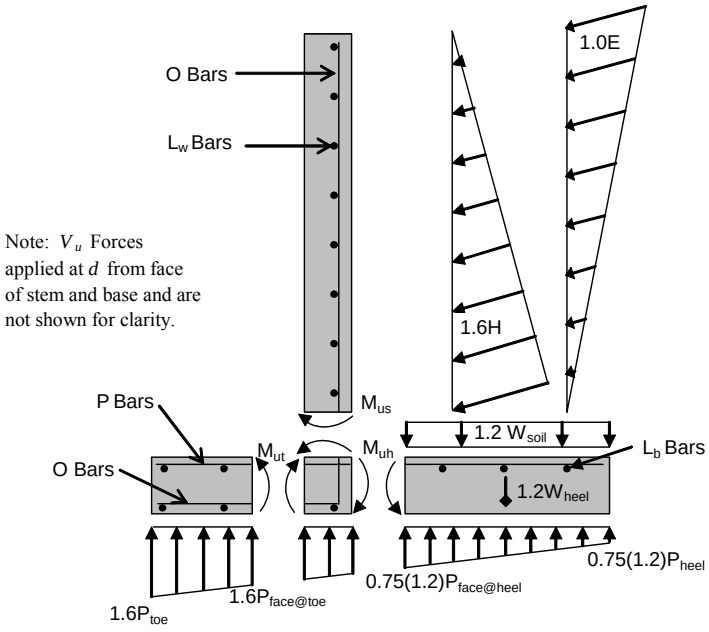


Figure 1: Reinforcing Bars and Element Loads

According CRSI, service load analyses are used to establish concrete wall and footing dimensions that control deflection at the top of the wall, limit soil stresses and tilting of the base, and provide the minimum safety factors for overturning and sliding. Strength design analyses are used to select the reinforcement required under factored loads. The bearing load from the service load condition should be used for the strength design with appropriate load factors applied. The bearing load should not be recalculated using the factored applied load.

A cantilevered retaining wall can be idealized as a structure made up of three connected structural elements; a stem, a toe, and a heel. Each element should be designed for using the appropriate load combination from the current ACI 318 code. According to Section 14.1.2 of the ACI 318-05 Building Code[b], cantilever retaining walls are to be designed according to flexural design provisions of chapter 10 with minimum horizontal reinforcement according to 14.3.3. CRSI conservatively applies the critical load condition of ACI section 9.2 to each element.

Stem Loads and Forces

The stem is designed to resist the directly applied lateral earth and seismic increased lateral earth pressures. The lateral earth pressure on the stem, defined as H, is typically given a load factor of 1.6 while the increased lateral earth pressure due to a seismic event E, is given a load factor of 1.0. Note that if the geotechnical engineer supplies earthquake loads that have not already been factored, use a factor of 1.4 instead of 1.0 for earthquake loads.

The maximum moment M_{us} is found at the base of the stem. Using the maximum moment, the required area of steel can then be found. Also, ρ_{max} should be checked. For the "O" bars and all others, it should be verified that the size and spacing of steel chosen is more than that which is required for shrinkage and cracking control.

The factored shear V_{us} is calculated at d from base of the stem. A check for the shear resistance of the reinforcing should also be made, at the critical section.

Toe Loads and Forces

The "O" bars also make up the flexural reinforcement of the toe. The downward force of the toe and soil above it are conservatively ignored. Note that the soil pressures used here are those calculated during the service load analysis (i.e. P_{toe} & $P_{face@toe}$), which are then factored by 1.6 at the toe.

The bending moment M_{ut} is calculated at the face of the wall. The "O" bars should be checked for the flexural requirement, ρ_{max}, temperature, and shrinkage requirements at the toe.

V_{ut} is calculated at the critical section d from face of the stem and is used to check the shear requirements of the toe.

Heel Loads and Forces

The heel is designed for the force of the soil above the heel W_{soil}, the weight of the heel W_{heel}, and any surcharge load above. The dead load forces are factored

TECHNICAL ARTICLE (cont.)

by 1.2 and the surcharge live load is factored by 1.6. These forces are counteracted by the upward force of the soil reaction pressure. The upward soil reaction pressure is factored conservatively by a load factor of 1.2 and further reduced by a 0.75 factor, as recommended by CRSI, to verify that the reaction pressure is not overestimated.

The factored moment M_{uh} is calculated at the face of the stem. The factored load moment for the heel M_{uh} must be larger of this calculated value or the moment in the stem minus the moment in the toe ($M_{us} - M_{ut}$) but need not be larger than M_{us}. The "P" bars should be checked for the flexural requirement, ρ_{max}, temperature, and shrinkage requirements at the heel.

The shear V_{uh} is calculated at d from the face of the stem and is used to check the shear requirements of the heel.

L_w, $L_{b\ Top}$, and $L_{b\ Bottom}$ bars are designed using the minimum reinforcement requirements of ACI.

Development Lengths

For all the development lengths checked, it may be useful to note that according to ACI 318-05 Section 12.2.5, the development length in flexural members may be reduced by a ratio of the area of steel required to the area of steel provided. For hooked bar development length reduction, see ACI 318-05 Section 12.5.3.d. If the steel requirement for shrinkage and cracking control is greater than the flexural requirement, the development length requirements can be reduced.

It should be verified that the hooked "O" bars in the stem at the top of the footing are fully developed into the footing according to ACI 318-05 Section 12.5. Even though this bar extends into the toe and is used as the toe flexural reinforcement, the ACI code makes no provision for reducing the development length for a lengthened tail of a hook. Quite often the development length of the "O" bar to the footing governs the thickness of the footing or the amount of reinforcing used.

The anchorage of the "O" toe bars from the face of the stem into the stem should also be checked for development length. Lapped bars may need to be provided if that development length is found to be inadequate.

The above two development length checks are not included in the CRSI Handbook but these checks should be included in the retaining wall design as they may govern the design lengths of those bars.

The development of the "O" bars into the toe from the face of the stem should be checked. If the length is not enough, the bars should be hooked according to ACI 318-05 Section 12.5. A longer toe may be required to provide the development length required.

The development length of the "P" bars from the face of the stem on the heel side must be checked in both directions. If the length is not enough, the bars should be hooked according to ACI 318-05 Section 12.5. The length of the toe and the heel may need to be increased to provide adequate anchorage.

Closure

This article was not meant to be a descriptive design but a guideline of considerations for use in retaining wall design. The newsletter committee invites and welcomes any comments on this article.

References

a. Concrete Reinforcing Steel Institute, "CRSI Design Handbook", Schaumburg, IL, 9th Edition, 2002
b. American Concrete Institute, "Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary (ACI 318R-05)"

BULLETIN BOARD

SEAU – PR/WEB COMMITTEE by CHRIS HOFFHEINS

The PR/Web Committee would like to share their '07-'08 goals with the SEAU membership. Our goals for the coming year are:

PR:

- Educate public about the activities of structural engineers and their benefit to society
- Establish SEAU members as the preeminent members of the structural engineering community
- Make SEAU the "go-to" organization for public issues related structural safety and policies
- Serve as a contact group for media requests and offer a prompt response to queries after a disaster

Website:

- Update website that will store and advertise important information for the public and SEAU members

SEAU – PR/WEB COMMITTEE (cont.)

I am sure everyone has tried to explain our profession to a friend, family member or neighbor only to hear them say "I thought that's what an architect did". We hope our PR goals will slowly change the public's understanding of our profession. We want to inform local newspapers and television reporters about SEAU and how we can assist them in their reporting on structural issues. We will also publish articles in local newspapers that will provide the general public a basic understanding of what it means to be a structural engineer.

Our committee will continue to work on the website to provide important information to the public and SEAU members. If you haven't been to the website lately, take some time to see what information is available to you. You will be surprised to find the resources that are available to you.

Please let us know if you have any suggestions on how the PR/Web Committee can better serve you and SEAU.

SEAU – EMERGENCY RESPONSE COMMITTEE by BLAKE HOSKISSON

The Emergency Response Committee is preparing its 'Outreach' ATC-20 trainings. Look for the upcoming time and venue for this great opportunity in St George and Ogden. We would also encourage you to take advantage of our your local Community Emergency Response Training (CERT). The following are the upcoming dates:

- Salt Lake City-call (801) 355-1664 or email rick.soltis@slcgov.com
- West Valley-see www.wvcert.org –classes starting on Feb, 14th, May 10th, Sept 5th
- Sandy City- call (801) 568-2944 – classes on Oct 30th, Jan 2nd, Mar 4th, and May 6th
- Provo City- call (801) 852-6321 for next classes-no classes scheduled now.
- South Jordan- call (801) 254-3742 ask for fire department or use www.sjc.utah.gov, do search for CERT, and follow registration link
- Orem city- call(801) 229-7146 or email emergencymanager@orem.org
- Layton-call 801-336-3820 or email twhitesides@laytoncity.org

To find out about CERT in your city, call your local fire department for information, look at your cities web pages, or go to www.citizencorps.gov and follow the link "Programs and Partners" located on the top of the page.

Are your ATC-20 skills a little rusty? Take an online refresher course at:

http://ccelearn.csus.edu/oes/

We will give the first 20 people to finish the course an ATC-20 field guide! (send Blake an email)

If you are interested in becoming active in the committee, please contact the SEER Committee chair: Blake Hoskisson (bhoskisson@dbswest.com).

ETHICS by DEBORAH LONG

Personal Responsibility

In the aftermath of the Columbine tragedy, it was both repugnant and fascinating to watch television pundits and newspaper editors blame everything from poor parenting to anti-gun control politicians. Similarly, parents blamed toxic cultural influences, such as the rap music and MTV. The NRA indicted the media. Everyone blamed everyone else: it was rare to see anyone accept personal responsibility for the Littleton massacre.

Yet personal responsibility is one of the important pillars of character. Even if we don't live in Littleton, Colorado, or Conyers, Georgia, or Jonesboro, Arkansas, we can all do better jobs of being ethical than we are doing. How?

1. We must be role models. Children learn by watching adults. Employees learn from their managers. Many of us are in positions to lead others, either because we have accepted the responsibility of leadership or because circumstances have thrust leadership upon us. Parents must role-model ethical conduct because their children will learn from them. Teachers must be moral agents because they influence their students. Athletes must be good people and set examples because young people hero-worship these celebrities. Engineers and architects must develop safe products and design. Real estate agents must support fair housing practices. Government leaders must inspire us to do better and be

ETHICS by DEBORAH LONG (cont.)

better or risk increased cynicism among their constituents.

2. We have to inspire others. Psychologist Lawrence Kohlberg's research into moral development tells us that people are cognitively attracted to ethical thinkers. While we are not always capable of ethical conduct or even mature ethical reasoning, we are attracted to those individuals who are. That is why we still speak in reverential tones about Martin Luther King's "I Have A Dream" speech or the spell-binding words of Kennedy's inaugural address: "Think not what your country can do for you, but what you can for your country." Such words inspired a generation of young people to contribute to their country and to others. Those who have the gift of ethical clarity should be recognized, rewarded, and given the opportunity to lead within their organizations. Those who have the gift have the obligation to use it.

3. We must critically examine elements of our culture that may have a toxic effect on young people. While technology has created a wealth of opportunity for communication and education, some uses of technology can encourage or emphasize isolation rather than participation and pro- social behavior. To counter the negative aspects of technology, we must provide more opportunities for interaction, both at work and at home. Sociologist Mary Pipher, author of Reviving Ophelia and In the Shelter of Each Other warns that despite the advances of this century, we see more depression, eating disorders, addictions and suicide and murder attempts, particularly among the young, largely due to the influence of the media. Rather than censoring or boycotting TV, however, she suggests that we take time at home to watch what our children our watching. We must help them develop healthy and critical perspectives regarding the messages of commercial television. At work, we have to make an effort to create opportunities for social interaction (meaningful meetings, company picnics, group sabbaticals or retreats) so that co-workers have a chance to learn about each other and to create or renew relationships. Employers have to give parents time to spend with their children to accomplish the same goal. And we have to encourage the media to take the high road even when their competitors may earn more money by appealing to baser instincts.

4. We must be agents of change. It is easy to be overwhelmed by the evil in the world: seeing the tragedy of Columbine and across the globe in Kosovo makes us all feel impotent. But it is because we cannot fix all of the world's ills that we must do what we can to prevent future tragedies. Chances are, the evil at Columbine was the result of many failures--social, parental, and cultural. We can all take responsibility for not doing enough. Pointing the blame at others is part of a misguided belief that we are not personally responsible. But we are in a position of making a difference. It may be simply an issue of being more ethical more often. As Anne Frank wrote, "Isn't it wonderful that we don't have to wait a single moment to improve the world?"

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UPCOMING EVENTS

November 4-9, 2007

The Third Structural Engineering World Congress - 2007 (SEWC 2007) will be held in Bangalore, India. Please contact info@sewc2007.org for further info.

November 15, 2007

SEAU Membership Meeting: **LRFD Masonry Design** presented by Chris Pantelides, PhD, P.E., Professor of Civil Engineering at the University of Utah. Meeting at 5:30 PM University of Utah, WEB 103 (formerly the EMCB)

Quote of the Day - submitted by Kim Robinson

"The dimensions shouldn't change,
just the location of the steel."

SEAU Presents:

LRFD Masonry Design

November 15, 2007
5:30 PM
WEB 103 at the University of Utah
(Formerly the EMCB)
Salt Lake City

Presented by Chris Pantelides, PhD, P.E.
Professor of Civil Engineering at the University of Utah

Dr. Pantelides will lecture on the use of the building code requirements for masonry structures as reported in the 2005 Masonry Standards Joint Committee Code and Specifications (ACI 530-05/ASCE 5-05/TMS 402-05), which is referenced in IBC 2006. The emphasis of the presentation will be the design of masonry using strength design. In addition, the proposed changes for inclusion in the 2008 ACI 530 Code will be identified and discussed.

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