**PCMAC/Caltrans Workshop**
**Caltrans TransLab**
**Sacramento, CA**
**November 17, 2011**

1. Welcome and Opening Remarks:

The Workshop was called to order by the California State Bridge Engineer, Barton Newton, at 8:30 AM. He gave opening remarks and welcomed the group.

2. PCMAC Welcome; Introductions:

Doug Mooradian, Executive Director of PCMAC, gave welcoming remarks. He introduced PCMAC Producer Members and announced that PCMAC is now a Chapter of PCI. He thanked and noted the workshop sponsors: AECOM, NBM Splice Sleeve, SWPC, DSI, and Caltrans. A few successful precast projects were mentioned including the Angeles Crest and Dana Point projects. Doug mentioned that they are now getting into precast pavement market. PCMAC strives to advance the design, manufacture, and use of plant fabricated, precast, and prestressed concrete products and systems in California. Education, dissemination of information and communication with industry are important aspects to having a successful project.

3. Caltrans DES Welcome; News:

Barton Newton gave welcome and opening remarks for Jim Davis who wasn't able to attend. He thanked Jim Ma, Sue Hida, and Doug Mooradian for setting up the workshop. Barton discussed Caltrans' budget for future work. A sizable portion of Caltrans' work comes from the Federal Highway Trust Fund and the news coming from the federal government regarding that is not good. The future workload is trending downward. However, the condition of the infrastructure is showing its age and will need attention to keep them in operation. He stressed the need to get better at preserving the existing infrastructure as well doing work faster, with less money, and without losing quality. He noted that precast products provide that quality. He challenged the group to look for limitations in the new precast technology with the goal of getting them solved so that they become standard tools to help us with our work. He gave an example of how research on the seismic performance of precast structures has cleared up some of the limitation issues. He mentioned that the Federal Highway Administration (FHWA) is encouraging states to employ Accelerated Bridge Construction (ABC) through their "Every Day Counts" Innovation Initiative. While implementing ABC practices, we need to ensure long-term performance and durability. Within the Division of Engineering Services, the new Subdivision of Structure Policy and Innovation (SP&I) was created to work on and improve Caltrans' standards and guidance material. This group will also focus on risk management strategies to mitigate project risks, and improving the new bridge standards and detail sheets many of which have recently been released. Caltrans will be staying with the AASHTO LRFD 4$^{th}$ Edition (with CA Amendments) and will adopt the 6$^{th}$ Edition in 2013. Work is currently being done to update the CA Amendments for the new edition.

Bart also discussed the recent news article about fabrication of gamma-gamma testing data and said that the three locations in question are safe. The gamma-gamma testing that is done by Caltrans is above and beyond what is done in other states – some states do not perform gamma-gamma testing of their cast-in-drilled-hole (CIDH) piles. He also explained that pile quality does not necessarily equate to structural integrity.

He concluded by encouraging everyone to get something from this workshop.

4. Co-hosting Subdivisions SD/SC/METS:

This discussion item was cancelled.

5. Caltrans Accelerated Bridge Construction (ABC) Update:

Roberto Lacalle from Caltrans, Office of Structure Quality Management gave an overview of ABC and presented examples of where it is has been applied throughout the state (I-580 connector replacement, I-5 Truck Route UC repair, I-40 Mustang Wash Bridge, Craig Creek Bridge in District 2, San Francisco-Oakland Bay Bridge roll-in, and Hardscrabble Creek Bridge on Route 199). The FHWA is promoting ABC and Prefabricated Bridge Elements and Systems (PFES) as part of the "Every Day Counts" Innovation Initiative. Currently ABC has been used on high profile and emergency projects. Caltrans' goal is to use ABC on conventional projects. ABC research is being done to make ABC more practical and provide confidence in theoretical application. Research on the seismic performance of inverted T-caps was recently completed. The recently completed Planning Phase Decision Making Tool was developed to help determine if ABC should be used over traditional methods. It involves comparing various criteria to determine whether ABC should be employed. This fall, formal ABC methods will be presented to Caltrans' management and boards to show the benefits of ABC and how it can be utilized as a tool. ABC policy, action plan, guidance and technical standards as well as training for designers are being developed. Ultimately ABC will be available as an on-line tool.

6. AASHTO T10 Concrete Committee; technical partnership w/PCI:

Sue Hida from Caltrans, Office of State Bridge Engineer Support and AASHTO HSCOBS T-10 Technical Committee Member, presented a "behind the scenes" look at AASHTO BDS, Section 5: Concrete Structures. She provided an overview of what the AASHTO T-10 committee is responsible for, what they are working on, how changes get implemented into the new design codes. Examples of on-going research include: calibration of service / fatigue factors, strand debonding specifications, performance of HP/HS/lightweight concrete used in girders and decks, and PS loss values. Topics and research possibilities for 2013 were noted with the acknowledgement of the support of PCI.

7. PCI Overview: Relation to PCMAC, Bridge Committee and Seismic Subcommittee, Plant Certification, Bridge Manual, Journal, Seminars, Awards, assistance with "Every Day Counts":

William Nickas, the Managing Technical Director of Transportation Services for PCI, and former State of Florida's Chief Structures Engineer, gave an overview of PCI and the PCI perspective. He discussed the history of PCI (founded in 1954) and the National Quality Initiative by FHWA in the 1990's. He talked about the 12 elements that make them a unique institute: 1. Industry, 2. Clearly Stated Purpose, 3. Broad Professional Involvement, 4. Governance and Consensus, 5. Research, 6. Validation, 7. Dissemination, 8. Certification of Personnel, 9. Certification of Fabrication Process, 10. Independent Audits, 11. Feedback and Recourse, and 12. Continuing Commitment.

He mentioned the State-of-the-Art Report on full depth precast bridge deck panels and the PCI website which has information and an e-learning center for free online training. He also talked about the National Highway Institute training course. PCI serves to advance the industry, is non-profit, and strives for accountability and problem solving. It is important to consider Life Cycle Analysis for concrete products which include the discussion of long-term life vs. the energy consumed to manufacture the products (with the ability to use "waste" materials as part of their products).

8. Precast Bridge Performance During the 2011 New Zealand Earthquake:

Mark Yashinsky from Caltrans, Office of Earthquake Engineering presented observations from his post-earthquake assessment of bridge damage from three recent earthquakes. He started with the magnitude 8.8 Chilean earthquake that occurred on February 27, 2010. He showed photos of the damage and noted that if the bridges had better shear keys and wider seats there would have been less damage. It was also observed that the typical two-span bridges over the divided highway rotated. The second earthquake discussed was the magnitude 6.3 New

Zealand (Christchurch) earthquake that occurred on February 22, 2011. The bridges there performed well, in large part to the strong seismic code under which they were designed. Photos of the damage observed at the Anza Bridge, Chaney's Overcrossing, and Fitzgerald Bridge were shown. The bridges survived the earthquake fairly well. One major observation was lateral spreading of the embankment fill that pushed the abutments in to the structures. Although the abutment piles were damaged, the fact that the abutments moved into the structure kept them from unseating. It is important to provide an Earthquake Resisting System (ERS) in order to obtain good structure performance. The AASHTO Guide Specification for the Seismic Design of Highway Bridges provides ERS examples.

9. Precast Bridge Performance During the 2011 East Japan Earthquake:

Jim Schroder from NMB Splice-Sleeves presented the Splice Sleeve coupler system and their application. A video of the testing on the system was shown. It was noted that ACI 550 allows cast-in-place detailing in precast structures. Test done in Tokyo showed that precast elements with proper detailing performed similarly to cast-in-place elements. University of Nevada Reno (UNR) testing on columns with the Splice Sleeve system showed good results. Jim suggested that Caltrans' current ten times bar diameter rule on staggering splices should be re-evaluated based on the UNR and other recent test results. He showed examples of where the NMB Splice Sleeve system has been employed on bridges in the United States. On the I-85 Interchange project in Georgia, a project where ABC was employed, the Splice Sleeve system was used to connect precast columns to the footings allowing the contractor to speed up construction of the substructure. He also showed a bridge that was constructed in eight days using precast elements.

The performance of precast structures in the 1993 Guam EQ, 1995 Kobe EQ, and 2011 East Japan EQ/Tsunami was discussed. In all three earthquakes, precast buildings performed well. It was pointed out that there exists a similar seismic condition along the northwestern coast of the United States as one along the eastern coast of Japan. In the 2011 Japanese EQ, it was observed that some bridges floated off their piers due to the formation of air pockets between the deck and girders and more than 90% of the total damage was caused by the tsunami and liquefaction. PCI sent a reconnaissance team to Japan and their report will be coming out soon. The emulative precast concrete elements with the NBM system performed well, even at those locations where the splices were not staggered.

10. Caltrans Research – Seismic Connections in Prefabricated Superstructures:

Professor Sri Sritharan of Iowa State University presented the research results on seismic connections in prefabricated superstructures. The scope of the research project was to understand the seismic behavior of inverted-tee bent cap to I-girder connection. He showed details of the standard inverted-tee and I-girder connection and pointed out that a pin was expected to form in the connection due to the lack of positive moment capacity in the girder/bent cap connection. An improved connection using the prestressing tendons (untensioned) to tie the girder to the bent cap was included in the 50%-scale test model for study. (Google Caltrans inverted-tee test to see video of the test.) Results showed better performance than expected. Some of that is attributed to higher than expected concrete strength. The observed girder load distribution was 20%, 25%, and 15% for the center, intermediate, and exterior girders respectively. It was close to the calculated values of 22.8% center, 21.2% intermediate, and 17.4% exterior.

The outcome from Phase 1 testing was good. Phase 2 testing involved moving the vertical actuators toward the center of the girders to move the girders up 3" and down 6". The Phase 2 results showed that the girders pulled out of the bent caps. There was a noticeable difference between the as-built and improved connections. The improved connection was elastic and possessed higher moment capacity.

The conclusion from the tests was that the as-built condition behaved as fully continuous connection during seismic loading but that detailing is not recommended for new bridges. The takeaway from that is that the as-built inverted-tee cap/I-girder connection detail in existing bridges is not as bad seismically as originally thought.
Question: Was the connection using the prestressing strands designed to handle long-term creep?
Answer: That was not looked at but that can be calculated.

11. Caltrans Research – Seismic Connections in Prefabricated Substructures:
Ron Bromenshenkel from Caltrans, Office of Structure Design presented information on the work and research being done on the Next Generation Bridge (NGB) program. He showed details of the proposed seismic connections in prefabricated substructures and results of testing done at the University of Nevada, Reno and the University of Washington. At UNR, couplers that connect the main column reinforcement to the footing were studied by testing the connection in 50% scale precast column models. Results showed that the couplers were stronger than the traditional cast-in-place specimen. The University of Washington has tested steel concrete filled tubes embedded into concrete footings and found that with proper embedment, the system is capable of achieving similar performance as cast-in-place columns. The isolated precast bridge concept, in which the superstructure is isolated from the substructure via lead-rubber bearings to reduce seismic demand, was also presented. There was a test of an isolated steel bridge done at UC Berkeley in October 2011, a video of the test was shown. One challenge to the isolated bridge concept is to make it work for the new LRFD loads as well.
Plan sets for a 2-span single column bridge, a 2-span 2-column bridge, and 3-span 2-column bridge with the NGB details are being generated to help determine the cost of the typical NGB; life cycle costs will be considered as well. The plan sets will also serve as guidance material.

12. 405 Design/Build Project:
Jon Hamaguchi from Caltrans, Office of Structure Construction discussed the progress of the 405 Sepulveda Pass Improvement project. He gave an overview of the 10-mile long project in District 7 near UCLA from I-10 to Hwy 101. This design/build project will add a high-occupancy vehicle (HOV) lane along northbound I-405. The project is funded by Los Angeles County MTA (LACMTA) with Caltrans serving as administrator on the contract. One of the biggest challenges is coordination between the numerous stakeholders. The project includes 24 bridges and 130 retaining walls. The prime contractor is Keiwit and HNTB is the designer. Keiwit is performing the inspection. Twenty-five percent of the $1.4 billion budget is being used for the utility work. The project is currently 50% into the schedule with 40% of the work completed. Fifteen of the 24 bridges and 33 of the 130 retaining walls are under construction. The substantial completion date is May 2013. Sunset Blvd Overcrossing, the second largest bridge on the project utilizes precast girders and precast deck panels. There are several bridge types in the project: Bulb-Tee, voided slab, I-girders, and steel girders. There are 30 MSE walls on the project; the longest is 2000' long. Corrosive soils and differential settlement are challenges that the contractor is dealing with. Precast deck panels are being used on four bridges. Design challenges with the precast deck panels include: 1. not enough room for electrical conduits, 2. space for electroliers or pendent lights, 3. where to put utility hangers, 4. skewed bridges, 5. camber variance due to skew, 6. variable girder spacing – splayed or sweep, 7. high cross slopes.
The second half of the Mulholland Bridge will be taken down in 'Carmageddon II'. Public relations is a challenge – there are six PR staff on the project to deal with complaints.

Question: Why isn't the design builder coordinating the utilities work?

Answer: They are. MTA staff is doing inspection and serving as liaison to the utilities. There is a $39,000 / day delay cost which is why it is important to get the utility agreements promptly.

Question: Is the fact that the contractor inspects their own work the way it is written in the contract?
Answer: That is the way it is and will be in other design/build contracts.

13. Introduction to the New 3rd Edition PCI Bridge Manual:

William Nickas presented an overview of the new Precast Prestressed Concrete Bridge Design Manual by PCI. The original manual was published in 1997. The 2nd Edition was published in 2003 and updates have been provided since. The new 3rd Edition PCI Manual includes updates for LRFD and LRFR, which correspond to the AASHTO LRFD Bridge Design Specification, 5th Edition. One of the most significant revisions to the manual is Chapter 9, which includes expanded design examples. He walked us through each chapter noting important changes and improvements. Chapter 1 includes an interesting discussion on sustainability. Some high-lights about concrete structures include: durability, disaster resistant (including blast loads), concrete can use recycled / waste material within its mixture, and the carbon footprint is low when you look at life-cycle use. Chapter 2 includes updates on HP Concrete materials. Chapter 6 has valuable charts and tables (stresses, member sizes, weights, P/S forces, etc.) for preliminary design. Chapter 8 discusses design theory and procedures, noting that there are many choices for shear design. As noted above, Chapter 9 has many design examples showing various design choices. Chapter 10, Bearings, was completely rewritten. Chapter 18 was also completely rewritten for Load Ratings. Everyone was encouraged to purchase the new PCI manual.
Mr. Nickas also discussed Precast Prestressed Concrete Pavements (PPCP) and full-depth precast decks on girders. PCI and FHWA have a CoOp Agreement to provide guidance documents. The guidance material will include information on design, installation, construction tolerances and geometric control issues.

14. Butterfield Bridge Project, First Wide-Flange Girder Bridge in CA:

Po Chen from Mark Thomas & Co. Inc. presented the Butterfield Blvd. OH bridge project located in the City of Morgan Hill. The CA wide-flange (super) girder was utilized in the bridge design that will extend Butterfield Blvd. over an existing railroad line. Design was from 2008-2010. Bid opening was in 2011. The low and high bids were $15 million and $16 million respectively. The project is locally funded. The bridge will be a 2-span structure (90' and 130') with a structure depth of 6'. The girders will be supported by a drop cap. The girders are 5' deep and spaced at 10'. A shallower girder with a depth of 4'-6" was considered but it required a concrete strength of 10 ksi which drove the cost up too much.
Transport of the girders was discussed. Cost analysis of various girder lengths showed that the cost is about $1000/CY and $50,000 for erection of the 18 girders. Po showed photos of I-girder construction in 1975 for the Yuan Shan Bridge in Taipei, Taiwan and compared it to today's construction methods. He brought up construction issues that are to be considered and stated that constructability issues need to be addressed early in the design phase.

Doug Mooradian noted that anything over 125' long will require special permitting to transport. Girders up to 150' have recently been done without the need for splicing.

15. Prestressed Stay-In-Place Concrete Deck Panel Construction:

Brent Koch from Con-Fab CA Corp. discussed the use of precast prestressed stay-in-place concrete deck panels. He referenced Chapter 16 of the new PCI Manual for guidance. He noted that this technology is not new and it is widely used outside of CA. It is valuable for speed of construction, improved safety, better quality and less construction waste. A 'standard'

panel is 8' long, 3.5" thick and used 3/8" prestressing strands. He commented about Caltrans' new XS standard drawings that will be available in the near future. The XS sheets will have 2 construction alternatives to choose from: camber strips or leveling bolts. S-I-P concrete deck forms are being used on the Design-Build I-405 project. Brent explained the fabrication and installation process.

16. I-680 Precast Prestressed Concrete Pavement Project:

Tinu Mishra, a Caltrans District 4 Materials Engineer, presented the precast prestressed concrete pavement rehabilitation project on I-680. The project replaced existing 40 to 50 years old pavement along 12.8 miles of I-680. Five miles of the project included precast elements. He showed the typical FHWA precast pavement panel and how it is installed. Then he discussed how Con-Fab revamped the design by making the panels longer (18' – 36') and replacing the anchor block pockets on the surface of the panels with recessed block outs at the panel ends. The changes were an improvement over the original FHWA precast panel design. He showed us pictures of the installation process (grade lean concrete base, lay down bond breaker, install epoxy coated prestressing strands, stress, and diamond grind the surface).
Construction challenges included: varying lane widths, installation under structures (17' vertical clearance), dowel alignment, spalling of panel edges during installation, isolation joints >>1/2", and accurate layout of transverse joints.
It was mentioned that the largest precast pavement project in the world is currently in Java, Indonesia, it is 22 miles long.
He concluded by saying that they are working on precast approach slabs.

Question: Was the grout of a special type?
Answer: It was a standard grout.

Question: What is the expected life span of the precast pavement slabs?
Answer: About 40 years, but that is probably a conservative estimate.

Question: What was the purpose of the bond breaker?
Answer: It keeps the panel separate from the base to: keep the base from getting into the joint, allow the panels to shorten during prestressing, and enable the panels to be re-lifted off easily.

17. Typical Handling of Utilities in Precast Bridge Structures / Stay-In-Place Precast Full Depth Bridge Deck Panels / and the Handling of Long Span Precast Girders:

Larry Bohne, Engineering Manager from Coreslab Structures (LA) Inc., presented these topics. He explained that utilities can be hung between precast girders from either threaded inserts or clips attached to the edge of the girder flange or deck panel. Precast boxes can have the conduits cast into the box void. Handling of long span girders is a fabricator's issue, but the designers need to be aware. The girder shape determines the amount of bracing needed for handling and transport. Bulb-T girders are much more stable than I-girders. Bulb-Ts can be hauled up to 145' while I-girders are limited to about 130'.

18. Every Day Counts in Improving Mobility: Accelerated Bridge Construction over Craig Creek:

Christian Santos of Caltrans Structure Construction gave a presentation on the Craig Creek Bridge project in District 2 which employed ABC. Nearly all of bridge elements were precast except for the deck and barrier. The project had originally been planned to be done in two construction stages but was changed to one. A Mabey Bridge was use to temporarily detour the traffic. The new bridge was assembled in four weeks. (If everything had gone as planned, it would have been built in three weeks.) Photos of the construction were shown. Improvements to the CIP deck include quiet deck construction, use of shrinkage reducing admixture, synthetic macro fiber reinforcement, and high performance cure.

Question: Why not cast the barrier onto the exterior girder or pour higher to reduce finish work?
Answer: The extra weight was too much. The barrier will crack. There would be a differential camber issue because of a different strand pattern in the exterior girders.

Question: Did the contractor work double shifts.
Answer: The contractor only worked a single 12-hour day shift although they did work a couple weekends.

19. Closing Remarks:
Doug Mooradian and Sue Hida thanked everyone who attended and presented.