cross sections

Magazine for the Structural Engineers Association of New York

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SEAoNY
536 LaGuardia Place
New York, NY 10012

www.seaony.org

publications@seaony.org

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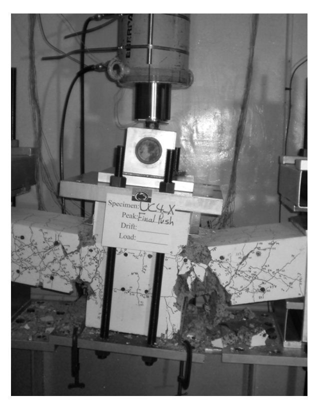
ON THE COVER

A failed concrete beam sample under hydraulic loading.

Photo: Hooman Tavallali



President's Message

At the time of this writing, another year of great SEAoNY programs and activities is successfully rolling along. I'm very pleased to report that we are on target to meet all of our annual goals for 2013-2014.

Our continued success is largely because of the efforts of many talented individuals, and on behalf of the board, I want to thank each of you for making SEAoNY's endeavors, which includes this issue of Cross Sections, as fantastic as they are.

SEAoNY is involved on your behalf on many fronts, some more visible than others. Of course we provide services directly to our members such as lectures, code updates, and social events, but our members and committees are also reaching out into the community and making a difference. Members are involved in evaluating and updating our building codes, improving the standards of how we practice, assisting students, representing us to other organizations, and coordinating with agencies like the Department of Buildings. For instance, many of you have been involved with the newly released 2014 Construction Code and remain involved in preparations for the creation of a NYC construction code for Existing Buildings. In addition, SEAoNY has representatives on the Concrete Industry Board, the Applied Technology Council, and the NYC Building Commissioner's Forum.

Our future is looking increasingly bright with new activities and initiatives. Some of these can impact you directly - such as our first Round Table covering the use of Building Information Modeling (BIM) in our practices, how BIM is being implemented in various structural engineering organizations, and what are BIM's strengths and weaknesses for us. Some initiatives will improve the safety of all New Yorkers – such as laying the foundation for a Structural Engineering License in the State of New York. And some will allow us to support the public in their most dire times of need as we have proposed an official Structural Engineering Emergency Responder (SEER) program in cooperation with both the city and state agencies of New York. These are exciting and important steps for our organization and state.

Of course, there is always room for improvement, and I am sure that there are other activities and initiatives that we should be pursuing. I welcome and encourage your input. SEAoNY is, and always will be, your organization.

Brian A. Falconer PE, SE

Editor's Message

Thank you for your membership and for reading the latest issue of Cross Sections. As we embark upon a new year of issues the Publications Committee strives to provide you with pieces that showcase or diversity as individuals and as an organization.

In this particular issue, we've included updates from SEAoNY representatives who serve as liaisons to various professional committees and organizations. We hope that this series may become a fixture in our magazine and provide a reliable forum whereby you can be kept abreast of recent innerworkings of SEAoNY.

You will also find articles touching upon the legal, technical, and ethical aspects of our industry.

At the programs committee we are always looking for opportunities for new article topics. Perhaps you've given a recent presentation to your office, or attended a lecture that you found to be informative or interesting, these are valid sources for suitable article topics and could conveniently segue into a feature piece for our publication.

Justin Den Herder, PE

UPCOMING EVENTS

March 18 @ the CfA — **Rewards of Failure: Changes in Codes, Standards, and Practices Resulting from Structural Failures**
Speaker: Robert T. Ratay, PhD, PE, Consulting Structural Engineer and Adjunct Professor at Columbia University. • *Registration @ 5:45 | Lecture @ 6:15*

April 15 @ the CfA — **Prototype Tsunami Evacuation Park in Padang, West Sumatra, Indonesia**
Speaker: Brian Tucker, President, GeoHazards International • *Registration @ 5:45 | Lecture @ 6:15*

Visit www.seaony.org/programs for additional information on these and other events!

SEAONY LIAISON REPORTS

UPDATES FROM ORGANIZATIONS & COMMITTEES

CONCRETE INDUSTRY BOARD

representative : Chris Cerino

Recently the Concrete Industry Board has renewed their partnership with SEAoNY by inviting me to be part of their Board of Directors in the liaison role. The CIB continues to work with Gus Sirakis of the NYCDoB to promote and enhance the Certified Concrete Producers program. Not officially required for projects, the CIB, through discussions with practicing structural engineers, is hoping to get this requirement inserted in project 03300 specification sections. On a similar note, the CIB has geared up to offer adhesive anchor certification classes. The first Field Grade 1 class was held on January 14th.

I am currently working with Bill Phelan of Euclid Chemical, in association with the SEAoNY Board of Directors, to develop a full-day concrete seminar geared toward structural engineers. The seminar will be approached from the perspective of a concrete specification and will give designers the technical background required to make the proper edits in their own spec, which may continually have out-of-date references or other language that leads to RFIs and change orders. The seminar will highlight trends in admixtures, today's concrete mix designs including test data, corrosion resistance techniques, testing, and much more. SEAoNY has agreed to cross promote the event so keep an eye out!

NCSEA CONVENTION

representative : Eytan Solomon

SEAoNY's Allan Olson and Eytan Solomon became the newest members of NCSEA's Publications Committee at the 2013 NCSEA convention in Atlanta in October. The national Publications Committee publishes design guides, reference manuals, and other technical materials under the auspices ofNCSEA. The committee finds authors for specific topics, coordinates contracts for the writing of the materials, edits the copy, and then arranges printing and selling through NCSEA. Because the process from finding authors to final publishing contains many hurdles, the committee pursues many potential leads on new publications at once: Currently the docket includes potential publications on a foundation design guide, special topics in wind provisions, pool design, tsunami design, structural glass, design for diaphragm irregularities, and others. Seven members of the committee met in Atlanta, representing a broad range of the industry, geographically as well as between academia and private practice. The committee is chaired by Timothy Mays, a professor at the Citadel.

APPLIED TECHNOLOGY COUNCIL

representative : Erleen Hatfield

I am the SEAONY liaison to the Applied Technology Council (ATC) a nonprofit corporation established in 1973 through the efforts of the Structural Engineers Association of California. Many engineers in NY are not familiar with ATC or think of it as a west coast organization, but it produces useful information for all structural engineers.

ATC's mission is to develop and promote state-of-the-art, user-friendly engineering resources and applications for use in mitigating the effects of natural and other hazards on the built environment. ATC also identifies and encourages needed research and develops consensus opinions on structural engineering issues in a nonproprietary format.

In this 41st year of ATC, they are busier than ever on a broad range of activities to develop and present state-of-the-art structural engineering resources such as the popular training and manuals for ATC-20 "Procedures for Post-earthquake Safety Evaluation of Buildings" or ATC-45 "Safety Evaluation of Buildings after Windstorms and Floods." But ATC has more to offer than these two staples.

The ATC "Windspeed by Location" website http://www.atcouncil.org/windspeed is a useful tool for structural engineers. On this website, by entering an address in the United States, users can retrieve wind speeds from ASCE 7-10, ASCE 7-05 and ASCE 7-93.

The online store sells reasonably priced guides for structural engineers on earthquake, wind, flood and other topics such floor vibrations or blast mitigation. The webinar training series is quite popular and the schedule may also be found on the website

I encourage you to visit www.atcounil.org to find structural engineering resources and support this well run and relevant organization for structural engineers.

CHRIS CERINO, PE SECB
is the Structural Engineering Director at STV. Inc.

ERLEEN HATFIELD, PE
is a Principal at Buro Happold.

EYTAN SOLOMON, PE
is an Associate at Robert Silman Associates.

BEHIND THE BENCH

THE CONTINUOUS REPRESENTATION DOCTRINE

By Kriton Pantelidis

Design professionals enjoy a distinct advantage from other non-professionals under a New York law: the time within which a suit must be commenced (legally known as the Statute of Limitations) against architects and engineers is three years, irrespective of whether the claim sounds in negligence or breach of contract.[1] Where the damages alleged are purely economic[2] in nature (i.e. not personal injury or property damage) the Statute of Limitation accrues upon the cessation of the professional relationship, usually defined as when the architect or engineer last rendered any meaningful – not merely ministerial – services for the project.[3]

However, being professionals, architects and engineers are oftentimes held to higher standards of care by the law. This fact also informs the rules surrounding their professional relationships with their clients. As a result, as with physicians and attorneys, if a design professional continually advises his client on matters relating to a particular contract after its completion, the Statute of Limitations may be tolled, extending the date until which a suit may be brought. This rule is known as the Continuous Representation Doctrine.[4]

As a legal matter, for the Continuous Representation Doctrine to apply, a plaintiff must prove: 1) there was a continuing relationship, 2) that relationship related to the original act of malpractice, and 3) an expectation by both parties existed that further services were needed in connection with the complained of conduct.[5] Practically this means that any further actions by a design professional must be close in time to the cessation of the services (or else a court may deem it a resumption of the relationship rather than a continuation) and have a strong nexus with the alleged injurious performance: A mere continuation of the general relationship is insufficient.

Considering these legal principles, there are discrete but effective steps that design professionals can take to limit the application of the Continuous Representation Doctrine and consequently their exposure to suit: 1) Provide the prior client with a new engagement letter or written agreement; 2) describe in detail the new scope of services to clearly distinguish them from the prior work performed; 3) create different job numbers for the resumption of any services; 4) segregate new project files (physically and/or electronically) from past documents when asked to perform new/additional services; and 5) subtly express an understanding that the services are added and not interminable.

While each project (and lawsuit) must be evaluated on a case by case basis, taking simple steps to avoid the appearance of an uninterrupted, specific course of professional services – when unintended – will allow an attorney to make further arguments in support of an early dismissal that would otherwise not be available.

KRITON PANTELIDIS, ESQ.
is an associate at Harris Beach PLLC Attorneys at Law.

REFERENCES:

[1]See *In re R.M. Kliment & Frances Halsband, Architects (McKinsey & Co., Inc.)*, 3 N.Y.3d 538, 821 N.E.2d 952 (NY 2004). As a general rule, the Statute of Limitations for breach of contract is six years from the date of breach. See CPLR § 213 and *Med. Facilities, Inc. v. Pryke*, 62 N.Y.2d 716, 465 N.E.2d 39 (NY 1984).

[2]New York's Economic Loss rule has various implications that affect design professionals, however, the nuances of that doctrine – including what constitutes pure economic or pecuniary loss – are beyond the scope of the present article. Let it suffice to say that most actions filed against design professionals by their own clients (usually owners and developers) seek losses of this kind.

[3]See *Sendar Dev. Co., LLC v CMA Design Studio P.C.*, 2009 NY Slip Op 9153; 68 A.D.3d 500; 890 N.Y.S.2d 534 (1st Dep't, 2009).

[4]Much of the case law may also refer to this maxim as The Continuous Treatment Doctrine, as it arose first in the context of physicians and their patients. However, this article uses the term "Continuous Relationship Doctrine" as that phrase is also found in the case law and is more apposite for the present context.

[5]*Weiss v. Deloitte & Touche, LLP*, 63 A.D.3d 1045, 882 N.Y.S.2d 229 (2nd Dep't, 2009).

RECONSIDERING REBAR

A CASE STUDY ON HIGH STRENGTH REBAR TESTING

BY HOOMAN TAVALLALI

FOR DECADES, THE DESIGN AND CONSTRUCTION OF REINFORCED CONCRETE STRUCTURES in the U.S. have been dominated by the use of deformed steel bars with specified yield strength, f_y, of 60 ksi. The use of steel bars with higher f_y values could potentially reduce the amount of required reinforcement; lead to savings on material, and shipping and handling costs. Lowering the required reinforcement ratio also alleviates congestion problems and improves construction quality.

The limitations on f_y of reinforcing bars can be traced back to the requirements of the 1956 ACI code (ACI 318-56[1]), where a limit of 60 ksi was specified. This limit was increased to 75 ksi in 1963 (ACI 318-63[2]) provided that full-scale beam tests were conducted to demonstrate that the average crack widths at service load levels did not exceed 0.015 in. This concern is expressed in the commentary to Section 1505 of ACI 318-63: "This section provides limitations on the use of high strength steels to assure safety and satisfactory performance. High strength steels frequently have a strain at yield strength or yield point in excess of 0.003 assumed for the concrete at ultimate. The requirements of Section 1505(a) are to adjust to this condition. The maximum stress in tension of 60,000 psi without test is to control cracking. The absolute maximum is specified as 75,000 psi to agree with the present ASTM specifications and as a safeguard until there is adequate experience with high stresses." The commentary on Section 1508 of ACI 318-63 states: "When the design yield point of tension reinforcement exceeds 60,000 psi, detailing for crack control becomes even more important. …The Code, therefore limits tension reinforcement to 60,000 psi yield strength, unless special full-scale tests are made." Later, the 1971 version (ACI 318-71[3]) relaxed the limit on f_y to 80 ksi (550 MPa) to continue accommodating the highest strength covered by contemporary ASTM standards, but the limit on f_y for seismic applications remained at 60 ksi. ACI Innovation Task Group 6 formed in 2007, has developed design guidelines for the use of ASTM A1035 Grade-100 steel bars for structural concrete for buildings located in low seismic design categories (ACI ITG-6R-10[4]). Figure 1 shows a sample stress-strain curve of the conventional Grade 60 reinforcement alongside with commercially available high strength steel reinforcement.

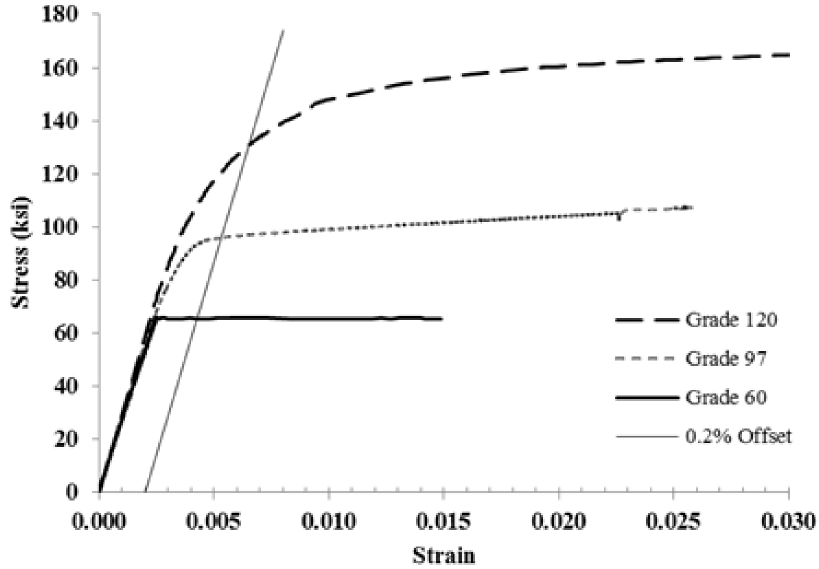
"An investigation... was conducted to provide benchmark data for studying the cyclic response of concrete beams reinforced with steel bars having **yield strengths approaching 100ksi.***"*

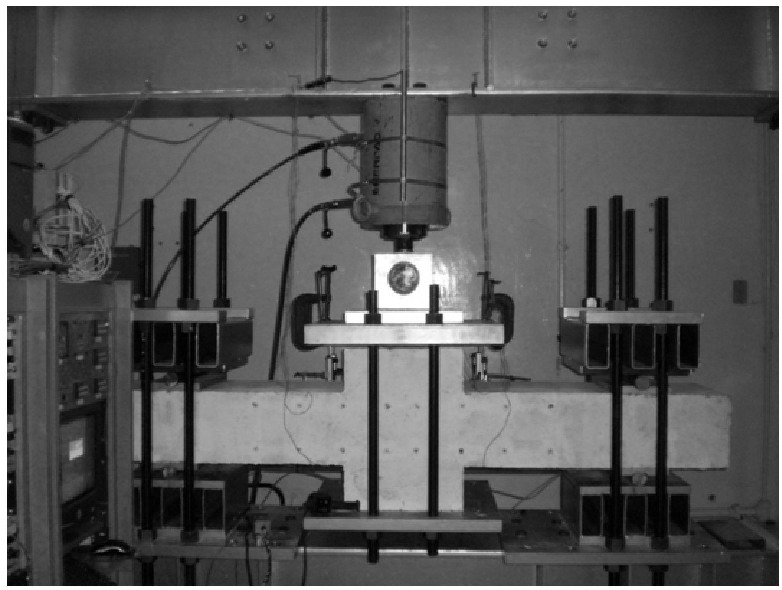
EXPERIMENTATION

An investigation aimed to reexamine limits introduced by ACI code, was conducted at Pennsylvania State University to provide benchmark data for studying the cyclic response of concrete beams reinforced with steel bars having yield strengths approaching 100 ksi (97 ksi)[5]. Seven specimens were subjected to large transverse displacement reversals (Figure 2): three specimens were reinforced with conventional steel bars (Grade 60) and four specimens were reinforced longitudinally with high-strength steel bars (Grade 97). All transverse reinforcement was Grade 60. The nominal concrete compressive strength was 6000 psi (for more details see Tavallali 2011[5]).

The specimens consisted of two beam elements connected to a central stub (Figure 2). Each beam element was intended to represent a beam cantilevered from the central stub. The overall length of each specimen was 88-in., consisting of two 36-in. long beam elements and a 16-in. central stub. The ends of the cantilevered beams were supported by rollers located 24 in. from the face of the central stub. All beams had the same cross-sectional dimensions, with an overall depth, h, of 10 in., and width, b, of 16 in., and an effective depth, d, of approximately 8 in. All beams were proportioned to have nearly identical flexural strength. All beams were tested under cyclic reversal loads. The load (i.e. shear force) vs. displacement of beams was recorded for all load cycles. The cyclic load test was conducted to provide a measure for seismic behavior of the beams. The drift ratio (or effective beam rotation) was defined as the ratio of transverse displacement to shear span, corrected for the rotation of the central stub. This definition of drift ratio closely corresponds to the interstory drift ratio of modern multistory frames (designed with columns stronger than beams), where inelastic action occurs predominantly in the beams. Figure 3 compares the hysteretic curves of a specimen reinforced with conventional Grade 60 reinforcement (CC4-X) with another specimen reinforced with high-strength reinforcement (UC4-X). Both specimens exhibited similar behavior. During cycles exceeding 1.5% drift ratios, specimen CC4-X showed a slight gain in strength while specimen UC4-X had a nearly flat shear vs. drift response. This difference is attributed to the differences in the stress-strain relationships of the longitudinal reinforcement (Figure 1). The comparison demonstrates that Grade 97 rebar is a viable option for seismic resistant design.

For reinforced concrete beams where a large fraction of the required reinforcement is due to seismic loads (for example, link beams between shear walls), crack widths due to gravity loads should not be a concern. However, if the gravity loads govern the design of beams, crack widths at service loads shall be limited. For many years concrete members were designed based on working stress design and the use of Grade-40 reinforcement. Crack control was seldom a primary design criterion. With the introduction of strength design provisions in ACI 318-63[2] and the use





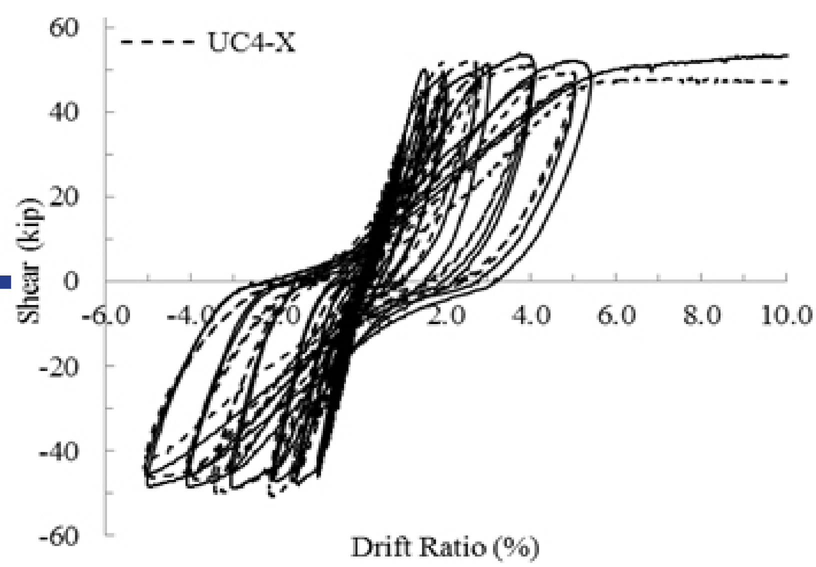


FIGURE 1 Sample stress-strain curves of Grade 60, 70, & 120ksi steel (Tavallali 2011).

FIGURE 2 Typical test setup.

FIGURE 3 Comparison of measured response, beams CC4-X north (Reinforced with Grade 60) and UC4-X south (Reinforced with Grade 97).

of higher grades of reinforcement, higher tensile stresses occurred during service conditions. The higher stresses typically led to wider cracks and the need for crack control. The occurrence of wider cracks may not be aesthetically acceptable, and may potentially increase the possibility of corrosion of the reinforcing bars. In versions of the ACI 318 code before 1999, provisions were given for distribution of longitudinal reinforcement based on a calculated maximum crack width of 0.016 in.

For the investigation conducted at Penn State, crack widths were measured in the test specimens. For meaningful crack width comparisons, an arbitrary reference service load was defined as the load corresponding to 60% of the nominal strength of the control specimen CC4-X, which corresponds to a shear force of nearly 35 kips. It is reminded that all specimens were designed to have the same flexural strength and therefore approximately the same service load demand. Figure 4 compares the crack widths at service loads for specimens CC4-X (Grade 60 Reinforcement) and UC4-X (Grade 97 Reinforcement.) Using high-strength steel bars (specimen UC4-X) generally resulted in increased crack widths. A comparison of the maximum measured crack width in specimen UC4-X with that of specimen CC4-X indicates that the crack width is nearly proportional to the specified yield strength of the longitudinal reinforcement. This indicates the need for considering specific measures to assure acceptable crack widths for gravity beams reinforced with high strength rebar.

LOOKING AHEAD

Using high-strength reinforcement could introduce several benefits to the AEC industry. It could alleviate congestion problems in many applications, therefore reducing the labor costs and improving the construction quality. This would result in more durable structures. Additionally the reduced amount of material usage and shipping would reduce the environmental impacts. The high strength rebar is commercially available now and experimental tests of concrete members reinforced with high-strength reinforcement (Tavallali 2011[5], Ratenburg 2011[6]) provide information and set a precedent for their mechanical behavior. Although, more research and experiments are needed with regards to serviceability issues such as crack control and deflections, the possibility of using high strength reinforcement in design and construction seems more likely than ever.

FIGURE 4

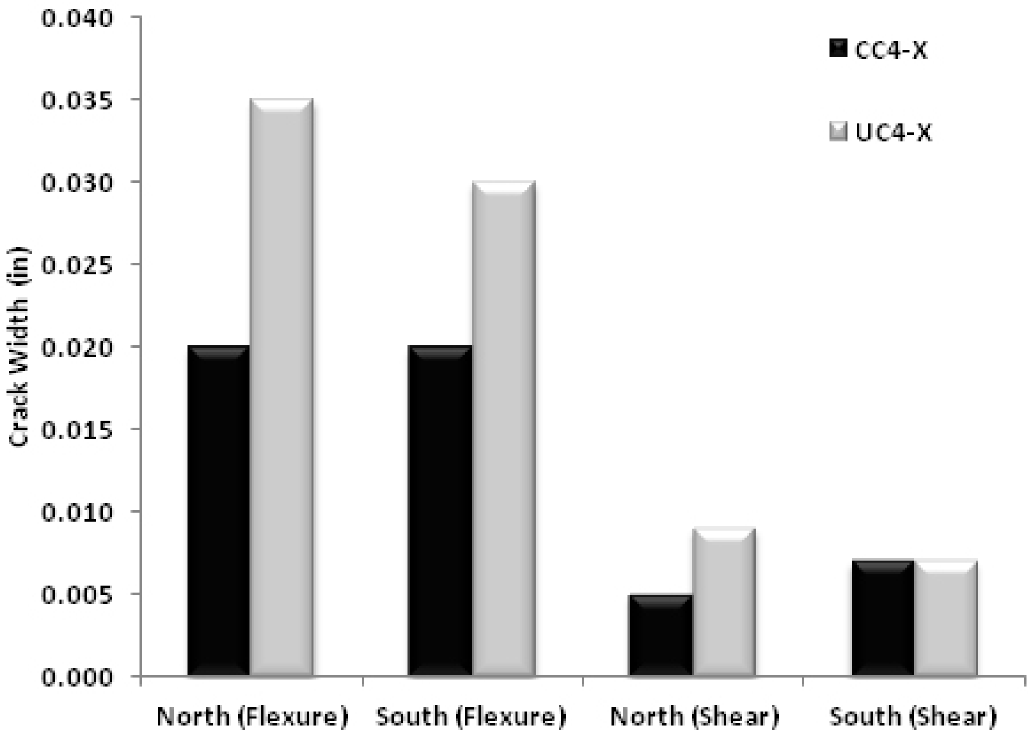


FIGURE 4 Comparison of Crack widths at service loads for beams reinforced with Grade 60 (CC4-X) and Grade 97 (UC4-X) bars.

FIGURE 5 Specimen UC4-X at the End of Test.

FIGURE 6 Specimen UC4-X after removal of loose concrete.

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[1]ACI Committee 318, *Building Code Requirements for Reinforced Concrete (ACI 318-56)*, American Concrete Institute, Detroit, MI, 1956.

[2]ACI Committee 318, *Building Code Requirements for Reinforced Concrete (ACI 318-63)*, American Concrete Institute, Detroit, MI., 1963.

[3]ACI Committee 318, *Building Code Requirements for Reinforced Concrete (ACI 318-71)*, American Concrete Institute, Detroit, MI., 1971.

[4]ACI Innovation Task Group 6, *Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete*, American Concrete Institute, Farmington Hills, MI, 2010.

[5]Tavallali, H., *Cyclic Response of Concrete Beams Reinforced with Ultrahigh Strength Steel*, Ph.D. thesis, The Pennsylvania State University, University Park, PA, 2011.

[6]Rautenberg, J. M., *Drift Capacity of Concrete Columns Reinforced with High-Strength Steel*, Ph. D. thesis, Purdue University, West Lafayette, IN, 2011.

HOOMAN TAVALLALI, PE
is a structural engineer at LERA

FIGURE 5

FIGURE 6

OUGHT WE?

ETHICALITY MUST EXTEND BEYOND THE NUMBER-CRUNCHING

> *"What is being promoted here is* **moderation and diversity in our project selections** *for the welfare and improvement of our society as a whole..."*

"YES, WE CAN BUILD IT, BUT OUGHT WE BUILD IT?"

That was the question posed by Robert Silman during a recent lunch time presentation in our office. The question was direct and succinct. As far as I was concerned, it was the paramount question to my career, one that required answering.

We are found daily at our desks, in our cubicles, in our conference rooms, discussing and debating the nuances and details of our design approaches and their implementation.

And it is imperative and obligatory that we do so.

But, before we even arrive at that stage, the design phase, as engineers and as humans, we must first satisfy a prerequisite.

"Ought we build it?"

We have all entered our beloved occupation with certain aspirations, some perhaps, more grandiose than others, but as a baseline I think it's appropriate to state that we have embarked on a profession that endeavors to serve our society, our city, our community as a whole by designing safe, useful buildings while earning a steady, comfortable living for ourselves and our families.

We have entered our profession with this simple, pure, and noble motivation.

We begin working. We are staffed to new, exciting projects. Before long our schedules are jam-packed with delegated analysis tasks and deadlines, so much so that we become entirely immersed in these efforts. They, our projects, become part of us, part of how we identify ourselves. At times we feel the tremendous weight of responsibility, but we forge ahead through deadlines, we continue to learn and adapt, to manage ourselves and our teams more effectively onward to the next deadline. We assume more work, our roles within our respective firms grow. And so our time gets filled, focused on churning out quality products as efficiently as we possibly can.

And that is commendable and necessary.

But I'm fearful that a scenario such as this leaves little time for contemplation of our profession at a broader level. We lose sight of the overall context that is informed by the philosophical imperative. The perspective that grants meaning and purpose to our profession, or to delve even deeper, the purpose of our existence.

By JUSTIN DEN HERDER

"There is no better catalyst for efficiency than **disciplined passion***."*

OUGHT WE?

Yes, this means understanding how our projects impact our world ethically and socially. Abbas El-Zein wrote a poignant article in the Guardian on the necessity of engineers to understand the ethical impact implications of their work. This is hardly a new topic for debate, it has been present since the Manhattan Project and far earlier; its origins can most assuredly be traced back to the dawn of Engineering.

This philosophical notion of "ought we", this manner of careful introspection, must influence the types of projects that we assume, not just as individual firms, but as a unified profession.

Are the projects that you are currently working on contributing to a city in which you would love to work and raise your own family? Are we fostering a city top-heavy with high-end residential and high-end retail developments or are we striving to create a balanced, diverse, educated, healthy city? To be clear, a moderate approach does not eliminate any particular market sector, it merely suggests that project diversity, a prudent dosage of public and private, high end and affordable, creates a sustainable path forward. Does our project portfolio on the whole as a profession reflect this? If not, what does that say about us and what we value and esteem most dearly, as a profession, as a firm, as an individual?

We strive for efficiency within our firms. We are altruistic beings. There is no better catalyst for efficiency than disciplined passion. Just observe the production levels of an employee who truly believes in her purpose, who is convinced that she is contributing to create a better society. With proper oversight and guidance, such an employee can be a formidable asset to any firm. Let us allow compassion to permeate our work lives. Let ours be a generation that sought for ethicality above all, ethicality in our project selection. For if a great paradigm shift doesn't start with us, namely Professional Engineers sworn to uphold an ethical standard more stringent than the status quo, then who will bring it about?

The hull of a great ship turns with the slightest angular shift of a small rudder. What is being promoted here is moderation and diversity in our project selections for the welfare and improvement of our society as a whole, for the fulfillment of our purpose, understanding full well the challenges that this entails, the pressures and obligations that fall upon the shoulders of firm leaders in our industry to maintain financially viable offices and to ensure that their employees can be fairly compensated. Our intention is not to vilify, but rather to cultivate an atmosphere of reflection and introspection, to challenge our current processes by holding them up to the flame of scrutiny, and to boldly encourage change where change is due.

Le Corbusier stated, in an essay wherein he proposed radical revitalization to the urban planning paradigm of his time "The bold spirits will be willing. But what of the rest? They will tremble all over! Very well then let the bold spirits invent the catapult which will fling everybody into the adventure. It will be something new. Everyone thrown into the water. They will have to swim. Yes! They will swim and they will reach the new shore."

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Abbas El-Zein, *As Engineers, We Must Consider the Ethical Implications of Our Work* http://www.theguardian.com/commentisfree/2013/dec/05/engineering-moral-effects-technology-impact, 5 December, 2013.

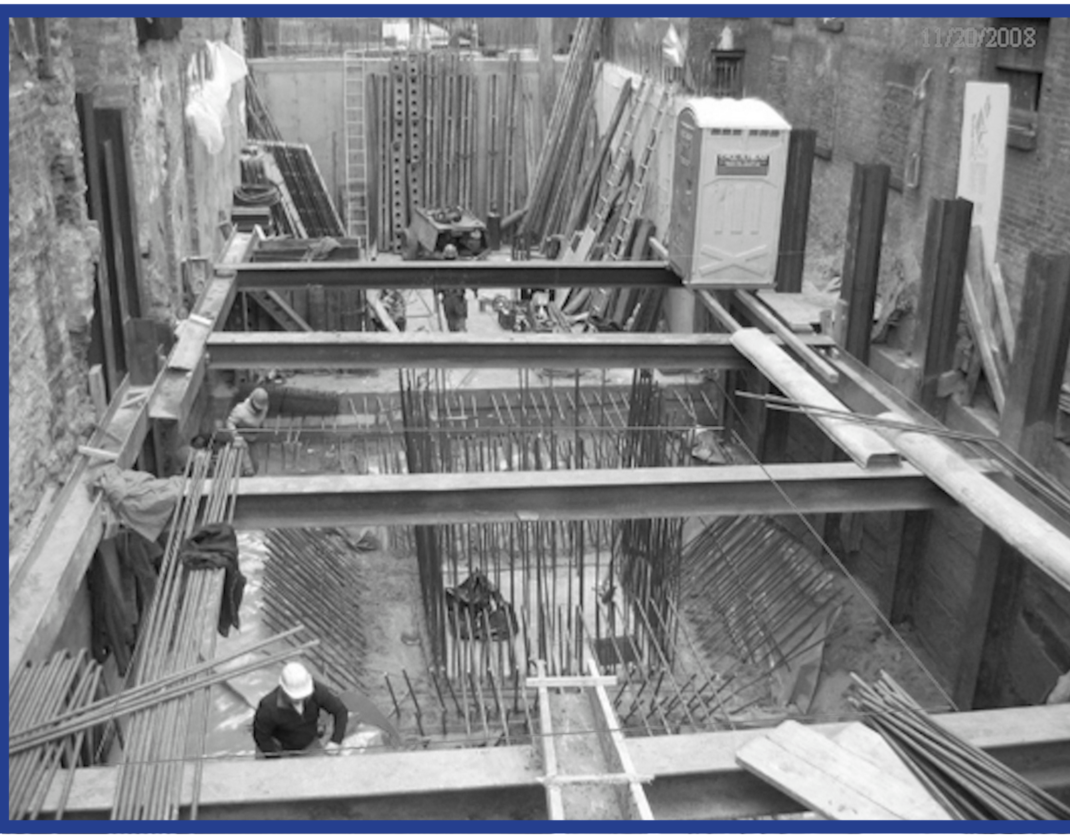
Le Corbusier Volume 3: 1934-38, English translation by A. J. Dakin, pages 20-24 Quatorzieme edition 2006, (Original Edition 1938).

JUSTIN DEN HERDER, PE
is a structural engineer at Robert Silman Associates.

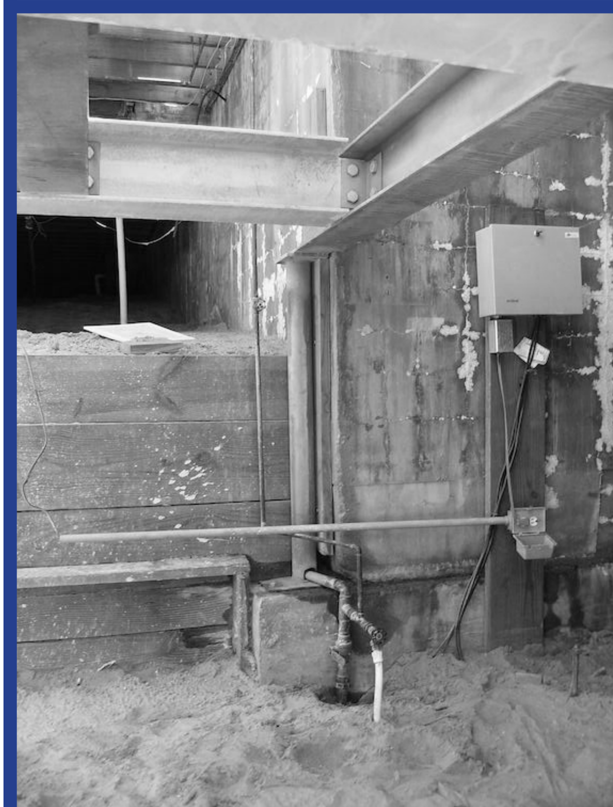
Partial building demolition provides egress shortcut.

Presence of unanticipated field conditions.

Bathroom is just down the hall and... to the right.



Really...
That spigot couldn't fit anywhere else?



Compiled by : Eytan Solomon

Out of Tolerance

SITE VISIT ADVENTURES

EYTAN SOLOMON, PE
is an Associate at Robert Silman Associates.

SEAoNY
536 LaGuardia Place
New York, NY 10012

SEAoNY THANKS ITS SUSTAINING MEMBERS

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WSP

Buro Happold Consulting Engineers

CASTCONNEX

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RGCE — ROSENWASSER / GROSSMAN Consulting Engineers, P.C.

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WAI

STRUCTURAL ENGINEERS ASSOCIATION — SEA — NEW YORK