

PCI Research Needs List

September 2017

Category	Subject	Comments
Parking Structures	Performance of double tee flange connections and joint leakage	
	Durability enhancement in precast concrete parking structures	
Seismic	Improved diaphragm connection performance when subject to earthquake loading	Connection characteristics are defined – new connections need to be qualified
	Simplified seismic connections for precast concrete shear walls	
Anchorage to Concrete	Effects of reinforcement in anchorage concrete breakout zones	
	Effect of reinforcement on side face anchorage breakout strength	Is shear friction strength provided by column ties at studs in column face plates effective in developing the anchorage strength across side face breakout failure planes?
	Simplification of anchorage calculations	Combine with a study of LW vs NW concrete
	Strand lifting loop capacity	
	Anchorage in lightweight concrete*	
Connections	Effective shear friction coefficient for smooth surfaces	
	Dowel action as an alternative to shear friction	ACI 318 does not cover dowel action in connections
	Simplified connections of prestressed bridge girders to deck	
	Reduction of volume change restraint forces in bearing pads	The N_u force used in bearing calculations can be calculated if the shear stiffness or slip stress of bearing pads is known.
	Post-tensioning anchorages in hybrid frames	Early research on the hybrid frame indicated potential issues with P-T anchors under cyclic load
Wall Panels	Effect of multiple insulation layers on composite behavior of precast concrete sandwich panels	
	Crack mitigation for insulated panels with solid spots	
	Effect of reinforcement to improve edge lifting devices in thin panels	
	Effective stiffness of vertical panel groups mechanically connected across vertical joints	Concern is how to evaluate the effective stiffness of such panel groups considering the flexibility of connections across vertical joints for proper modeling of systems
Erection	Temporary bracing design for vertical precast members	
	Probability study for temporary bracing loads	Provide design guide for address temporary loads
	Tripping and rotating erection methodology	

Systems	Hybrid frame application to disproportionate collapse	Hybrid frames used for seismic resistance may have significant capacity for disproportionate collapse
	Wind Energy	Precast concrete structures may have application in the generation of wind power. System developments are required
Component Design	Improved detailing of double tee bearing plates	
	Minimum shear reinforcement in double tee stems	
	Shear strength in end regions of pretensioned members	In particular, this should address anchorage of longitudinal reinforcement for reliable shear strength.
	Headed deformed bars as shear reinforcement*	
	Effects of partial debonding of prestressing strands	Include consideration of lightweight concrete
	Release stresses in pretensioned members	Consider all sections where compression and tension must be considered
	Post cracking shear strength of bridge girders using self-consolidating concrete	
	Use of high strength reinforcement for spirals in prestressed concrete piles	Can allowable yield strength of spirals be increased to 120 or 150 ksi?
	Minimum spacing requirements for large prestressing strands	
	Inverted tee or spandrel beams that require more prestress than a plant can pull on beds/abutments	How to determine strength and stresses for combined pretention (with strain compatibility) and unbonded post-tensioning (without strain compatibility)
	Concrete filled cores in hollow core slabs	Research increase in shear capacity and effect of materials, timing and method of placement.
	Hangers for openings in hollow core slab systems	Explore different hanger designs and effectiveness including support of reaction at adjacent members.
Deflection calculations for Class T and C prestressed flexural members	Examine available data to evaluate current calculation methods and propose better methods	
Sustainability	Development of tools for Life Cycle Assessment of parking structures	Sustainability assessment of parking structures requires new criteria to understand the benefits of high performance precast concrete construction

	Development of detailing to enhance resiliency in precast concrete structures	As compared to other construction materials, precast concrete has opportunities for superior resiliency for fires and natural events.
	Development of better tools to assess the positive effects of thermal mass on operational efficiency of structures	
Materials	Cement replacement in concrete mixes	Sustainable concrete specific to precast
	Characteristics of SCC*	Include creep, shrinkage, early age modulus and shear strength
	Structural design guidelines for sand lightweight concrete	
	Effects of elevated temperatures from fire on fiber reinforcement and FRP composites in precast concrete structural members	
	Rate of tensile strength gain vs compressive strength gain in lightweight concrete	This information would contribute to knowledge on early age strength of anchorage in concrete
	100 year life for structure and repairs	Bridges and, eventually, parking structures will have requirements for a 100 year life. Materials and detailing need development to meet this requirement.
	Delayed ettringite formation (DEF)	This research will evaluate the use of the “delta ettringite” testing method, which was developed as part of a PCI funded study in the late 1990’s. This proposed work will extend the scope to include measurements of concrete at later ages.
Architectural Precast	Effect of moisture content on APC color	Architectural panel color can be judged at many different ages. What is the effect of moisture content?
	Bond of face mix and backup mix in APC	
	Anchorage in thin APC panels constructed of UHPC	
	Durability of textured finishes used for APC	
	Form suction for stripping APC with projections and rustications	
	Bond of brick, tile, and precast concrete medallions in APC	
	Post pour replacement techniques for brick, tile, and precast concrete medallions in APC	
Operations	Trucking of precast concrete members from manufacturing plants to job sites	Managing specialty carriers and non-standard sized loads to arrive at the crane at the correct time + or – 5 minutes

	Handling of steel reinforcing, connection plates and inserts is the majority of work done in the manufacturing plant.	Eliminating or drastically reducing non-value added materials handling work in the manufacturing plants. Robotic application for highly repetitive low skilled work? Impact of autonomous delivery vehicles?
	Improved ergonomics in work tasks of production employees	Reduced bending and stooping, lifting of heavy and awkward loads.
	Inspection of product, both finished goods and work in process, by electronic means	Utilize cameras or lasers to measure product vs. conventional steel tape. Compare to CAD drawings or 3D models for tolerances.
	Understand ability of current processes to meet tolerances, especially dimensional tolerances that affect fit-up and subsequently productivity on job sites.	Capture all variances from standard dimensions, not just go/no go based on adherence to published tolerances. Use data captured to calculate and publish process capability analysis.

*These topics also are on a list of research needs maintained by the ACI Concrete Research Council.

See: http://www.concreteresearchcouncil.org/Portals/7/Files/PDFs/Research_Needs.pdf