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High-Performance Concrete for Bridge Decks
Final Report

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INTRODUCTION

In 2011, the Illinois Tollway adopted a 15-year, $12 billion capital program entitled, *Move Illinois: The Illinois Tollway Driving the Future*. The purpose of this program is to make much needed improvements to the Tollway system. The program is projected to create more than 120,000 permanent jobs and add $21 billion to the local economy. *Move Illinois* is expected to improve mobility, relieve congestion, reduce pollution, and link economies across Northern Illinois.

The Tollway is committed to minimization of environmental impact, with initiatives to improve the sustainability of highway infrastructure through the use of recycled materials and the improvement of service life. As new infrastructure is constructed, amongst the primary objectives will be to provide long lasting and durable concrete bridge decks. To achieve this goal, a new performance-related specification will be needed for future bridge deck concrete mixtures. In addition to creating durable concrete that possesses the required mechanical properties, the purpose of the specification is to minimize the potential for cracking in newly constructed bridge decks based on current structural design. Minimization of cracking will prolong the service life of the bridge decks by preventing or delaying corrosion of reinforcing steel. Longer service life is valuable for many reasons, including reduction of life cycle cost of the Tollway infrastructure, reduction of the impact on the environment through sustainable construction, and reduction of interruptions to traffic and delays for Tollway users.

As the first phase of the development of new bridge deck specifications, CTLGroup has conducted a literature review on the development and use of high-performance, crack-resistant concrete (HPCRC) for bridge deck applications. This document presents the basics of what constitutes HPCRC, differentiating it from traditionally defined high-performance concrete (HPC). It then reviews projects that have been constructed using HPCRC, including successes and failures, and discusses recent research completed on HPCRC for bridge deck applications.

HISTORY OF USE OF HPC IN CONCRETE BRIDGE DECKS

HPCRC is one type of HPC. In 1993, the Federal Highway Administration (FHWA) initiated a national program to implement the use of HPC in bridges. In total, 19 bridges were constructed in 14 states as demonstrations of the HPC technology (Mokarem and Khan 2010). As part of this program, FHWA defined HPC for highway applications according to the following eight performance characteristics (Goodspeed, Vanikar, and Cook 1996):

- Freeze-thaw durability – relative dynamic modulus after 300 cycles tested in accordance with AASHTO T 161 (ASTM C666) Procedure A,
- Scaling resistance – Visual rating of the surface after 50 cycles in accordance with ASTM C672.
- Abrasion resistance – Average depth of wear in mm in accordance with ASTM C944.
- Chloride permeability – Coulombs in accordance with AASHTO T 277 (ASTM C1202).
- Strength – Compressive strength in accordance with AASHTO T 22 (ASTM C39).
- Elasticity – Modulus of elasticity in accordance with ASTM C469.
- Unrestrained shrinkage – Microstrain in accordance with ASTM C157.
- Creep – Microstrain/pressure unit (specific creep) in accordance with ASTM C512.

Four different FHWA performance grades were defined for each of the eight characteristics, and a given HPC mixture design was specified by a grade for each desired performance characteristic. Table 1 summarizes the FHWA performance grades for each characteristic.

Table 1: FHWA HPC performance grades and performance characteristics (Goodspeed, Vanikar, and Cook 1996).

Performance Characteristics[1]	Standard Test Method	FHWA HPC Performance Grade[2]			
		1	2	3	4
Freeze-thaw durability (x = relative dynamic modulus after 300 cycles)	AASHTO T 161 ASTM C666 Procedure A	60% ≤ x ≤ 80%	80% ≤ x		
Scaling resistance (x = visual rating of the surface after 50 cycles	ASTM C672	x = 4,5	x = 2,3	x = 0,1	
Abrasion resistance (x = average depth of wear in mm)	ASTM C944	2.0 > x ≥ 1.0	1.0 > x ≥ 0.5	0.5 > x	
Chloride penetration (x = coulombs)	AASHTO T 277 ASTM C1202	3000 ≥ x > 2000	2000 ≥ x > 800	800 ≥ x	
Strength (x = compressive strength in ksi)	AASHTO T 22 ASTM C39	6000 ≤ x < 8000	8000 ≤ x < 10000	10000 ≤ x < 14000	14000 ≤ x
Elasticity (x = modulus of elasticity in psi	ASTM C469	$4 \le x < 6 \times 10^6$	$6 \le x < 7.5 \times 10^6$	$7.5 \times 10^6 \le x$	
Shrinkage (x = microstrain)	ASTM C157	800 > x ≥ 600	600 > x ≥ 400	400 > x	
Creep (x = microstrain/psi)	ASTM C512	0.52 ≥ x > 0.41	0.41 ≥ x > 0.31	0.31 ≥ x > 0.21	0.21 ≥ x

[1] All tests to be performed on concrete samples moist or submersion cured for 56 days.
[2] A given HPC mixture design is specified by a grade for each desired performance characteristic. For example, a concrete may perform at Grade 4 in strength and elasticity, Grade [3] in shrinkage and scaling resistance, and Grade 2 in all other categories.

As is evident in Table 1, the performance criteria to achieve FHWA HPC Grade 1 for most performance characteristics are not “high performance” at all. For example, the requirements for freeze-thaw durability, scaling resistance, abrasion, chloride penetration, shrinkage, and creep are relatively easily achieved and would likely be met by conventionally specified concrete. Even the elasticity requirement is near normal at the low end of the required range. Only the strength requirement, at 6000 psi, is higher than that of “normal” concrete. This reflects that at the time HPC was being adopted for use in transportation structures in the late 1990’s, the emphasis was on higher strength. This is understandable as the origin of HPC was high-rise construction where strength was the most important parameter. But as is presented later, strength is not the most important concrete characteristic required to construct long-lasting concrete bridge decks.

It is also observed in Table 1 that as the HPC Grade increases, the performance requirements become more stringent. The appropriate Grade for some of the performance characteristics is selected after considering the climatic, exposure, and loading conditions to which the HPC will be subjected. For example, if less than 3 freeze-thaw cycles are expected annually, no

consideration needs to be made with respect to freeze-thaw durability whereas if 50 or more freeze-thaw cycles are expected annually, the HPC should have a freeze-thaw durability of Grade 2. Specifically, recommendations are made for freeze-thaw durability, scaling resistance, abrasion resistance, and chloride permeability. For the latter, the required recommended Grade for chloride permeability is related to tons of salt applied per lane mile per year. This makes sense from the perspective of corrosion of embedded steel, but neglects broader reasons for reducing permeability that include environmental factors unrelated to deicer application. No guidance is provided on the selection of appropriate Grades for the mechanical properties of the HPC (strength, elasticity, shrinkage, and creep), leaving these decisions to material and structural designers. Further, no guidance was provided to suggest that the desired performance characteristics vary from one type of structure to another.

The performance of the bridges, including the cast-in-place bridge decks, constructed using HPC as part of the FHWA implementation program in the 1990's has been documented and recommendations made with regards to redefining HPC for bridge deck applications (Russell et al. 2006). Ultimately, 19 bridge decks were included in the performance review, located in 14 states (Mokarem and Khan 2010). An interesting commentary made in the FHWA report (Russell et al. 2006) is that the primary durability test run was chloride permeability. Further, the specified strengths for the bridge deck concrete ranged from 4000 to 6000 psi, except for bridges constructed in Georgia, Nebraska, and one in Texas. Although this is lower than the specified range of the strength performance characteristics for high-strength concrete (HSC), the report states that "this is to be expected since there is no reason to specify an HSC for the deck in most slab and girder bridges. For decks, the emphasis should be on durability. An HSC does not ensure a durable concrete." This statement again illustrates that high strength does not equate to high performance for bridge deck concrete. This same point is emphatically stated in a Portland Cement Association (PCA) report on guide specifications for high performance concrete for bridges, in which it is stated in bold type that "strength should never be used as a surrogate for durability" (Caldarone et al. 2005).

Further, other mechanical properties of the concrete were largely left untested, including shrinkage, in which it was stated that a difficulty in running shrinkage is that it takes 180 days to run the test, an impractically high number that will result in construction delays (Russell et al. 2006). It is also stated that shrinkage limits are "somewhat arbitrary because there is no direct correlation between shrinkage of a laboratory specimen and the likelihood of cracking in the deck." Later in the same report, it states that "a performance characteristic related to cracking is highly desirable since the performance of bridge decks is generally better when they do not exhibit cracking" (Russell et al. 2006).

In further analysis of the bridge deck data reported by Russell et al. (2006), Mokarem, Russell, and Khan (2009) reported on a number of observations made relating concrete properties to cracking density (linear ft. of cracking per $ft.^2$ of deck surface area). Cracking of the HPC decks,was relatively common and was considered a threat to service life, thus an attempt was made to correlate cracking density to concrete mixture parameters including the water-to-cementitious materials ratio (*w/cm*) and total cementitious materials content. The study by Mokarem, Russell, and Khan (2009), as summarized by Mokarem and Khan (2010), found that the average overall cracking density for the 14 bridges with full-depth cast-in-place decks was 0.074 $ft./ft.^2$, with a range of 0.01 to 0.54 $ft./ft.^2$. Further, it was found that a concrete bridge deck with a *w/cm* between 0.35 and 0.40 resulted in an average crack density of 0.069 $ft./ft.^2$ and a concrete with a total cementitious materials content between 600 and 700 lbs/yd^3 resulted in an average crack density of 0.053 $ft./ft.^2$. Based on these results, it is stated that "a high performance concrete mixture with a *w/cm* between 0.35 and 0.40, cementitious materials

content between 600 and 700 lb/yd^3, and appropriate construction practices, is expected to result in lower crack density" (Mokarem and Khan 2010).

Through field study of in-service concrete bridge decks, Lindquist et al. (2006) concluded that the rate of chloride ingress into the concrete decks was highly accelerated by the presence of cracking. It was also concluded that the cracking was of far greater importance than the properties of the concrete with regards to the chloride concentrations exceeding the corrosion threshold for conventional reinforcement at the top level of the reinforcing steel. In response, a large pool fund study was implemented by19 state departments of transportation (DOTs) and the FHWA under the direction of the Kansas Department of Transportation (KDOT) to construct 40 low-cracking, high performance concrete (LC-HPC) bridge decks around the country (Browning and Darwin 2009). The HPC mixtures used in these bridge decks are in stark contrast to those used in the previous study, having no supplementary cementitious materials (SCMs), a low paste content (less than 25%), low slump (1.5 to 3.0 in.), moderate *w/cm* (0.43 to 0.45) and an elevated total air content (6.5 to 9.0%). Further, an optimized aggregate gradation was used, the concrete temperature at placement had to be between 55 and 70^{o}F, and a 14-day wet curing regime was adhered to, followed by the application of a curing compound. Further, the desired concrete compressive strength was 4000 psi at 28 days. Higher strength was undesirable as it is was considered unneeded in bridge decks, resulting instead in increased cracking due to a reduction in creep which produced higher tensile stresses from restrained drying shrinkage and thermal contraction (Browning and Darwin 2009).

These two types of concrete mixtures, those from the 1990's which in general had high-strength and low permeability yet were susceptible to cracking and those advocated through the Kansas work in the 2000's which had moderate strength and permeability but were crack resistant, represent the spectrum of HPC for bridge decks considered over the last two decades. The next section of this literature review discusses how various DOTs have implemented one or both of these approaches in their bridge decks. The last section of this review discusses how advances in chemical admixtures and a better understanding of the mechanisms of internal curing provide an additional alternative, one in which low permeability, crack-resistant concrete can be created.

RECENT STATES' EXPERIENCE IN USE OF HPC FOR BRIDGE DECKS

EXPERIENCE IN ILLINOIS

Chicago Department of Transportation – Wacker Drive

An early and high profile use of HPC in Illinois was on the Wacker Drive reconstruction project in Chicago more than 10 years ago. This project used HPC in order to achieve a longer than normal service life, with the goal of 75 to 100 years. The primary objective was to develop a mixture with maximum durability, rather than high strength. A maximum strength was thus specified to avoid creating brittle high-strength concrete, as such mixtures are known to have a greater potential for cracking due to thermal and shrinkage stresses. The selected mixture was a blend of portland cement, Class F fly ash, slag cement, and silica fume. The combination of SCMs was chosen to create a low permeability mixture, thus maximizing durability while minimizing potential side effects from high dosages of any one of the SCMs. A 2.25 in. thick overlay was bonded to the deck using a latex-modified concrete mixture to further enhance the durability of the entire system (McGovern 2001).

The specifications for the Wacker Drive reconstruction project were very thorough in terms of the number of tests required. Amongst the performance tests were requirements for hardened

air-void system (ASTM C457), freeze-thaw durability (AASHTO T 161/ASTM C666), salt scaling (ASTM C672), chloride permeability (AASHTO T 277/ASTM C1202) and depth of chloride penetration requirements. Minimum and maximum compressive strengths of 6,000 and 9,500 psi were specified at 28 days. To ensure workable concrete, the specified slump was 8 in. after the addition of high-range water-reducing admixture (HRWRA) and 4 in. after 45 minutes. Initial set was not permitted for at least 3 hours (McGovern 2001).

The field implementation of the specification provided several learning opportunities. The project documents called for adding the HRWRA at the job site but the concrete supplier achieved more consistent air contents if some HRWRA was added at the plant (McGovern 2001).

The current specifications for the Chicago Department of Transportation (CDOT) have two different classes for high strength and normal strength HPC. The only difference is the minimum compressive strength allowed at 28 days; 4,000 psi for the normal strength HPC and 6,000 psi for the high strength HPC. The rest of the specifications are very similar to the Wacker Drive project except that Class C fly ash replaces Class F fly ash and freeze-thaw resistance and salt scaling testing are not specified.

Illinois Department of Transportation

The Illinois Department of Transportation (IDOT) has used HPC for several bridge decks and has reported a few difficulties. The thickness of the typical bridge deck specified by IDOT is 7.5-in. When IDOT first used HPC in their bridge decks they found the deck cracked in nearly all cases. The cracking was similar to traditional concrete mixtures despite the added effort and cost of HPC. IDOT believed the decks were too thin to resist cracking and updated their standards to require an 8-in. minimum deck thickness (Lange et al. 2003).

IDOT funded a research project in the early 2000s at the University of Illinois at Urbana-Champaign (UIUC) to examine the behavior of HPC mixtures. This study looked at existing HPC mixtures used by IDOT, which at the time exhibited some of the benefits of HPC without some of the negative effects seen in some HPC mixtures. The study found by not permitting the use of a *w/cm* significantly lower than is used in traditional concrete and by not allowing silica fume additions greater than 5%, IDOT mixtures exhibited relatively low autogenous shrinkage. The heat evolution characteristics were similar to those observed in traditional concrete mixtures (Lange et al. 2003).

The study also found the stress development due to drying shrinkage was much greater than daily temperature fluctuations and long-term temperature variations. In place monitoring showed that the highest temperature gradients occurred due to mid-day heating of the structure. Laboratory evaluations demonstrated that higher strength mixtures with fly ash and a minimum cement past content were better able to resist early temperature and shrinkage stresses (Lange et al. 2003).

Thermal, shrinkage, and creep properties were incorporated into a three-dimensional non-linear finite element model to study stress development throughout each bridge deck. The results were used to study areas of high stress within a bridge structure and seek ways to reduce stress as a means of reducing the tendency of the bridge deck to crack. Bridges with very stiff support structures developed higher stresses and were thus more likely to crack (Lange et al. 2003).

To date IDOT has not yet implemented a standard specification for HPC, although a current study, in cooperation with UIUC, is ongoing.

Illinois State Toll Highway Authority

The Illinois State Toll Highway Authority (Tollway) has studied the use of HPC and conducted research with local consulting and testing firms to aid in the development of HPC specifications. Initial work with HPC lead to higher than normal rejection rates of concrete loads, primarily because of high initial concrete temperature at time of delivery. Concrete suppliers are now able to produce HPC with lower rejection rates and with greater consistency due to experience (Congestion Relief Plan 2007).

The Tollway conducted a mixture development and testing project with two ready-mix suppliers and a consulting firm in 2002 and 2003 to explore different concrete mixtures for possible use on the I-294 Cal-Sag Bridge. The mixtures were intended for conventionally reinforced bridge decks, amongst other applications. All mixtures were tested for hardened air-void system parameters (ASTM C457), compressive strength (ASTM C39), freeze-thaw durability (ASTM C666), and rapid chloride permeability (ASTM C1202). All but the substructure mixtures were also subjected to chloride ponding, salt scaling (ASTM C672), and drying shrinkage testing (ASTM C157). Both suppliers were able to produce mixtures that consistently met project specifications (Krauss 2003).

Through the “Congestion Relief” program, the Tollway has been collaborating with IDOT and CDOT and the various industrial partners to develop an HPC specification. This collaboration led to the incorporation of an allowance for the use of slag cement in HPC mixtures, whereas prior IDOT specifications for any bridge deck mixture only made reference to fly ash, silica fume, and metakaolin as possible SCM sources. In general the specifications for HPC are similar for the different agencies, although the Tollway is more restrictive in a few areas. For example, the original Tollway specification limits the maximum temperature of the concrete at the time of placement to 85°F whereas IDOT allows up to 90°F for standard bridge deck mixtures. The Tollway also requires wet curing to start twenty-five feet behind the paving machine whereas IDOT allows thirty-five feet for standard bridge deck mixtures. And the Tollway specification also required fogging equipment be used on all deck placements to reduce the potential for plastic shrinkage cracking whereas IDOT only requires fogging equipment when the evaporation rate is expected to be above 0.1 lbs. per ft^2. Further, the Tollway requires the temperature of the steel to be within 10°F of the temperature of the concrete at the time of placement. This often necessitates cooling the steel on hot days, reducing the likelihood of thermal cracking in the concrete. The Tollway also required the installation of thermocouples in concrete bridge deck placements to monitor temperature rise, limiting the maximum internal temperature of the concrete to 140°F and thus reducing the potential for thermal cracking (Gillen 2007). This would also reduce the potential for delayed ettringite formation (DEF). The strict limits for constructability along with the reduced workability of the concrete mixtures inhibited the local industries from supporting its use and the original Tollway HPC specification was never fully implemented.

IOWA

A specification developed by the Iowa Department of Transportation (Iowa DOT 2003) defined HPC as a concrete mixture which provides desired workability, a minimum compressive strength of 5,000 psi, and a target permeability of 2,500 coulombs or less for substructure concrete or 1,500 coulombs or less for deck concrete. Iowa requires a *w/cm* of 0.42, with a

maximum of 0.45, and the use of slag cement (AASHTO M 302/ASTM C989), either through the use of AASHTO M 240/ASTM C595 blended cement or a Type I/II cement with 35% weight replacement by slag cement. The specification also allows up to 15% fly ash as a replacement for cement. Requirements for a maximum allowable evaporation rate at the time of placement is also specified. Curing with wet burlap for 7 days is also required and the temperature of the concrete must remain above 50°F during the curing period. Any time the concrete temperature drops below 50°F is not counted towards the 7 days of wet curing (Iowa DOT 2003). A revision to the development specification was published in 2007 which had a few minor modifications to the allowable composition of the binders and target strength values. A 2011 special provision included metakaolin as an SCM.

INDIANA

Researchers at Purdue University have recently completed projects looking at cracking of bridge decks. Field investigations found many similar results as those found in other states; that areas of high restraint exhibited more cracking and low humidity and high wind speed at the time of placement leads to more cracking. This study looked into the role curing plays in the likelihood of cracking to occur. Longer periods of wet curing were also found to lead to reduced cracking. Mixture proportions were also examined. Unsurprisingly lower shrinkage mixes were found to result in fewer cracks. Lower cement content and the addition of fly ash were both identified as leading to reduced shrinkage without reducing the strength of the concrete. They also identified reductions in the heat of hydration can reduce the likelihood of thermal cracking. Another phase of this project looked at the role of reinforcement in reducing cracks. Reinforcement ratios below 0.42% did not have a significant impact on crack control. Values above 0.42% saw a reduction in strain that was linearly proportional to the reinforcement ratio. The highest reinforcement ratio studied was 1.25%. The final recommendation was to use a reinforcement ratio of 0.63% with traditional strength steel and concrete with a strength of 4,000 psi. Crack width was found to follow vary with respect to reinforcement ratio as well. (Frosch, et. al. 2010)

Another study conducted by researchers at Purdue focused on the material components used to make concrete bridge decks and how different selections could be made to reduce cracking. They looked at various ternary mixtures using portland cement, fly ash, and silica fume and found the best performance was achieved with a mixture containing 5% silica fume and 20% fly ash, with the balance made up of portland cement. Fly ash contents were varied between 20 and 30% and silica fume contents were varied between 5 and 7%. The mixtures with higher dosages of fly ash and/or higher dosages of silica fume did not perform as well in the durability tests as the mixture with 20% fly ash and 5% silica fume. The study also looked at curing conditions and found wet burlap curing, both 3 and 7 days duration, led to better results than curing compounds or air drying. The study also looked at in place performance of such mixtures. It was observed that mixtures placed in late fall exhibited early surface scaling. The early scaling was attributed to early application of deicing salts to the concrete. The researchers recommended that the DOT require extended moist curing and potentially heating systems with late fall placement to ensure the ternary concrete mixtures develop strength and a dense pore structure to resist early degradation. The team also recommended against the use of concrete pumping for the placement of bridge deck concrete unless it can be proved during mixture qualification that the concrete will have an adequate air void system after pumping. (Radlinski et. al. 2010)

NEW YORK STATE

In the spring of 2000 the State of New York established a task force to examine cracks in bridges that were recently constructed using HPC. The examination of cracks in cores removed from bridges found that transverse cracks existed primarily in the mortar fraction of the concrete and the aggregate was not fractured, indicating the cracks formed at early age. Transverse cracks formed in the center of spans and longitudinal cracks formed near abutments and piers or over steel girders (Subramaniam 2009).

The second phase of the project involved instrumenting bridges prior to the placement of concrete to measure temperature and strain in the bridge at early ages. The goal was to better understand the behavior of bridge decks and the support system at early ages. The results showed there are significant thermal effects during the first 48 hours as the concrete hydrates and then starts to cool to ambient temperature. Temperature effects after the first 48 hours are related to changes in ambient temperatures, not hydration of the concrete. The data indicates the concrete contracts more than the top flange of the steel while the concrete is cooling due to the initial temperature rise in the concrete due to the heat of hydration. They also concluded the restraint conditions for thermal deformation are not the same as for shrinkage because the steel support girders experience similar temperature changes due to ambient conditions but do not shrink due to hydration like the concrete deck material. (Subramaniam 2009).

The third phase of the project involved laboratory testing to investigate early age properties of HPC mixtures. The findings indicate larger temperature rises during the first day result in larger residual stresses when the concrete cools and reaches thermal equilibrium with the environment. This residual stress contributes to the total stress due to shrinkage. In addition to the residual stress due to thermal expansion, the rate and magnitude of drying shrinkage and the elastic modulus all contribute to the total stress developed in the concrete deck. Based on these findings it was concluded there is a higher likelihood of cracking due to restraint and shrinkage if there is a rapid increase in elastic modulus occurring while shrinkage is increasing (Subramaniam 2009).

KANSAS

A Kansas DOT study investigated cracking in bridge decks over a ten year period, It involved crack surveys of bridges constructed from the early 1980's through the 1990s' and included revisiting the same bridge multiple times over the course of the study to determine how quickly cracking progressed in an individual bridge. The study found most cracking occurred at early age but progressed throughout the life of the structure, and that increased water content, cement content, and paste volume all led to higher amounts of cracking. The overall finding was that total paste volume should be limited to 27% for the bridge deck types evaluated (monolithic decks, conventional deck overlays, and concrete overlays with silica fume in the mixture).

It was also found that increased strength led to increased cracking density. This relationship was strongest for the monolithically cast bridge decks and the researchers suggest a maximum allowable compressive strength in project specifications may result in decreased cracking densities. They suggest a value of 5500 psi for an upper bound on compressive strength. The research also found bridges with increased restraint, particularly bridges that were fixed to the abutments, exhibited greater cracking densities. Crack densities in bridges cast with conventional overlays or cast monolithically increased over the last twenty years but the cracking densities in bridges cast with overlays containing silica fume have exhibited reduced

cracking density. They attribute the reduction in cracking density in newer silica fume overlays to stronger efforts made during placement to reduce evaporation prior to the start of wet curing (Darwin 2004).

COLORADO

The Colorado Department of Transportation funded a project to look into cracking of newly constructed bridges. The research team analyzed field inspections from seventy-two bridges constructed between 1993 and 2002. The team also inspected nine bridges in person to map cracks and determine crack widths. The findings were similar to other states; cracks tended to form in either the transverse or longitudinal direction with very low frequencies of cracks with a random orientation. The measured crack widths varied from 0.01 to 0.10 in., indicating a potential for chloride ions to penetrate to the steel reinforcement. The report generated recommendations for future bridge specifications regarding mixture design, such as the use of SCMs and lower cementitious content to reduce heat generated during hydration. A maximum 5% silica fume was recommended to prevent high early strength gain. Silica fume and slag cement were recommended to reduce permeability and increase the durability. The common practice in Colorado is to only specify 28-day strength and the study recommended early age strength specifications. Permeability, shrinkage, and crack resistance were recommended for future acceptance programs (Zi 2003).

Bridge design recommendations included increases in minimum shrinkage and temperature reinforcement due to the arid environment. Smaller reinforcement and tighter spacing were thought to more likely prevent cracking. Thicker decks were also recommended with an increase from 8.0 in. to 8.5 in. as well as increased cover over the top reinforcing steel (Zi 2003).

Construction practices were critiqued to help reduce cracking. A narrower window for ambient temperature during placement was recommended, with a minimum of 45°F instead of 40°F, which only applies to silica fume overlay mixtures, and maximum of 90°F for all placements. An evaporation rate limit below 0.20 lb/ft^2 for normal concrete and below 0.10 lb/ft^2 for low *w/cm* concrete was proposed, with fogging of the concrete until placement of a cover. Any deck constructed with silica fume or fly ash should receive seven days of moist curing (Zi 2003).

WASHINGTON STATE

Washington State Department of Transportation (WSDOT) funded a research project completed in April 2010 which looked at shrinkage cracking in bridge decks. The study looked at multiple aggregate sources and sizes available in the state, the use of shrinkage reducing admixture (SRA), SCMs, and different paste contents. In total, twenty experimental mixtures were tested and compared to two current concrete mixtures used in the state. In all tests cases, the use of an SRA was found to significantly reduce shrinkage and none of the restrained shrinkage ring specimens fabricated to test crack resistance failed within 28 days. The study looked at different SCMs and found mixtures with fly ash exhibited decreased strength and increased cracking tendency. The authors did not identify the type of the fly ash used but the chemical data provided indicated it was a Class C fly ash. The researchers came to the conclusion that reduced paste volume can lead to reductions in shrinkage and delayed cracking in the ring specimens, noting that the mixture with the largest size aggregate, 2.5 in., had the lowest paste volume and exhibited the greatest resistance to cracking. The researchers also noted difficulty in obtaining the desired air content values when using combinations of different admixtures including an air entraining admixtures (AEA), high-range water-reducing admixture (HRWRA),

and SRA. Their final recommendations were to use an SRA and to reduce paste volume as much as possible through the use of the largest feasible aggregate size, and to use an HRWRA to maintain workability (Qiao 2010).

TRENDS ACROSS STATES

The literature review demonstrates that many states have begun using HPC mixtures for bridge deck concrete and in most cases, there have been difficulties with cracking of the bridge decks at an early age. The primary motivation in moving to HPC concrete is to create a more durable concrete which will result in a longer lasting, lower maintenance bridge deck. The occurrence of early-age cracking defeats the purpose of creating a more durable concrete as it provides an easy path for chloride ions to reach the embedded reinforcing steel. Cracks also create a need for more frequent maintenance to prevent premature degradation of the bridge elements. Many states have conducted research into the factors influencing early-age cracking and means of preventing or reducing cracking. It has been recognized by many states that proper curing, from the moment the paving operations have placed the concrete, is critical to reducing cracking. Immediate application of fogging machines and early wet curing are important tools in combating early-age cracking due to plastic shrinkage. These methods are even more important in windy or dry environments where the rate of evaporation is high, but are good practices in all situations. Several states also came to the conclusion that early work with HPC, which focused on higher strengths, was not necessarily the path to go with bridge decks and that rapid strength and stiffness gain can be detrimental. It is widely recognized that high additions of silica fume (>5%) are not needed for the strength ranges needed for bridge decks and that the use of higher amounts of silica fume can lead to more cracking and more difficulty in placement and curing. Table 2 shows the trends across several agencies for requirements to improve performance.

Table 2: Performance requirements by state.

Performance / State	IL Tollway	Chicago DOT	Iowa DOT	New York DOT	Wisconsin DOT
w/c	0.38	0.38	0.42 (max 0.45)	0.40 max	0.45 max
Slump, inch	8" max	8"	4" max	3" - 5"	4" max
Air Content, %	5.5% - 8.5%	5.5% - 8.5%	5% - 7.5%	5% - 8%	4.5% - 7.5%
Curing Type & Duration	Wet Burlap for 7 days	Wet Burlap for 7 days	Wet Burlap for 7 days	Wet Burlap for 7 days	Wet Burlap for 10 days
Compressive Strength, psi	4,000 at 14 days	4,000 min. at 28 days	5,000 at 28 days	5,000 at 28 days	3,500 - 4,300 at 7 days
Permeability, Coulombs	2,000 at 56 days	< 2,000 at 28 days	1,500 at 56 days (deck)	<1200 at 56 days	1,400 - 1,600 at 56 days

Concrete shrinkage is inevitable due to the nature of hydrating cement systems, but it can be reduced through better mixture proporting strategies. A balance between strength and stiffness gain and shrinkage can be achieved to reduce the likelihood of cracking. The research funded by the various states has led to the implementation of mixture qualification specifications which better capture the shrinkage and cracking tendency of mixtures and monitor the strength gain more closely. Table 3 shows the mixture proporting requirements of several agencies as a prescriptive measure for improving performance.

Table 3: Mixture proportion requirements by agency.

Proportions / State	IL Tollway	Chicago DOT[1]	Iowa DOT	New York DOT	Wisconsin DOT
w/c	0.38 max	0.38 max	0.40 (0.42 max)	0.40 max	0.45 max
Cement Type	Type I	Type I/II	Type I or II	Type I	Type I/IP/IS
Cement Quantity, lb/yd³	451	525	312	506	460
Fly Ash Type	Class C	Class F	Class F or C	Class F	Class C
Fly Ash Quantity, lb/yd³	22.9%	7.7%	15% max	20%	30%
Silica Fume Quantity, lb/yd³	3.7%	3.9%	---	6%	---
Slag Cement Quantity, lb/yd³	---	11.5%	35%	---	30%
Fine/Coarse Aggregate Blend	39% / 61%	39% / 61%	---	40% / 60%	45% / 55%
Coarse Aggregate Max. Size, in	1" max	3/4"	1" max	1/2"	1"

The incorporation of SCMs has been shown to be beneficial in reducing heat, reducing permeability, improving durability, slowing strength gain, and leading to reduced cracking. Although the WSDOT research showed increased cracking tendency with fly ash, most studies indicate that the incorporation of a moderate volume of fly ash is beneficial if qualification testing demonstrates the mixture as a whole is resistant to cracking.

MITIGATION STRATEGIES

EXTENDED WATER CURING

As previously discussed, several states specify extended wet curing of HPC to reduce the likelihood of early-age cracking. A similar study was conducted in Quebec during a project to reconstruct 28 bridges. The concrete had a *w/cm* of 0.36 and 8% of the cementitious materials were silica fume. With a low *w/cm* and a dosage of silica fume this concrete would be at high risk of early cracking if the same curing methods for traditional concrete were employed. For this project all surfaces were fogged as soon as the surface was finished and fogging continued until the surface was strong enough to support workers who would then place the water curing system. The authors did not state how long water curing was applied to the bridge decks in Quebec but elsewhere in their report recommend water curing be applied for seven days. No cracks were noticed in the bridge decks within the first 28 days at which time a hot-mix asphalt wearing layer was placed. The contractor estimated the cost of the water curing system amounted to 1.5% of the total project cost. The city of Montreal continued to specify water curing for all HPC placements and have noted the quality of the infrastructure has improved due to reduced cracking. The cost of water curing on these additional projects ranged from 0.1% to 1.5% of the total cost of the project (Aïtcin 2004).

SHRINKAGE REDUCING ADMIXTURES

There is substantial research documenting the use of SRAs to reduce shrinkage and cracking. An SRA functions by reducing the surface tension of the liquid-solid interface in capillary pores by up to 54% for additions up to 10% SRA, as a replacement for water. Additions beyond 10% have no further impact on the surface tension of the water. The addition of an SRA will reduce both autogenous shrinkage and drying shrinkage, and has been shown to effectively reduce early shrinkage leading to substantial benefits at early age. The reduction is proportional to the amount of SRA added and small expansions at early ages (<1 day) were observed at higher SRA dosages. This expansion is thought to play a significant role in the improved performance

of concrete mixtures with SRA at early ages. The use of SRA was found to delay setting but did not impact long-term strength and stiffness properties. Studying the relative humidity (RH) of the pore solution in several different concrete mixtures found mixtures containing SRA maintained higher RH values in sealed conditions which led to reduced shrinkage (Pease 2005, Lura 2007, Weiss 2008 and Bentz 2001). Recent work for the Oregon DOT (Ideker) has shown that the combined strategies SRA and saturated lightweight aggregate (SLA) showed a synergistic effect, resulting in the greatest potential to reduce shrinkage and subsequent cracking of any available mitigation method.

The use of an SRA has been shown in some instances to have an effect on the air content for a given dosage of AEA, as compared to a mixture without SRA. AEAs form stable air bubbles that can be destabilized by the SRA, which is also a surfactant. The loss of air could result in poor freeze-thaw performance if not monitored properly and corrected. Comparing mixtures with similar hardened air contents, higher strengths were seen in the mixtures with SRA and freeze-thaw durability was not a problem. Reductions in unrestrained shrinkage of 40% to 50% were observed using a range of dosages of an SRA from 1.0% to 2.0% addition by weight of cement (Schemmel 1999).

ALTERNATIVE REINFORCEMENT

Up to this point this literature review has focused primarily on how to reduce cracking of concrete bridge decks and to reduce the ingress of chloride ions which can attack embedded reinforcing steel. This attack will lead to corrosion, expansion, cracking, and spalling of the cover concrete. An alternative approach is to look into reinforcement that slows the rate of deterioration in the presence of chloride ions.

Of the available options, two metallic products were identified; MMFX, which adheres to ASTM A1035[1], and stainless steel. Both products meet the AASHTO specification covering the use of uncoated corrosion resistant reinforcement[2]. Fiber reinforced polymer (FRP) reinforcement is also a possible alternative material. All three products experience a slower rate of deterioration, making them a viable alternative or supplement to impermeable concrete. Evaluation of these products should not be based solely on the expected life of the reinforcement itself, but should incorporate the effect of cracking of the concrete and subsequent exposure.

The Missouri Department of Transportation (MoDOT) has funded research into the use of FRP bars and fiber reinforced concrete (FRC) to examine the potential for extending the service life of bridge decks through reduced corrosion and reduced cracking. For this work, polypropylene fibers were incorporated at a 0.5% volume fraction. The addition of the discrete fibers to the concrete mixture did not improve the strength of the tested elements, but they did increase the post crack performance by increasing the ductility of the elements by 40%.The research also showed the incorporation of fibers increased the fatigue strength of the tested elements by strengthening the bond between the concrete and the FRP bars. It was also observed that cracking in specimens made with FRC was more distributed throughout the element and the crack widths were smaller. Smaller crack widths can significant improve durability even in situations where traditional reinforcement is used by reducing the ingress of chloride ions (Gopalaratnam 2006).

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[1] ASTM A1035/A1035M – 11 “Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement”
[2] AASHTO MP 18M/MP 18-09 “Standard Specification for Uncoated, Corrosion-Resistant, Deformed and Plain Alloy, Billet-Steel Bars for Concrete Reinforcement and Dowels”

MoDOT also performed weathering tests to see how durable elements with FRP and FRC can be relative to traditional concrete and traditional reinforcement materials. The elements cast with FRP reinforcement and traditional concrete exhibited a 28% reduction in bond strength but the elements cast with FRP reinforcement and FRC only exhibited a 6% loss in bond strength. Similarly the FRP elements with plain concrete had a 26% reduction in stiffness while the elements with FRC and FRP only had a 10% reduction in stiffness, relative to elements cast with traditional reinforcement and concrete without fiber reinforcement. The work also looked at the use of different FRP materials including glass fiber reinforced polymer (GFRP) and carbon fiber reinforced polymer (CFRP). MoDOT found the CFRP bars provide better fatigue performance and attribute this to the higher strength a durability of CFRP. MoDOT recommends the use of a combination of both GFRP and CFRP to take advantage of the improved performance of CRFP in critical areas while saving on cost as the CFRP is more expensive than the GFRP (Gopalaratnam 2006).

Galvanized reinforcement is another approach to reducing the corrosion rate of embedded reinforcing steel to prolong the life of bridge decks. Non-coated plain steel reinforcement is passivated until the pH drops below 11.5 but zinc coated reinforcement remains passivated until the pH is below 9.5. Galvanized steel also requires anywhere from between four to ten times greater concentrations of chloride ions, as compared to plain reinforcement, before corrosion will initiate. Flaking or chipping of the coating is a potential drawback to any coated reinforcement. Zinc coating can be repaired with zinc rich paints. This is one advantage to zinc coated reinforcement over epoxy coated reinforcement. Epoxy coatings are difficult to repair in the field and care must be taken to avoid damage. Field trials in states where deicer salts are used (Iowa, Pennsylvania, and Vermont) in the 1970s and early 1980s showed bridge decks constructed with galvanized steel performed well and exhibited little corrosion induced deterioration. Mild or superficial corrosion of the zinc coating was observed in a few test specimens with no resultant deterioration in the surrounding concrete. Distress was observed in locations where there was insufficient cover over the reinforcement or in locations with poor quality concrete (Stark 1982 and Yeomans 1991).

The use of alternative steel may prove to be beneficial in extending the service life of concrete bridge decks, but it should not be viewed as an alternative to crack resistant HPC. The quality of the concrete is still critical to the life of the deck and having alternative steel reinforcement will not reduce the need to produce bridge decks that resist cracking. It may reduce the need for very low diffusion coefficients, which could be beneficial for producing low-crack concrete, similar to the approach used in Kansas.

INTERNAL CURING

Internal curing is a relatively new technique that has received attention from researchers and industry as a potential means of improving the performance of HPC mixtures. HPC mixtures often exhibit lower permeability and sorptivity than traditional concrete and as a result curing with external sources of water may not be effective in preventing self-desiccation that can occur, particularly in mixtures made with low *w/cm*. Internal curing is most often achieved by replacing a portion of the fine aggregate in the concrete mixture with saturated lightweight aggregate (SLA), which provides water to the concrete during early hydration without increasing the *w/cm*. Hydration progresses further than in traditional concrete mixtures as the cement uses some of the water stored in the SLA. This technique has the potential for reducing cracking and making the concrete less sensitive to variations in the application of curing methods (Daigle 2008 and Cusson 2009).

Numerous experimental programs have investigated early-age shrinkage (autogenous, chemical, and drying) of HPC and mitigation with SLA. One study found significant strain, 260 με, developed in the first twenty-four hours of hydration due to drying and autogenous shrinkage and creep reduced the strain by a factor of two. By replacing 6% of the fine aggregate with SLA a 33% reduction in shrinkage in the first day was realized. It also increased creep within the first seven days by nearly 50%, resulting in a 15% reduction in cracking potential. The 6% fine aggregate replacement was found to have no significant impact on fresh properties or strength and modulus of the concrete (Cusson 2005). Another experimental program was carried out on concrete with a *w/cm* of 0.35 and results showed replacing 20% of the fine aggregate fraction (by weight) with SLA would reduce drying and autogenous shrinkage without sacrificing 28-day compressive strength (Durán-Herrera 2007).

The National Institute of Standards and Technology (NIST) has also conducted research on internal curing using SLA with different binder compositions. This work found internal curing is more beneficial in mixtures with silica fume and slag cement. Mixtures with Class F fly ash exhibited less autogenous shrinkage and had more porosity and a coarser pore structure. The pore structure of the fly ash mixtures leads to a more rapid transport of water. One conclusion from this work was external curing may be more effective for HPC mixtures containing fly ash while internal curing would be more beneficial in mixtures containing silica fume or slag cement. Internal curing led to strength gains of 10% at 28 days for all three mixture types. (Bentz 2007) A similar study looked at only mixtures with ordinary portland cement (OPC), a silica fume blended cement, or a slag cement/silica fume blended cement. This study also found the greatest performance gains were found in the mixtures with the silica fume blended cement as compared to the control mixture with no SLA (Cusson 2008).

Paul and Lopez (2011) compared the performance of natural and manufactured lightweight aggregates. Pumice natural lightweight aggregate from two different countries were compared to expanded slates and expanded clays. Tests were conducted to characterize pore structure and examine how they absorbed and released moisture. The natural lightweight aggregates absorbed more water, absorbed water at a faster rate, released more water, and released water at a faster rate. Examination of the pore structure also found the natural lightweight aggregates had greater capillary porosity and a more open and interconnected pore structure. As a result of these properties, smaller amounts of natural lightweight aggregate were needed to provide similar amounts of internal curing as compared to the manufactured lightweight aggregates. The natural lightweight aggregate was shown to be more efficient than manufactured lightweight aggregate when considering strength, stiffness and chloride ion penetrability properties but the results for autogenous shrinkage were inconclusive. A potential drawback to the rapid absorption and release of water in natural lightweight aggregates is management of moisture content of the aggregate stockpile, which could introduce more variability in the moisture content of the aggregate making it more difficult to maintain production consistency.

The cost implications of using SLA will depend on the local product availability and configuration of the individual plant. The material cost associated with lightweight fines is relatively low compared to admixtures or SCMs; but the added cost would be due to storage (an extra bin if needed), plant operation, and moisture management (soaking).

SHRINKAGE COMPENSATING CEMENTS

Shrinkage compensating cements have existed for decades, having the potential to reduce the risk of early age cracking in bridge decks, but to date have not gained widespread use for this application. ASTM C845[3] identifies three types of shrinkage compensating cements (Types K, M, and S). Of these, Type K is the most commonly used. Type K cements contain OPC blended with calcium sulfoaluminate. During hydration the sulfoaluminate forms additional ettringite beyond that which is part of normal OPC hydration. The formation of ettringite is expansive, resulting in early-age expansion of the concrete. After the initial expansion has occurred the concrete will shrink and return to state with a net shrinkage/expansion of near zero. Concrete made with Type K cement typically requires more water to attain the same workability as traditional portland cement concrete and slump loss occurs more rapidly with Type K cements. Another important factor is concrete made with Type K cement is sensitive to curing, requiring moist curing at early ages to achieve the early expansion (most expansion occurs in the first twenty-four to thirty-six hours) which is necessary to have a net shrinkage of zero (Ramey 1999).

A recent survey of US states and Canadian provinces found of the twenty-six states that responded, only two allow the use of Type K cement. Most of the states indicated they do not allow the use of Type K cement due to concerns over long-term durability and higher water demand. Several states indicated they have used Type K in the past but no longer allow it. For example, Type K cement was used extensively throughout the state of Ohio in the 1980s (Grunder 1993) but is no longer used due to both higher cost and a lack of durability/chloride penetrability resistance (AASHTO Survey 2011).South Dakota also indicated it is not readily available in their area. It is possible more modern admixtures may be able to overcome some of the difficulties seen with Type K cement related to water demand, workability, and slump life but research is needed to explore this area. Currently researchers at UIUC are working with IDOT on evaluation of modern Type K products for bridge decks.

In addition to the traditional shrinkage compensating cements specified under ASTM C875, new shrinkage-compensating cement additives have recently entered the market. These are identified in ACI 223R-10[4] as a Type G shrinkage-compensating cement. Cements of this type have not yet been included in ASTM C845. Type G additives function differently than the other three shrinkage-compensating cements/additives listed under ASTM C875 which expand due to the early formation of ettringite. Type G cements expand through increased production of calcium hydroxide. As is true with ettringite, calcium hydroxide is a normal reaction product of hydrating cement but the use of a Type G additive increases the production of calcium hydroxide resulting in expansion. Type G is used in dosages of 3 to 6% by weight of cement. This is less than half the typical dosage with a Type K cement additive. (Russell 2002) No long-term durability studies were found to review, a concern that exists with the use of a Type G additive is that calcium hydroxide is a soluble mineral, and that the solubility increases as temperature decreases. This would have the potential for leaching out if the concrete were not fully sealed, especially under winter conditions when deicers lower the freezing point of water. Further, research on calcium and magnesium chloride brine deicing solutions suggests the calcium hydroxide plays an important role in the potentially deleterious formation of calcium oxychlorides (Sutter et al. 2006). More research is necessary to fully evaluate the long-term performance of Type G additives.

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[3] ASTM C845-04 “Standard Specification for Expansive Hydraulic Cement”
[4] ACI 223R-10 “Guide for the Use of Shrinkage-Compensating Concrete”

CORROSION INHIBITORS

Another way to extend the life cycle of bridges or other reinforced structures is to find ways of actively reducing the rate at which corrosion occurs. As the name implies, corrosion inhibitors are admixtures that slow the rate of corrosion. Corrosion inhibitors can either impact the anode or the cathode side of the corrosion reaction. Anodic inhibitors promote the formation of passive oxides on the reinforcement steel and reduce the pitting potential. Anodic protection can reduce the corrosion rate by orders of magnitude. With cathodic inhibitors, pitting corrosion is still possible and the cathodic reaction must be reduced by several orders of magnitude to have a significant impact on the corrosion of the reinforcement. Corrosion can be further reduced by introducing both anodic and cathodic inhibitors to the system. Of the multiple types of corrosion inhibitors on the market, only calcium nitrite admixtures have more than ten years of performance data. Although corrosion inhibitors can significantly reduce the rate of corrosion, they cannot overcome poor quality concrete, so it is still imperative to limit the amount of cracking and ingress of deleterious agents (Berke 2005).

SUPPLEMENTARY CEMENTITOUS MATERIALS

Some of the research already discussed examined the use of SCMs as a means of reducing cracking and making more durable concrete bridge decks. The most common SCMs are silica fume, slag cement, and fly ash (Class C and Class F). Silica fume is particularly useful where high strength and low permeability are needed but may have some significant limitations when used in high replacement levels due to reductions in workability and increased incidence of early age cracking. Fly ash and slag are generally beneficial for reduction of diffusion coefficients, improvement in long-term strength, and also provide a reduction of early age shrinkage stresses.

A recent study examined 20, 40, and 50% replacement of cement with an SCM combination that was two parts slag and one part fly ash. In this study chloride penetrability, assessed using ASTM C1202, was reduced from approximately 3000 coulombs at 56 days with no SCMs to values of 500 coulombs at 56 days for the mixture with 50% replacement blend. The diffusion coefficient was reduced from 15.0 to 1.3 for the same mixtures. Strength, as might be expected, was lower in the mixtures with SCMs at early ages but was actually higher at later ages for replacement levels up to 40%. There was a slight drop off in strength between the 40% and 50% mixtures. The salt scaling test, ASTM C672, showed increased scaling with increased replacement of cement by SCM, particularly for the 50% replacement mixture, but all mixtures exhibited less than 400 g/m^2 of mass loss due to scaling. (Thomas 2010).

A PCA R&D project carried out at the University of Missouri studied the performance of ternary mixtures. One key finding was that regardless of the cement composition the concrete performed well in freeze-thaw testing as for all mixtures with at least 4% air content. The addition of fly ash was found to result in lower chloride permeability at later ages. Two fly ash replacement levels were studied, 25 and 50%, and even the 50% replacement level resulted in significant improvements in chloride permeability testing but the team cautioned the material must be allowed to fully mature. At early ages the material will be less durable than a traditional cement mixture. The study also looked at the use of silica fume, at 5 and 10% replacement levels, and saw more benefits with increased silica fume dosages at the higher *w/cm* ratios. At lower values, 0.25 and 0.30, the impact of higher dosages of silica fume is negligible. (Stundebeck 2007) The study did not look at cracking potential. Silica fume dosages on the order of 10% should be used with caution due to the potential for early age cracking.

It is well documented that the use of ternary blends of cementitious materials and pozzolans improves durability and service life while limiting some potential draw backs of high SCM dosages in a binary blend mixture. This approach is particularly useful when the use of alkali-silica reactive aggregate cannot be avoided. As has been discussed earlier, high dosages of silica fume reduce workability and potentially increased early-age cracking. Mixtures combining either slag or fly ash with silica fume and cement exhibit reductions in chloride permeability and reductions in ASR expansion with less impact on fresh and early-age concrete properties. In one study, an OPC mixture exhibited 0.238% expansion under ASTM C1293 testing after two years while a mixture with 8% silica fume had 0.048% expansion and none of the ternary blended mixtures exhibited significant expansion (Bleszynski 2002). One drawback to the use of ternary blends is testing should be conducted at later ages. Early-age testing on such mixtures may exhibit reduced performance when compared to an OPC mixture or a mixture with OPC and silica fume as mixtures made with OPC or OPC and silica fume will react more quickly than mixtures with fly ash or slag. As a result, later age testing, such as 56 or 90 days, should be specified for durability tests to give the SCMs ample time to react so the benefits of the use of slag or fly ash can be observed (McGrath 1997).

LIMESTONE CEMENT

Intergrinding cement clinker, calcium sulfate, and limestone has been used for several decades in Europe but it is a relatively recent practice in the United States. ASTM C150 only permitted the use of up to 5% interground limestone in portland cements in 2004 and AASHTO followed in 2007 with a revision to the AASHTO M 85 specification for portland cement. Pending final ballot approval, ASTM and AASHTO plan to permit the use of up to 15% interground or blended limestone to create a new classification of blended cement (under ASTM C595 and AASHTO M 240) to be known as a “Type IL” portland-limestone cement. Portland-limestone cements are produced by either intergrinding the cement clinker, calcium sulfate and limestone or by blending limestone dust with portland cement. Although it is common to think of the limestone fraction as an inert component of the system, this characterization is not entirely true. Physically, the limestone improves the particle size distribution of the cement as it is ground more finely than clinker during intergrinding. The smaller limestone particles act as nucleation sites for cement hydration, resulting in a faster and more dispersed hydration at early ages. Chemically, the $CaCO_3$ from the limestone reacts with the aluminate phases from the clinker and the SCM, if present. The net result is that the presence of up to 15% limestone dust often improves early-age strength gain with little to no negative impacts on long-term concrete performance.

In a Canadian project that evaluated SCM replacement levels they also compared an OPC with a portland-limestone cement that contained 12% limestone (Thomas 2010). The study looked at the performance of each cement product with varying levels of SCM addition. The SCM was a blend of two parts slag and one part fly ash. In all tests the cement with limestone had nearly identical performance to the materials made with the OPC. Testing included strength at five ages, rapid chloride penetrability (ASTM C1202), freeze-thaw resistance (ASTM C666 Procedure A), and salt scaling resistance (ASTM C672). Bulk-Diffusion testing (ASTM C1556) was also carried out on cores taken after thirty-five days (Thomas 2010).

Similar results were found in another study involving portland-limestone cements and the addition of slag (Irassar 2006). This work found limestone additions alone contributed to higher early-age strength but with a slight decreases in long-term strength. The addition of slag had an opposite effect, lowering early strengths yet resulting in higher later age strengths (>90 days), as compared to an OPC. Ternary mixtures were also studied with both interground limestone

and slag additions and the compressive strengths were similar to the OPC mixture. The study also looked at flexural strength development and found mixtures with slag had a better bond between the paste and aggregate and saw increases in flexural strength after seven days for both binary and ternary mixtures. Permeability was studied on OPC, binary and ternary blends as well. In the binary mixtures with interground limestone, the 12% limestone product showed reduced absorption and permeability as compared to the OPC mixture, but the 18% limestone mixture had higher absorption and permeability. The authors attributed this to a dilution effect of the limestone where at higher replacement levels the benefits of limestone on early hydration are no longer dominant and the reduction in cement in the mixture results in lower quality paste. The mixtures with slag showed higher permeability up to 28 days, but at later ages, the permeability decreased as compared to the OPC mixtures. The ternary blended mixtures exhibited permeability characteristics similar to the binary blends with slag. The authors point out, due to reduced early-age strength and increased early-age permeability, mixtures containing slag are more sensitive to curing techniques (Irassar 2006).

One concern that has been raised regarding the use of portland-limestone cement is the potential for a type of sulfate attack known as thaumasite attack. This is especially of concern in cold climates and high sulfate environments. Chemically, the presence of additional $CaCO_3$ in the paste would favor the formation of thaumasite. The potential for sulfate attack can be mitigated with the use of low C_3A cements. Additionally, any method of reducing permeability will also help prevent the ingress of sulfates from the surrounding environment and reduce the potential or damage due to thaumasite formation (Borsoi 2000). Other work has found thaumasite was only found to form in samples cured and kept at low temperatures and exposed to cyclic wetting and drying (Collepardi 2003). Another study found low limestone additions (10%) improved sulfate resistance while higher additions (20%) resulted in reduced sulfate resistance (Irassar 2001).

AGGREGATE OPTIMIZATION

Optimum aggregate gradations have been studied since the beginning of experimentation with concrete. Some of the earliest research on aggregate gradation and its impact on concrete properties was reported by Feret in the 1890s and continued through the work of Abrams and Powers in the 1920s and 1960s. Until recently, mixtures with fully optimized gradations were not achievable because they resulted in mixtures which were not workable using only cement and water. Advances in admixtures to achieve workability have made aggregate optimization a more realistic approach.

Numerous studies have been carried out to characterize aggregates based on their gradation and to combine them to make an efficient mixture. One approach, developed by Shilstone during a project funded by the U.S. Army Corps of Engineers, defined two parameters; coarseness factor and workability factor. The workability factor is the fraction of aggregate that passes the No. 8 sieve in the combined gradation of all aggregates. The coarseness factor is the fraction of material retained on a 3/8 in. sieve relative to all material retained on a No. 8 sieve. The values of each are plotted on a coarseness factor chart. Boundary boxes have been developed that characterize the aggregate combination with regions that are more suited for particular placement methods. (Shilstone 1990 and AFCESA 1997)

A second approach that often is used in combination with the coarseness factor/workability factor chart is the 0.45 power curve chart. This approach to looking at combined aggregate gradation has been in use by the asphalt industry since the 1960s and has only recently come into use by the concrete industry. The maximum density line is plotted from the origin of the

graph to the maximum aggregate size. The actual gradation of mixtures will have values above and below this line but aggregate gradation lines that plot closer to the maximum density line will result in better packing aggregates. (Panchalan 2007)

A Strategic Highway Research Program (SHRP) study published in 1993 looked at optimum combinations of coarse aggregate and fine aggregate for mixtures with one, two or three sizes of coarse aggregate. (Anderson 1993) This study produced tables where the average diameter and packing density of the individual aggregates are used as input parameters. The optimum volume fraction for each aggregate is the output produced by the model. One limitation of the model is it assumes spherically shaped particles. Obviously aggregates are not spherical and all aggregate combination recommendations produced by the model should be trial batched to verify their functionality. For mixtures with multiple coarse aggregates the model is a two-step approach. First the optimum combination of coarse aggregates is obtained by one table and then the particle packing density and average diameter of the combination of coarse aggregates is used with the parameters related to the fine aggregate to find the volume fractions of coarse aggregate and fine aggregate.

Efforts to optimize aggregate grading will be limited by the availability of materials and the number of aggregates the local plants can handle for a given mixture. Historically concrete has been made up of a single coarse aggregate and a single fine aggregate. Special projects, such as dams, were of such a size that additional aggregate sizes could be produced and used. Recently concrete suppliers have begun incorporating an intermediate-sized coarse aggregate which leads to better packing efficiency. In some areas this material is difficult to obtain and has a higher price than other aggregates. As a result, any specifications related to aggregate gradation should take into account factors related to the local aggregate market.

RECENT CASE STUDIES

WOODROW WILSON MEMORIAL BRIDGE

HPC was recently specified in the Woodrow Wilson Memorial Bridge in Washington, D.C. The bridge was completed in 2008 and the project used multiple performance criteria and prescriptive specifications to ensure the bridge would have a long service life. For this project a seventy-five year design life was specified by the Federal Highway Administration. Chloride ion penetrability was limited to 2000 coulombs at 56 days. To meet this specification the mixture was allowed to have up to 25% fly ash, 10% silica fume, or up to 75% slag cement. Ultimately slag cement was chosen as it was readily available in the area. Calcium nitrate was added at a rate of two gallons per cubic yard to reduce corrosion and shrinkage was limited to 400 microstrain at 28 days. The contract required mist spraying within fifteen minutes of placement and the application of two layers of burlap for wet curing within thirty minutes of placement. The contractor was required to continue the wet curing for seven days after placement. Additionally, epoxy coated steel was required for the deck concrete and once the seven day curing had been complete two coats of sealer were applied. It was estimated it would take sixty years for chloride ions to penetrate to the depth of the steel and another twenty years for the ions to reach a concentration sufficient to cause corrosion damage. A second element of the bridge which required different strategies was a bascule lift bridge portion. This part of the bridge required lightweight concrete to reduce the size of the lifting equipment. Stainless steel reinforcing was specified for this portion of the bridge but calcium nitrate corrosion inhibitors were not required. This example of a recent construction project with project specifications incorporating multiple approaches to ensure the durability of HPC (Kite 2005).

DEVELOPMENT OF THE PERFORMANCE SPECIFICATION

The role of concrete mixture specifications is to create a guide for ready-mix producers to ensure the quality and consistency of concrete being placed on jobsites. There are two types of specifications: prescriptive and performance. Prescriptive specifications limit innovation and drive the contractors and suppliers to focus primarily on the strength of the concrete. Performance specifications allow new materials and design approaches to be used and focus on the durability of the concrete.

CTLGroup performed an extensive testing program to develop a performance specification which produces a high performance concrete deck. The concrete mixture should be constructible, reduce or minimize cracking of the deck, improve the resistance to chloride penetration, provide adequate freeze-thaw resistance, enhance sustainability and not harm any other properties.

MATERIALS

The materials used in the program were from local producers and meet the requirements of the Illinois Tollway. Cement …

MIXTURE PROPORTIONS

For the testing program, five mixtures were evaluated for the desired characteristics. The mixtures are as listed below:

- BS Mixture – standard bridge deck mixture
- OPT Mixture – optimization of aggregate gradation
- SLA Mixture – saturated lightweight aggregate
- SRA Mixture –shrinkage reducing admixture
- ULT Mixture – a combined approach (OPT + SLA + SRA).

PHASE I – INITIAL MIXTURE DEVELOPMENT

The first phase of the program consisted of trial batching the mixtures at a range of *w/cm* and creating a three-point curve with strength data. … During this phase the … The average compressive strength comparison to the BS mixture for each mixture is shown in Figures 1 through 4.

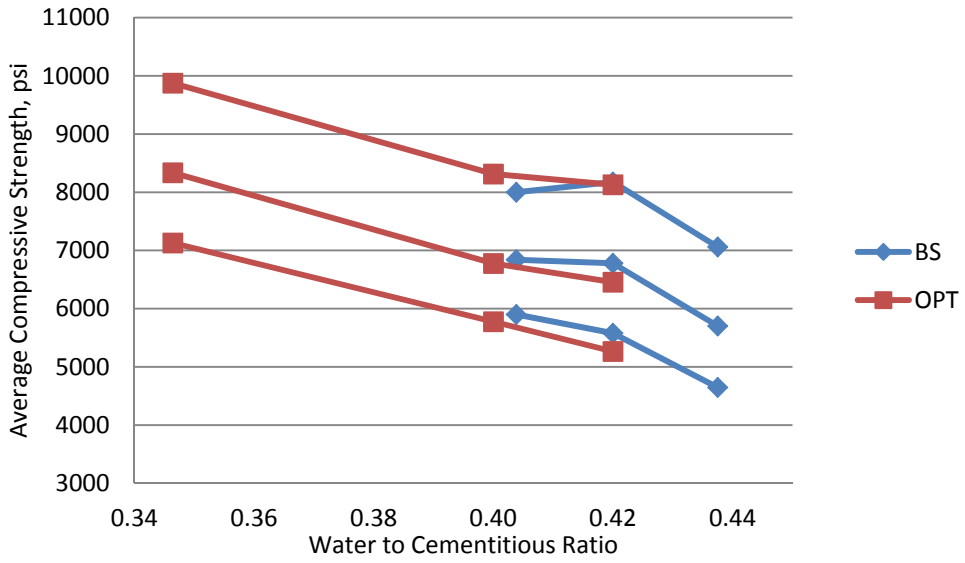

Figure 1: Average compressive strength of BS versus OPT

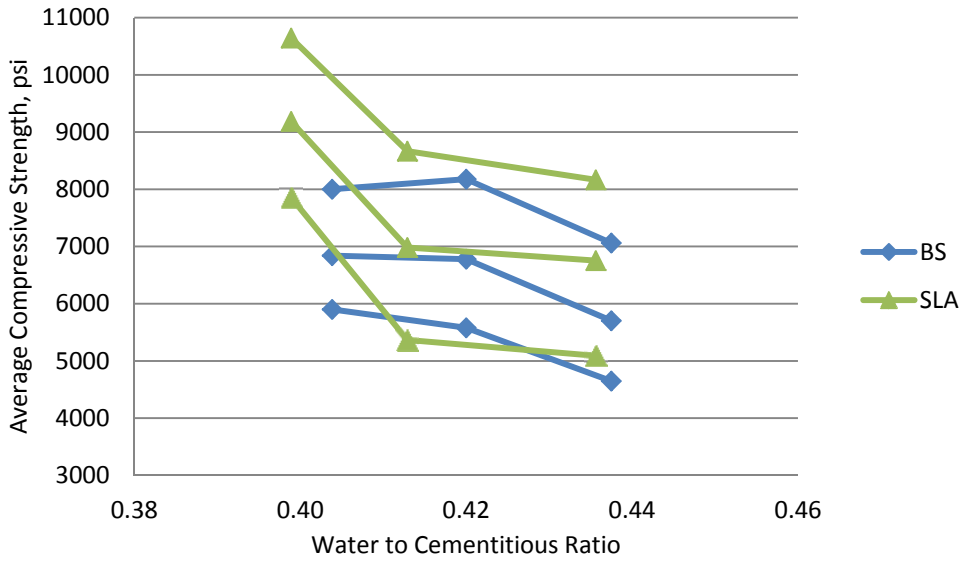

Figure 2: Average compressive strength of BS versus SLA

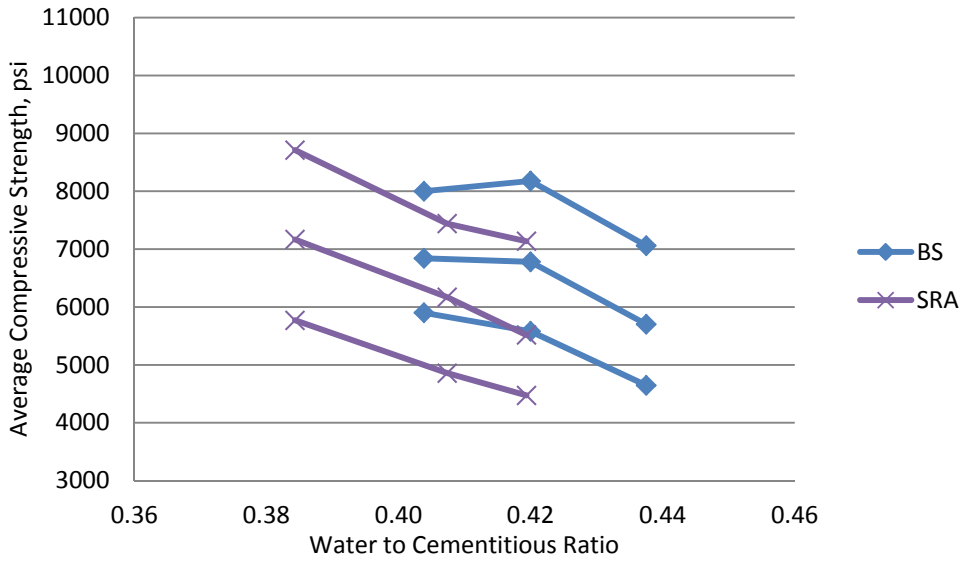

Figure 3: Average compressive strength of BS versus SRA

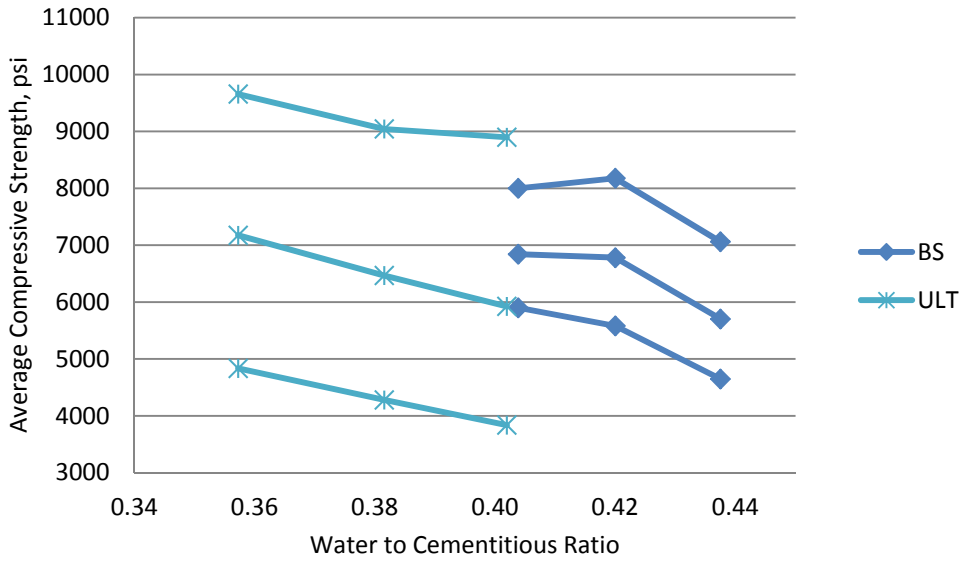

Figure 4: Average compressive strength of BS versus ULT

PHASE II -

From the results of the first phase of trial batching and testing, a *w/cm* was selected for each mixture and a full range of testing was performed. Testing included slump, plastic air content, time of set, compressive strength, elastic modulus, rapid chloride penetration, restrained shrinkage, freeze-thaw durability, drying shrinkage, and air void analysis. The target mixture proportions are shown in Table 4. …

Table 4: Target mixtures

Mix ID:	BS	OPT	SLA	SRA	ULT
Material	lb/yd³ (SSD)				
Cement	515	375	409	403	313
Fly Ash	0	125	0	134	111
Slag	110	0	136	0	154
Coarse Aggregate (CM-11)	1875	1501	1714	1840	1245
Coarse Aggregate (CM-16)	0	391	0	0	325
Saturated Lightweight Fines	0	0	364	0	236
Fine Aggregate	1160	1370	986	1323	1039
Water	263	210	237	226	220
Total Cementitious Content	625	500	545	536	578
w/cm (including water in admixtures)	0.43	0.43	0.44	0.43	0.39

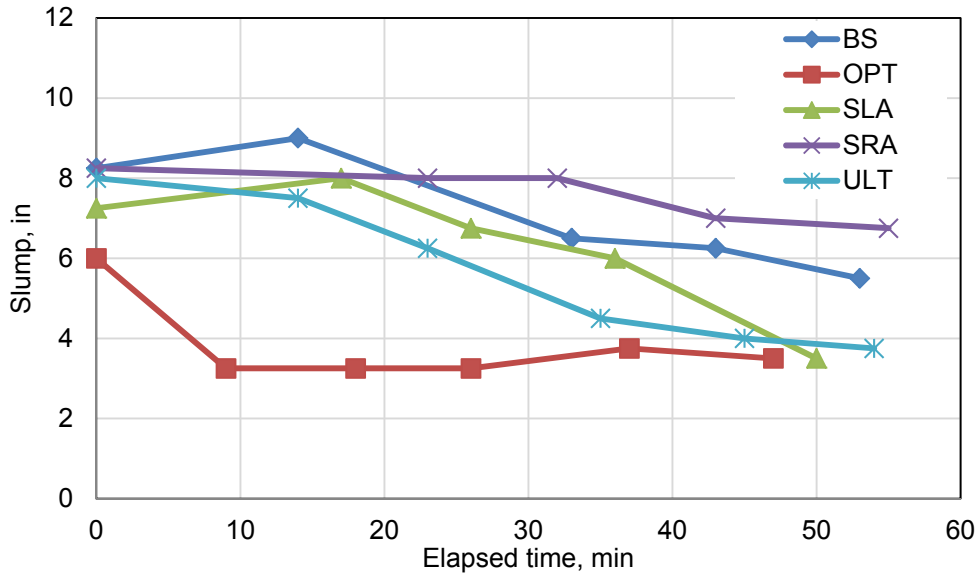

Figure 5: Change in slump over time

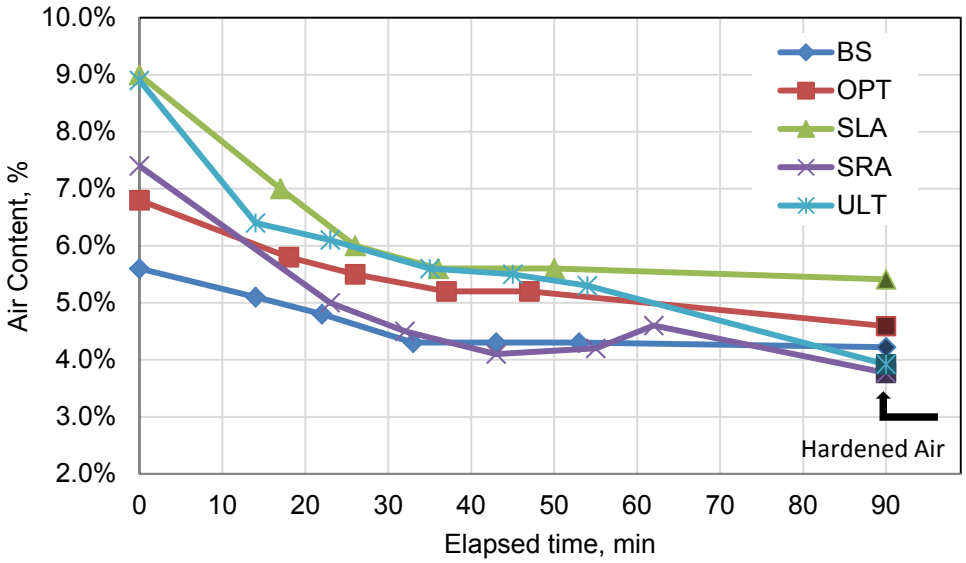

Figure 6: Change in air content over time

Table 5: Initial and final time of set

	BS	OPT	SLA	SRA	ULT
	[min]	**[min]**	**[min]**	**[min]**	**[min]**
Initial set:	300	458	350	537	514
Final set:	374	543	426	638	642

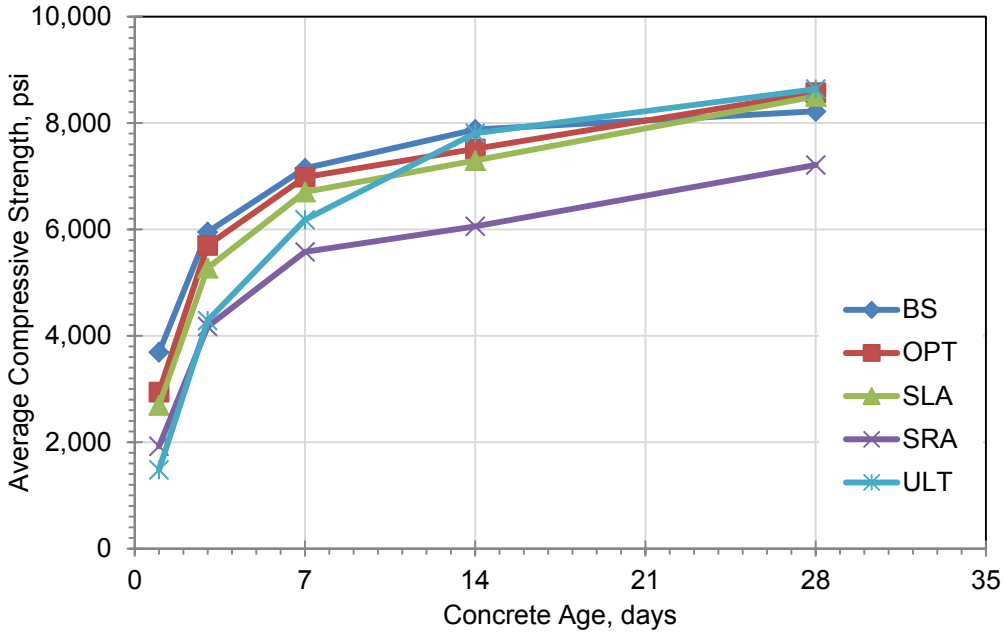

Figure 7: Average compressive strength

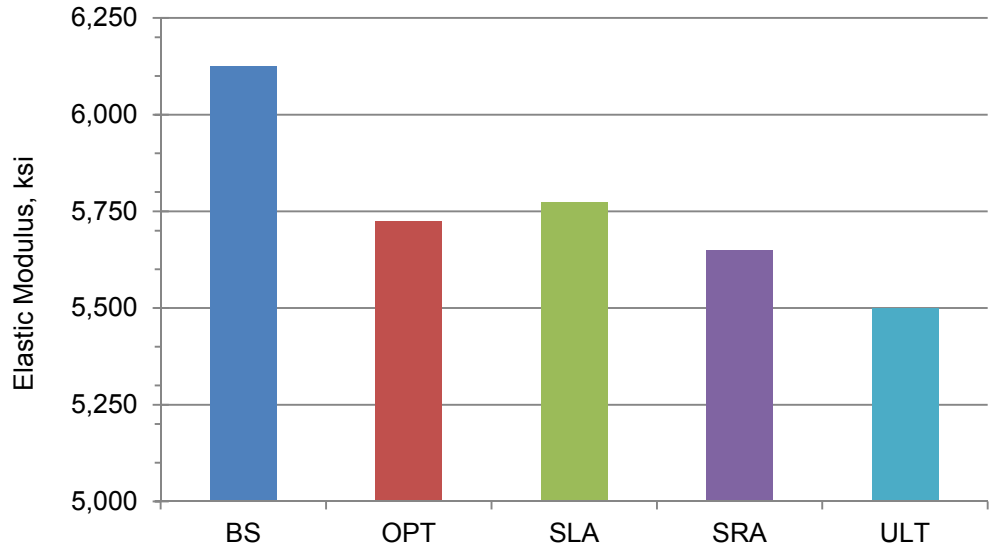

Figure 8: Elastic modulus at 28 days

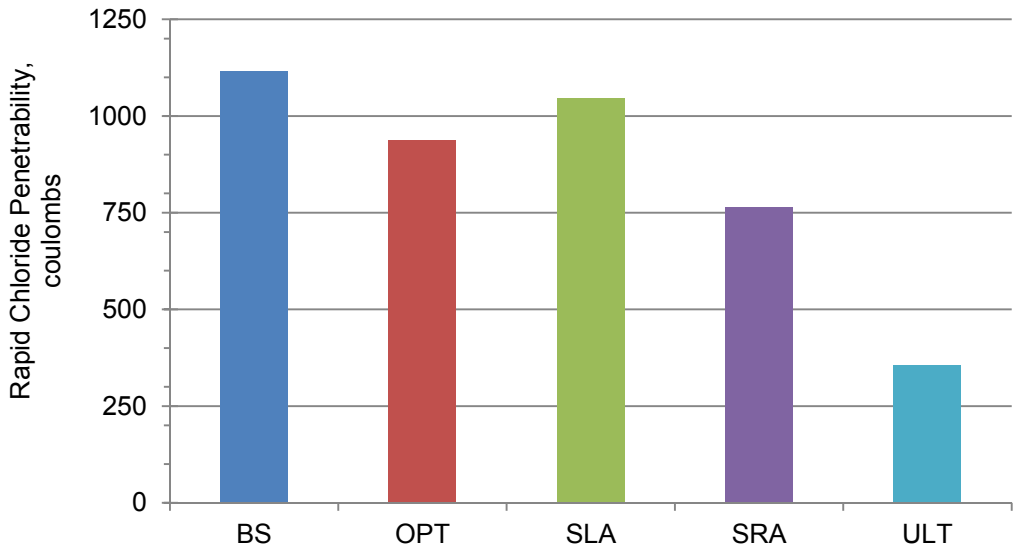

Figure 9: Rapid chloride penetrability (28 day accelerated)

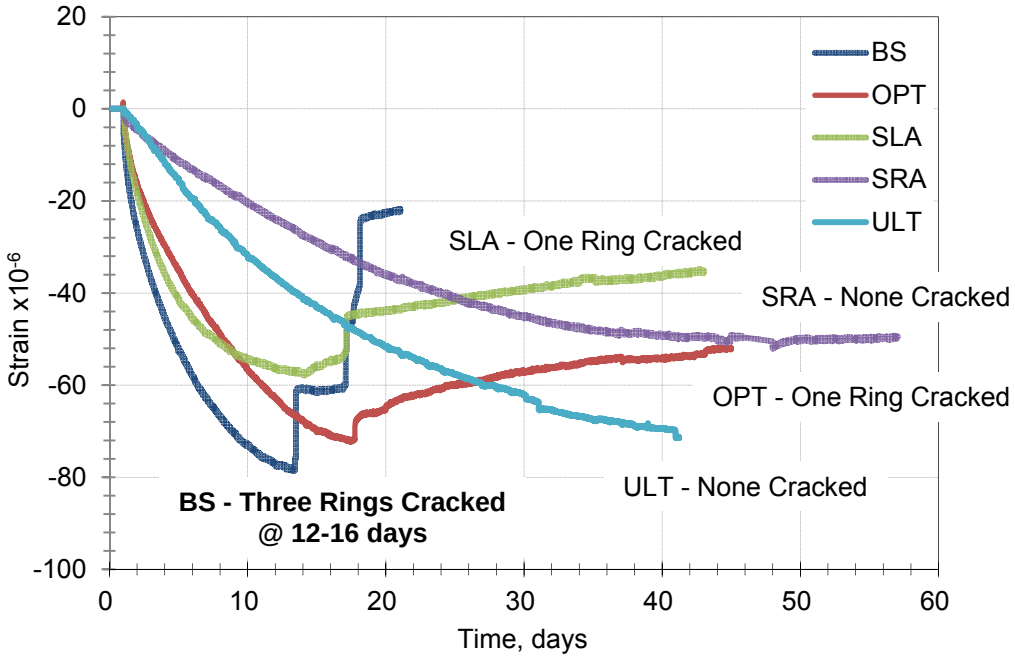

Figure 10: Restrained shrinkage over time

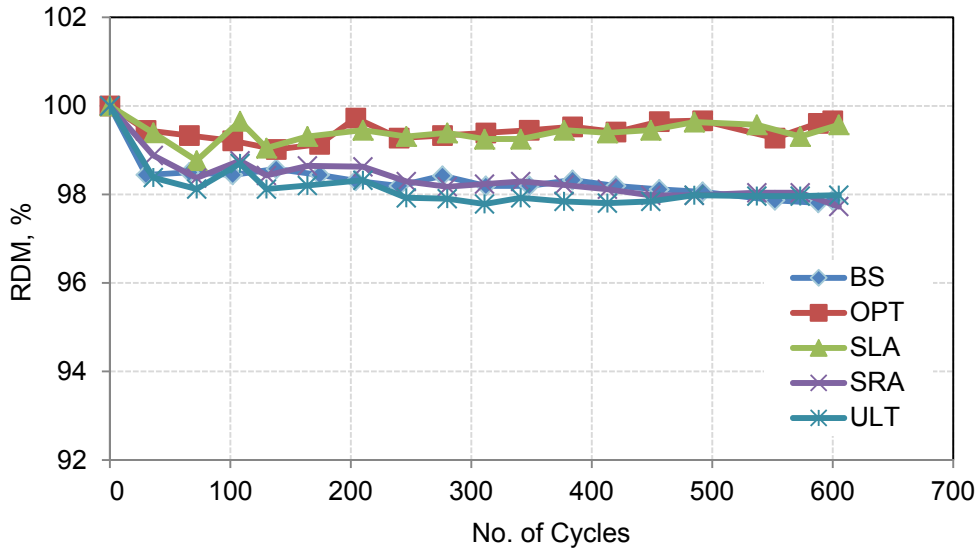

Figure 11: Freeze-thaw durability

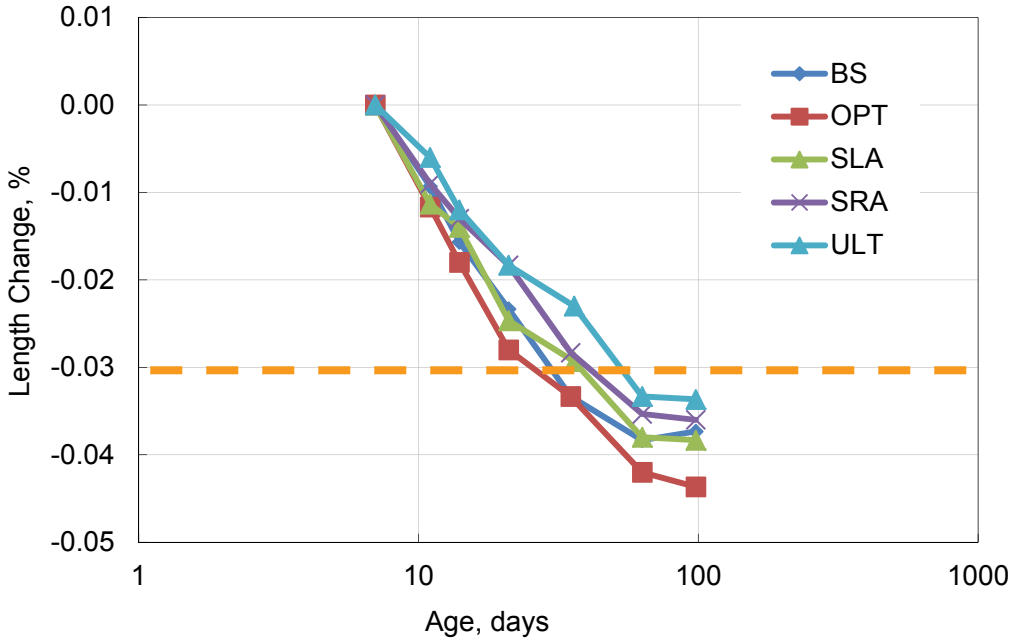

Figure 12: Drying shrinkage over time

PHASE III

The third phase of the testing program was to evaluate the application of the specification to performance of concrete mixtures in the field. This also aided in creating the field mixture qualification/validation portion of the specification. Local producers volunteered to modify one of the mixtures to suit their system, materials, and admixtures and allow CTLGroup to be onsite during mixing. Air and slump measurements were taken initially and after 45 minutes before cylinders were fabricated. The cylinders were brought back to CTLGroup for compressive strength, rapid chloride penetration, and air void analysis. Materials were also brought back to CTLGroup to recreate the field mixtures in the laboratory. From the laboratory mixing compressive strength, rapid chloride penetration and air void analysis was run along with drying shrinkage and restrained shrinkage testing.

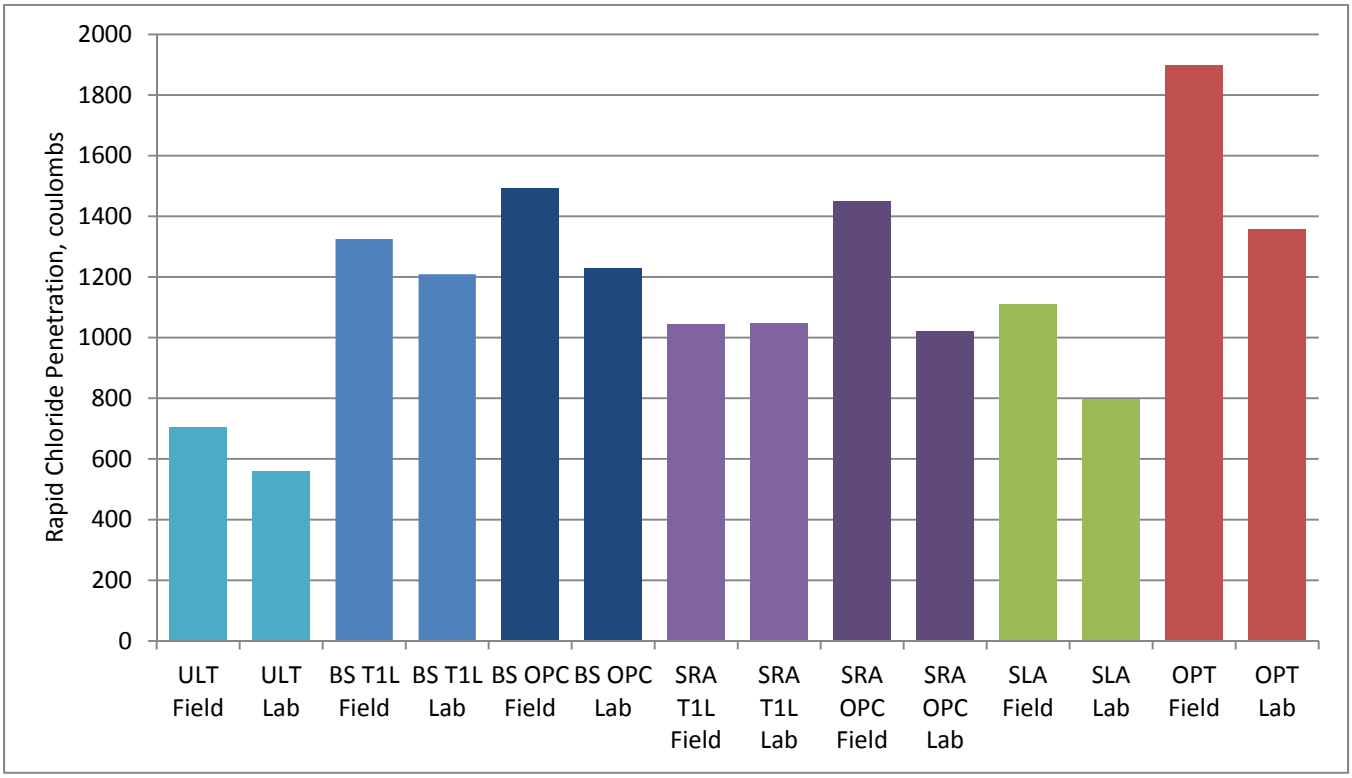

Figure 13: Rapid chloride penetration of field and lab mixtures

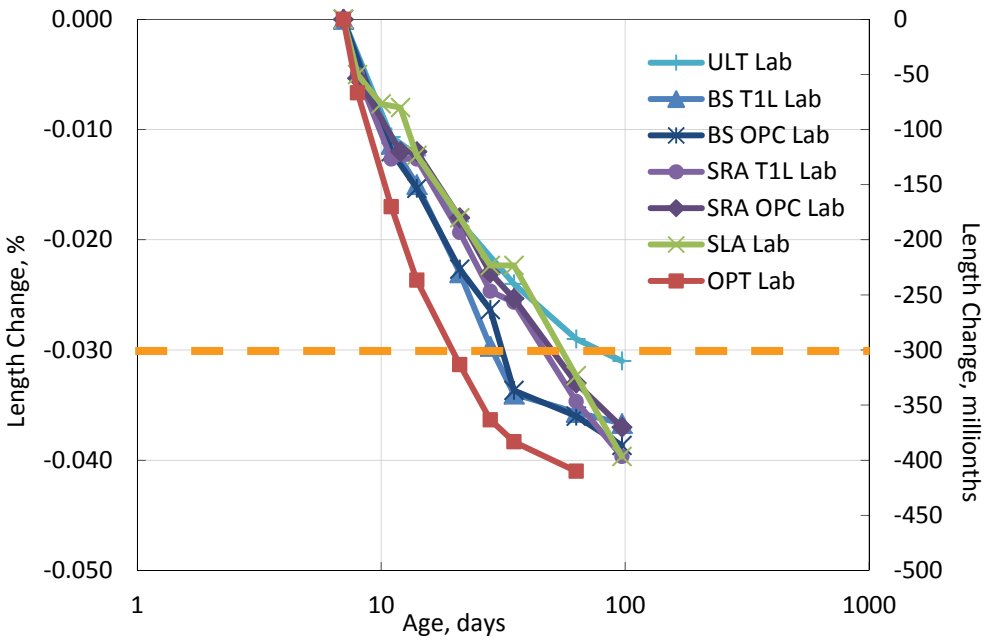

Figure 14: Drying shrinkage over time of Phase III lab mixtures

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Client: S.T.A.T.E.Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Date: August 29, 2012

CTLGroup Project No: 057122
Project Manager: M. D'Ambrosia
Technician: JP, BS
Approved: T. Van Dam

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ASTM C192 Mixture Summary

Mix ID:			BS-A	BS-B	BS-C	OPT-A1	OPT-A2	OPT-A3	OPT-A4	OPT-B	OPT-C	SLA-A	SLA-B	SLA-C	SRA-A	SRA-B	SRA-C	ULT-A	ULT-B	ULT-C
Date Fabricated:			7/2/2012	7/2/2012	7/2/2012	7/2/2012	7/2/2012	7/3/2012	7/3/2012	7/3/2012	7/9/2012	7/3/2012	7/9/2012	7/11/2012	7/3/2012	7/11/2012	7/11/2012	7/13/2012	7/13/2012	7/13/2012
Material		SG	lb/yd^3 (SSD)																	
Cement	*ASTM C150 Type I*	3.15	515	494	536	406	408	406	407	394	375	446	431	409	452	427	403	334	313	297
Fly Ash	*ASTM C618*	2.75	0	0	0	135	136	135	0	131	125	0	0	0	151	142	134	118	111	105
Slag	*ASTM C989*	2.99	110	106	114	0	0	0	136	0	0	149	144	136	0	0	0	164	154	146
Coarse Aggregate	*CM-11 Crushed Limestone*	2.74	1800	1800	1800	1506	1510	1505	1514	1487	1501	1686	1700	1714	1831	1831	1840	1245	1245	1245
Coarse Aggregate	*CM-16 Crushed Limestone*	2.67	0	0	0	402	394	393	395	388	391	0	0	0	0	0	0	325	325	325
Saturated Lightweight	*Saturated Lightweight Fines*	2.11	0	0	0	0	0	0	0	0	0	358	360	364	0	0	0	0	0	0
Saturated Lightweight	*Saturated Lightweight Fines*	1.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	236	236	236
Fine Aggregate	*ASTM C33 Fine Aggregate*	2.68	1234	1256	1213	1412	1379	1374	1382	1358	1370	977	978	986	1256	1286	1323	1002	1039	1066
Water	*Potable*	1.00	263	263	263	175	184	187	184	210	210	237	237	237	232	232	226	220	220	220
		SG	fl. oz./cwt (100 lbs of cementitous material)																	
Air Entraining Agent			0.37	0.37	0.37	1.16	1.01	0.72	0.72	0.72	0.61	0.64	0.64	0.56	0.90	0.93	0.93	0.64	0.66	0.69
Water Reducer			3.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Shrinkage Reducing Agent			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	33.7	35.8	32.0	33.2	35.0
Slump Retaining Admixture			0.0	0.0	0.0	0.0	4.0	8.0	8.0	8.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High Range Water Reducer			2.4	2.4	2.4	14.5	11.6	14.5	14.5	8.0	4.0	7.8	8.0	8.0	5.3	5.0	3.8	5.1	5.1	4.3
Hydration Stabilizer			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
w/cm			0.42	0.44	0.41	0.34	0.35	0.36	0.35	0.41	0.43	0.41	0.42	0.44	0.39	0.41	0.42	0.36	0.39	0.41
Total Cementitious Content, lb/yd^3			625	600	650	541	543	541	543	525	500	595	575	545	603	569	536	617	578	548
Paste Content Volume (including air), %			33.7%	33.2%	34.2%	27.4%	28.0%	28.2%	27.8%	29.1%	28.4%	31.8%	31.4%	30.8%	32.5%	31.9%	30.8%	32.2%	31.4%	30.8%
			Target Fresh Properties																	
Target Slump, in.			6-8 inches																	
Design Air Content, %			6%																	
			Measured Fresh Properties																	
Slump, in.	ASTM C143		5.75	6.25	5.25	3.25	4.25	7	8.5	8.5	4.25	2.5	6.5	7.25	7	6.75	7	4.25	6	3.5
Air Content, %	ASTM C231		5.8%	6.9%	6.3%	7.8%	7.0%	6.2%	5.2%	6.2%	7.1%	6.2%	6.3%	5.6%	5.3%	4.4%	4.4%	4.3%	4.5%	4.5%
Temperature, °F	ASTM C1064		83	81	81	81	81	78	78	77	75	80	75	76	78	76	76	77	76	75
Fresh Density, lb/ft^3	ASTM C138		146	144	145	147	147	149	151	147	146	147	145	145	149	149	150	145	144	145
Age, days			**Measured Compressive Strength, psi**																	
3	ASTM C39		5,580	4,647	5,900	6,277	6,577	7,130	8,207	5,777	5,267	7,857	5,367	5,090	5,770	4,857	4,473	4,833	4,280	3,837
7	ASTM C39		6,780	5,703	6,840	7,313	7,813	8,337	9,793	6,777	6,457	9,187	6,983	6,753	7,167	6,170	5,517	7,173	6,467	5,923
28	ASTM C39		8,177	7,060	8,000	9,187	9,860	9,873	11,407	8,313	8,130	10,643	8,667	8,167	8,710	7,440	7,137	9,657	9,043	8,897

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 5, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-A	BS-A	BS-A
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 10:23	7/2/12 10:23	7/2/12 10:23
Test Date / Time	7/5/12 11:12	7/5/12 11:15	7/5/12 11:18
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.01	3.99	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.17	8.18
Average Diameter, in.	4.02	4.00	4.01
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.69	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	70,918	70,249	70,224
Compressive Strength, psi	5,590	5,590	5,560
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,580

Report Notes

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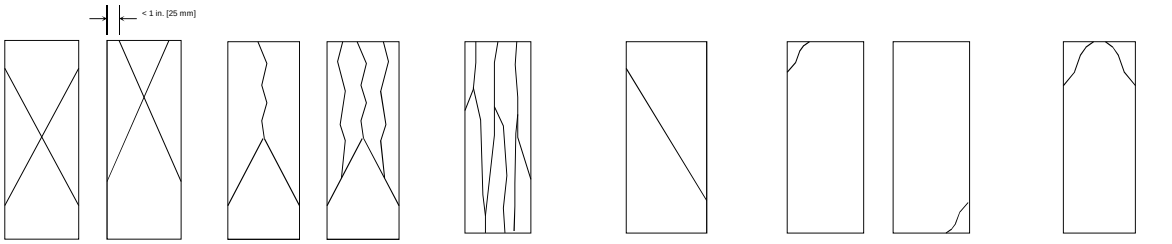
Schematic of Typical Fracture Patterns



Type 1
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Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

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Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-A	BS-A	BS-A
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 10:23	7/2/12 10:23	7/2/12 10:23
Test Date / Time	7/9/12 13:10	7/9/12 13:14	7/9/12 15:53
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.00	4.02
Diameter 2, in.	4.01	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.21	8.18
Average Diameter, in.	4.01	4.00	4.01
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.63	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	84,778	87,080	84,581
Compressive Strength, psi	6,710	6,930	6,700
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,780

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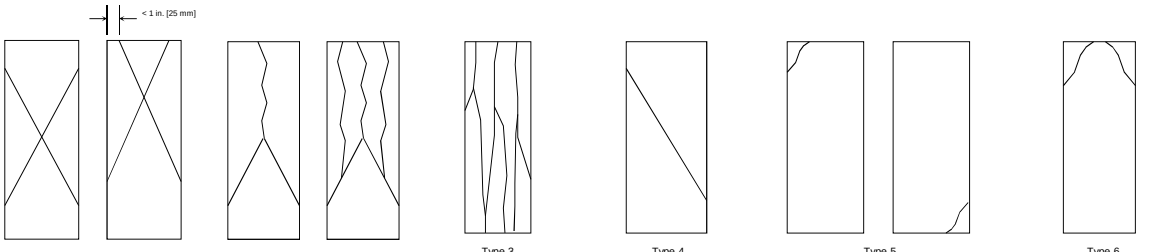
Schematic of Typical Fracture Patterns



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CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-A	BS-A	BS-A
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 10:23	7/2/12 10:23	7/2/12 10:23
Test Date / Time	7/30/12 13:40	7/30/12 13:45	7/30/12 13:50
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.01
Diameter 2, in.	4.02	4.02	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.23	8.16
Average Diameter, in.	4.03	4.02	4.00
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.76	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	103,979	104,824	102,131
Compressive Strength, psi	8,150	8,260	8,120
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,177

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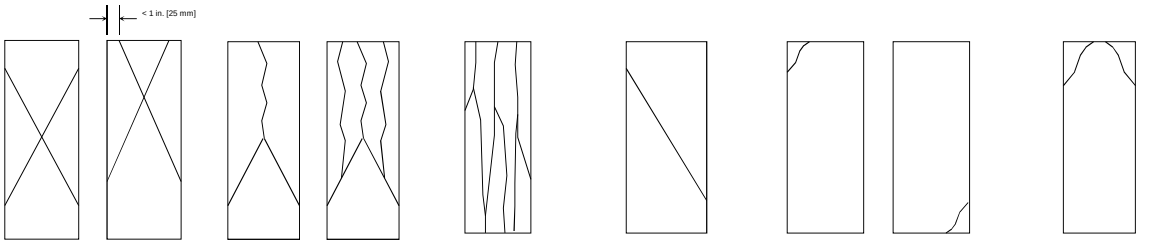
Schematic of Typical Fracture Patterns



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CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-B	BS-B	BS-B
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 11:04	7/2/12 11:04	7/2/12 11:04
Test Date / Time	7/5/12 11:21	7/5/12 11:24	7/5/12 11:27
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	4.00	4.02	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.15	8.21
Average Diameter, in.	4.01	4.02	4.02
Length / Diameter (L/D)	2.04	2.03	2.04
Cross-Sectional Area, in^2	12.63	12.69	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	59,240	58,956	58,400
Compressive Strength, psi	4,690	4,650	4,600
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,647

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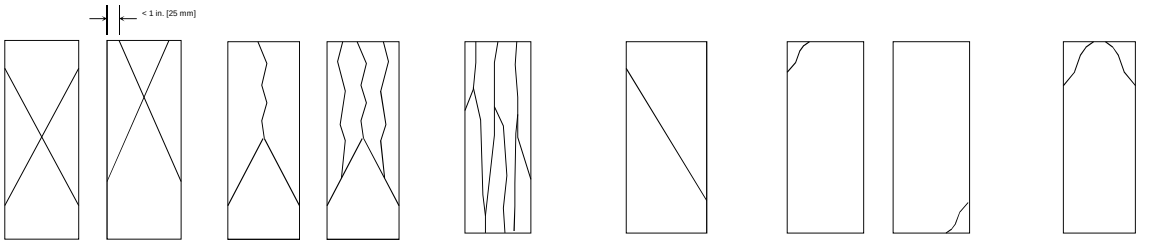
Schematic of Typical Fracture Patterns



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Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-B	BS-B	BS-B
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 11:04	7/2/12 11:04	7/2/12 11:04
Test Date / Time	7/9/12 13:22	7/9/12 13:26	7/9/12 13:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.03
Diameter 2, in.	4.03	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.15	8.19	8.21
Average Diameter, in.	4.03	4.00	4.02
Length / Diameter (L/D)	2.02	2.05	2.04
Cross-Sectional Area, in^2	12.76	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	72,477	71,441	73,004
Compressive Strength, psi	5,680	5,680	5,750
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,703

Report Notes

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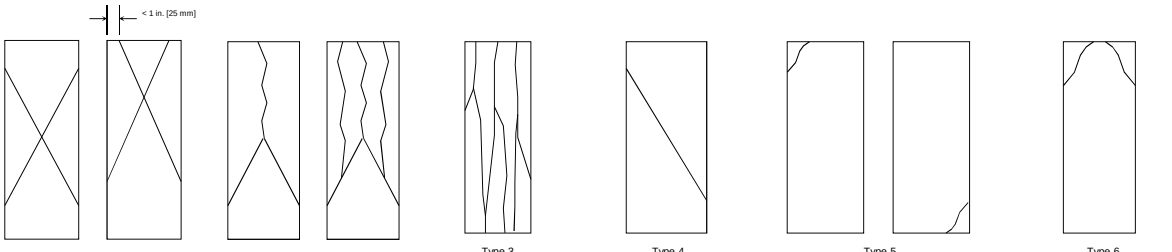
Schematic of Typical Fracture Patterns



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Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-B	BS-B	BS-B
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 11:04	7/2/12 11:04	7/2/12 11:04
Test Date / Time	7/30/12 13:54	7/30/12 13:58	7/30/12 14:02
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.02	4.01
Diameter 2, in.	3.99	4.01	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.18	8.16
Average Diameter, in.	3.99	4.01	4.01
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.50	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	90,335	88,416	87,815
Compressive Strength, psi	7,230	7,000	6,950
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,060

Report Notes

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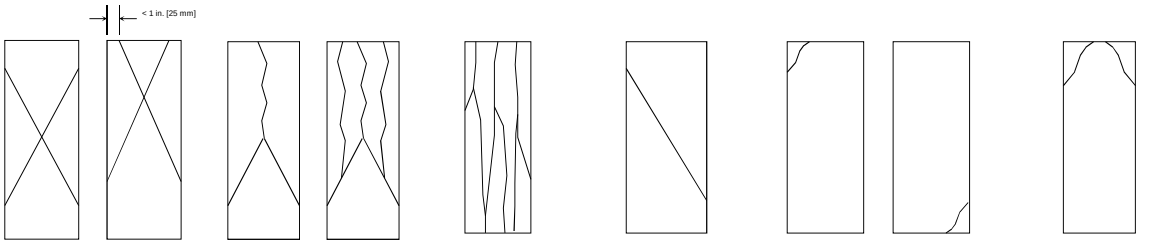
Schematic of Typical Fracture Patterns



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Project: HPC for Bridge Decks
Report Date: July 5, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-C	BS-C	BS-C
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 11:38	7/2/12 11:38	7/2/12 11:38
Test Date / Time	7/5/12 12:57	7/5/12 13:01	7/5/12 13:04
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.03	4.02
Diameter 2, in.	3.99	4.03	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.22	8.18	8.20
Average Diameter, in.	4.00	4.03	4.02
Length / Diameter (L/D)	2.05	2.03	2.04
Cross-Sectional Area, in^2	12.57	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	74,465	76,498	73,299
Compressive Strength, psi	5,920	6,000	5,780
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,900

Report Notes

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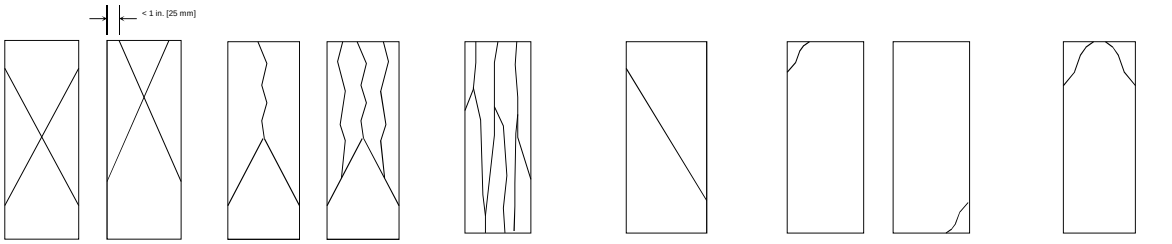
Schematic of Typical Fracture Patterns



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Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-C	BS-C	BS-C
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 11:38	7/2/12 11:38	7/2/12 11:38
Test Date / Time	7/9/12 13:34	7/9/12 13:39	7/9/12 13:43
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	4.01	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.22	8.18
Average Diameter, in.	4.01	4.02	4.01
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.63	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	86,128	86,025	87,423
Compressive Strength, psi	6,820	6,780	6,920
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	6,840

Report Notes

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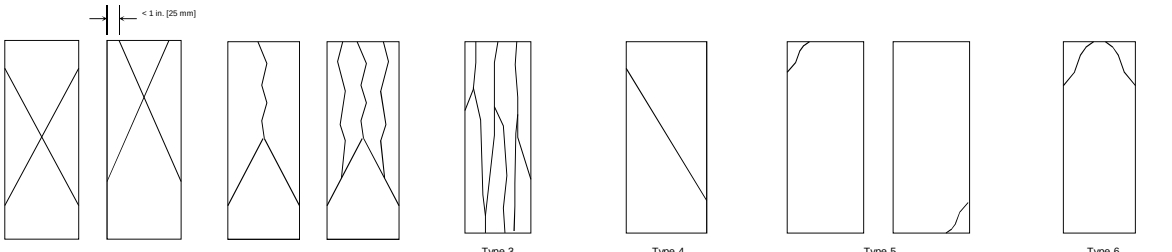
Schematic of Typical Fracture Patterns



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Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-C	BS-C	BS-C
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 11:38	7/2/12 11:38	7/2/12 11:38
Test Date / Time	7/30/12 14:04	7/30/12 14:08	7/30/12 14:12
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.02	4.04
Diameter 2, in.	4.01	4.00	4.03
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.23	8.24	8.18
Average Diameter, in.	4.02	4.01	4.03
Length / Diameter (L/D)	2.05	2.05	2.03
Cross-Sectional Area, in^2	12.69	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	102,665	101,848	100,217
Compressive Strength, psi	8,090	8,060	7,850
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	8,000

Report Notes

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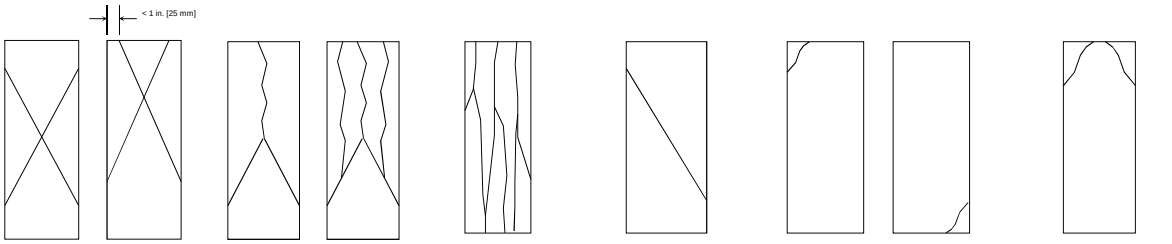
Schematic of Typical Fracture Patterns



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Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A1	OPT-A1	OPT-A1
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 13:50	7/2/12 13:50	7/2/12 13:50
Test Date / Time	7/5/12 13:06	7/5/12 13:09	7/5/12 13:12
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.00	4.02
Diameter 2, in.	4.01	3.99	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.22	8.17	8.19
Average Diameter, in.	4.02	4.00	4.01
Length / Diameter (L/D)	2.05	2.04	2.04
Cross-Sectional Area, in^2	12.69	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

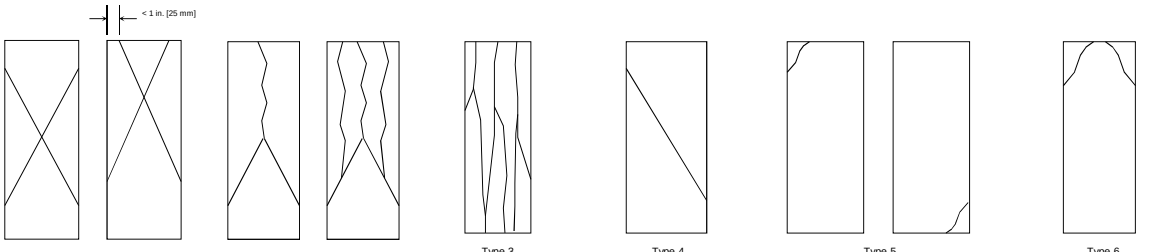
Maximum Load, lb	79,608	80,250	78,020
Compressive Strength, psi	6,270	6,380	6,180
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,277

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A1	OPT-A1	OPT-A1
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 13:50	7/2/12 13:50	7/2/12 13:50
Test Date / Time	7/9/12 14:27	7/9/12 14:20	7/9/12 14:24
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.04	4.03
Diameter 2, in.	4.01	4.03	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.24	8.23	8.20
Average Diameter, in.	4.02	4.03	4.02
Length / Diameter (L/D)	2.05	2.04	2.04
Cross-Sectional Area, in^2	12.69	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	92,168	94,020	92,801
Compressive Strength, psi	7,260	7,370	7,310
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,313

Report Notes

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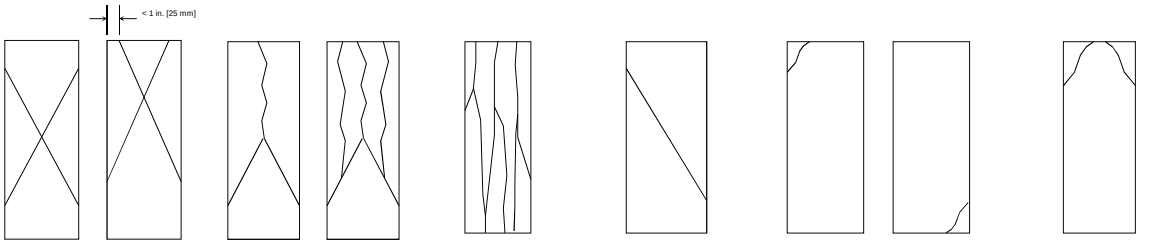
Schematic of Typical Fracture Patterns



Type 1
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Type 3
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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 30, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A1	OPT-A1	OPT-A1
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 13:50	7/2/12 13:50	7/2/12 13:50
Test Date / Time	7/30/12 14:16	7/30/12 14:20	7/30/12 14:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.00
Diameter 2, in.	4.02	4.01	3.99
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.19	8.17	8.21
Average Diameter, in.	4.03	4.02	4.00
Length / Diameter (L/D)	2.03	2.03	2.05
Cross-Sectional Area, in^2	12.76	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	117,766	115,376	116,209
Compressive Strength, psi	9,230	9,090	9,240
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	9,187

Report Notes

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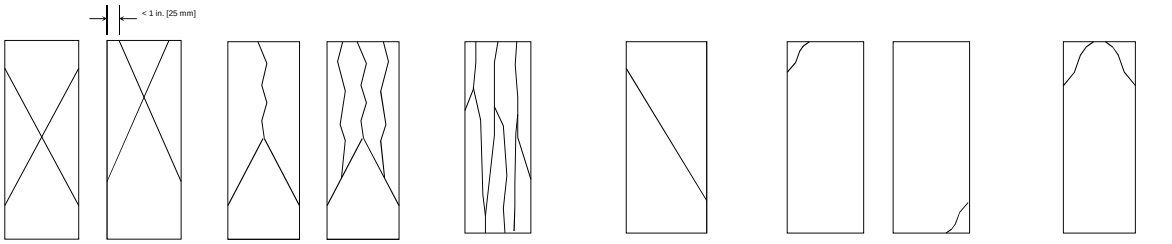
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 5, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A2	OPT-A2	OPT-A2
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 15:26	7/2/12 15:26	7/2/12 15:26
Test Date / Time	7/5/12 13:15	7/5/12 13:18	7/5/12 13:23
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.01
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.15	8.17
Average Diameter, in.	4.03	4.01	4.01
Length / Diameter (L/D)	2.04	2.03	2.04
Cross-Sectional Area, in^2	12.76	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	83,937	83,580	82,422
Compressive Strength, psi	6,580	6,620	6,530
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,577

Report Notes

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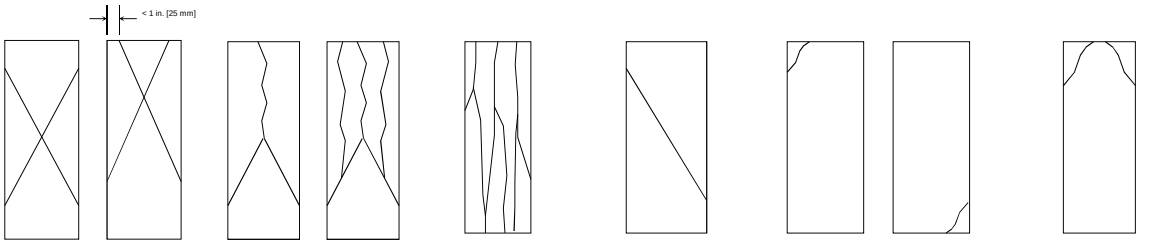
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A2	OPT-A2	OPT-A2
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 15:26	7/2/12 15:26	7/2/12 15:26
Test Date / Time	7/9/12 14:05	7/9/12 14:09	7/9/12 14:13
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.03
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.15	8.18	8.19
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	2.02	2.04	2.04
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	99,123	99,387	98,927
Compressive Strength, psi	7,770	7,870	7,800
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,813

Report Notes

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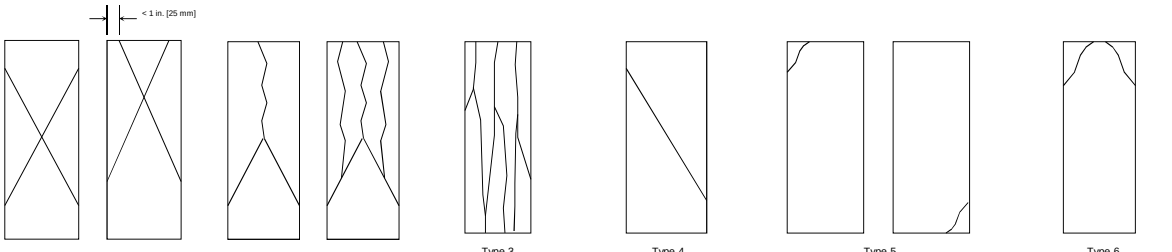
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 30, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A2	OPT-A2	OPT-A2
Client Identification	N/A	N/A	N/A
Casting Date	7/2/12 15:26	7/2/12 15:26	7/2/12 15:26
Test Date / Time	7/30/12 14:30	7/30/12 14:35	7/30/12 14:40
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.01	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.18	8.16
Average Diameter, in.	4.02	4.01	4.01
Length / Diameter (L/D)	2.03	2.04	2.03
Cross-Sectional Area, in^2	12.69	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	126,621	122,073	125,382
Compressive Strength, psi	9,980	9,670	9,930
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	9,860

Report Notes

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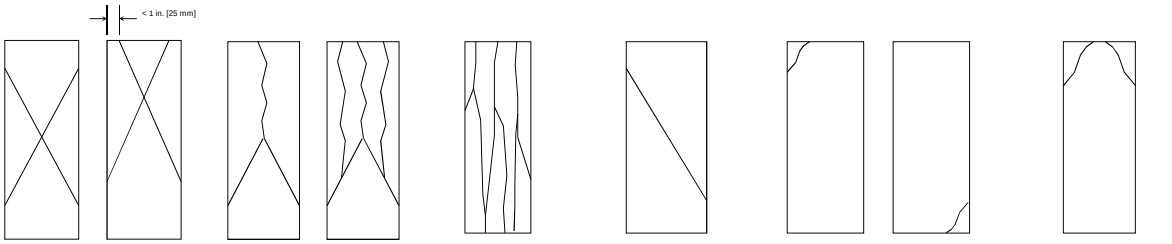
Schematic of Typical Fracture Patterns



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Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A3	OPT-A3	OPT-A3
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 9:04	7/3/12 9:04	7/3/12 9:04
Test Date / Time	7/6/12 11:16	7/6/12 11:21	7/6/12 11:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.00	4.01
Diameter 2, in.	4.01	3.99	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.21	8.22
Average Diameter, in.	4.01	4.00	4.01
Length / Diameter (L/D)	2.04	2.05	2.05
Cross-Sectional Area, in^2	12.63	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	90,120	89,847	89,731
Compressive Strength, psi	7,140	7,150	7,100
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,130

Report Notes

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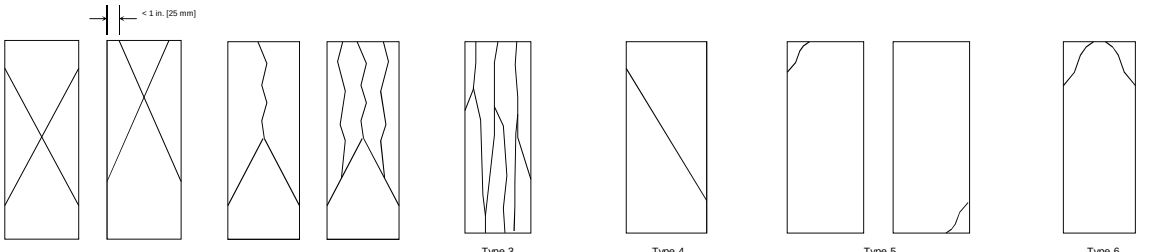
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: W. Wilson
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A3	OPT-A3	OPT-A3
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 9:04	7/3/12 9:04	7/3/12 9:04
Test Date / Time	7/10/12 13:03	7/10/12 13:07	7/10/12 13:11
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.04
Diameter 2, in.	4.01	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.24	8.21	8.17
Average Diameter, in.	4.02	4.01	4.03
Length / Diameter (L/D)	2.05	2.05	2.03
Cross-Sectional Area, in^2	12.69	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	105,455	104,784	107,243
Compressive Strength, psi	8,310	8,300	8,400
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,337

Report Notes

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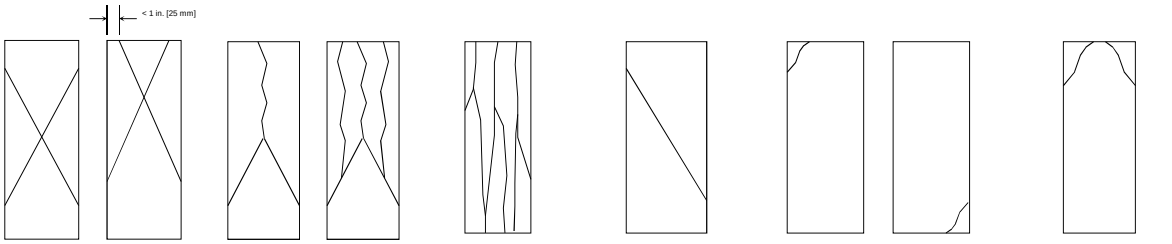
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A3	OPT-A3	OPT-A3
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 9:04	7/3/12 9:04	7/3/12 9:04
Test Date / Time	7/31/12 10:41	7/31/12 10:46	7/31/12 10:50
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.00	4.02
Diameter 2, in.	4.02	3.99	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.15	8.20
Average Diameter, in.	4.03	4.00	4.01
Length / Diameter (L/D)	2.03	2.04	2.04
Cross-Sectional Area, in^2	12.76	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	123,723	124,208	126,777
Compressive Strength, psi	9,700	9,880	10,040
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	9,873

Report Notes

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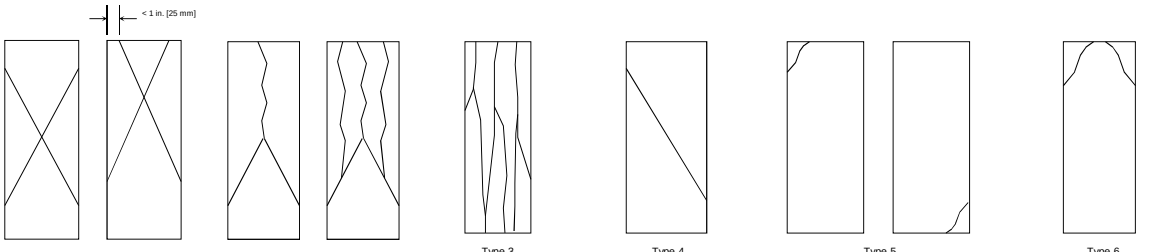
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A4	OPT-A4	OPT-A4
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 9:56	7/3/12 9:56	7/3/12 9:56
Test Date / Time	7/6/12 11:30	7/6/12 11:35	7/6/12 11:39
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	3.99	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.20	8.17
Average Diameter, in.	4.00	4.01	4.01
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

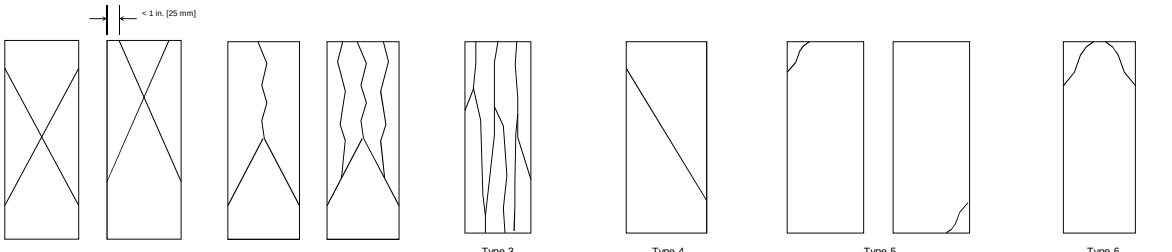
Maximum Load, lb	103,295	104,448	102,667
Compressive Strength, psi	8,220	8,270	8,130
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,207

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
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Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: W. Wilson
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A4	OPT-A4	OPT-A4
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 9:56	7/3/12 9:56	7/3/12 9:56
Test Date / Time	7/10/12 13:43	7/10/12 13:47	7/10/12 13:51
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.00	4.01
Diameter 2, in.	4.02	3.99	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.20	8.21
Average Diameter, in.	4.02	3.99	4.01
Length / Diameter (L/D)	2.03	2.05	2.05
Cross-Sectional Area, in^2	12.69	12.50	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	125,000	121,382	124,062
Compressive Strength, psi	9,850	9,710	9,820
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	9,793

Report Notes

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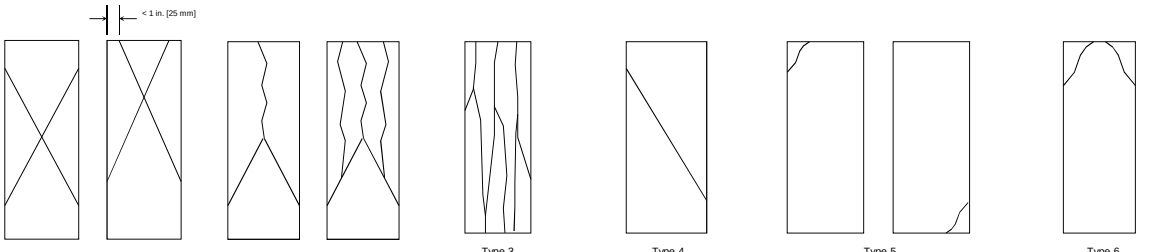
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-A4	OPT-A4	OPT-A4
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 9:56	7/3/12 9:56	7/3/12 9:56
Test Date / Time	7/31/12 10:26	7/31/12 10:31	7/31/12 10:36
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.04
Diameter 2, in.	4.01	4.00	4.03
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.22	8.20
Average Diameter, in.	4.02	4.01	4.03
Length / Diameter (L/D)	2.04	2.05	2.03
Cross-Sectional Area, in^2	12.69	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	145,918	143,051	145,365
Compressive Strength, psi	11,500	11,330	11,390
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	11,407

Report Notes

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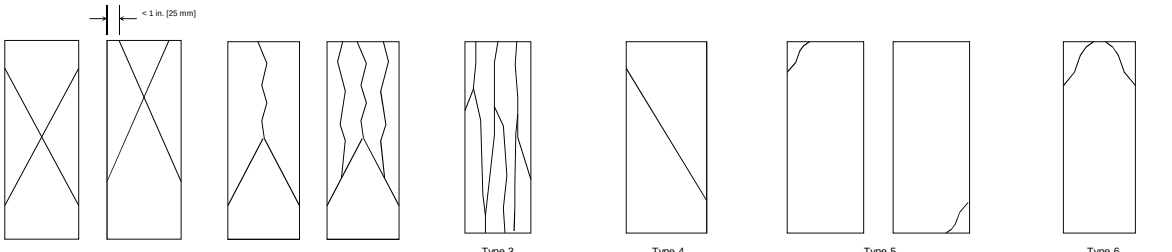
Schematic of Typical Fracture Patterns



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Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-B	OPT-B	OPT-B
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 14:27	7/3/12 14:27	7/3/12 14:27
Test Date / Time	7/6/12 15:12	7/6/12 15:16	7/6/12 15:20
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	3.99	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.19	8.17
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	73,151	72,738	73,032
Compressive Strength, psi	5,820	5,730	5,780
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,777

Report Notes

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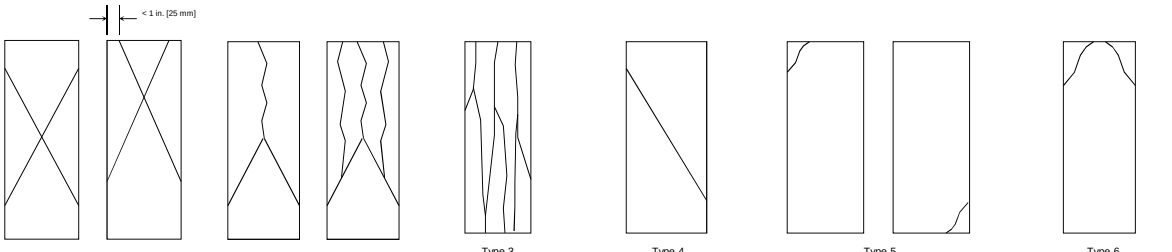
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: W. Wilson
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-B	OPT-B	OPT-B
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 14:27	7/3/12 14:27	7/3/12 14:27
Test Date / Time	7/10/12 14:42	7/10/12 14:46	7/10/12 14:50
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.03	4.03
Diameter 2, in.	3.99	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.23	8.22
Average Diameter, in.	4.00	4.03	4.02
Length / Diameter (L/D)	2.05	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	84,537	87,182	85,963
Compressive Strength, psi	6,730	6,830	6,770
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,777

Report Notes

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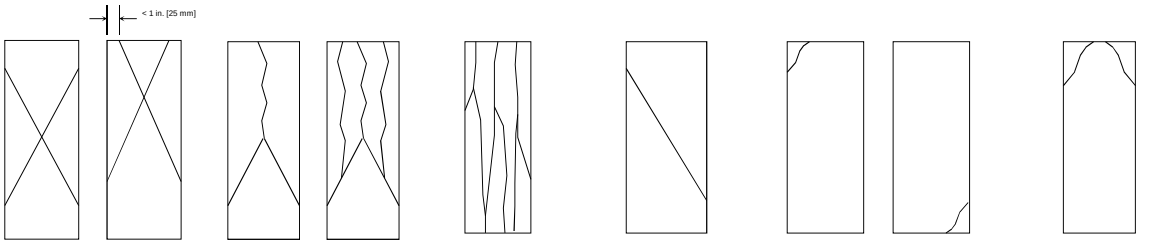
Schematic of Typical Fracture Patterns



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Type 4
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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-B	OPT-B	OPT-B
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 14:27	7/3/12 14:27	7/3/12 14:27
Test Date / Time	7/31/12 14:48	7/31/12 14:55	7/31/12 14:59
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.02	4.02
Diameter 2, in.	3.99	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.20	8.20
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	2.04	2.04	2.05
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	104,681	104,859	105,514
Compressive Strength, psi	8,330	8,260	8,350
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,313

Report Notes

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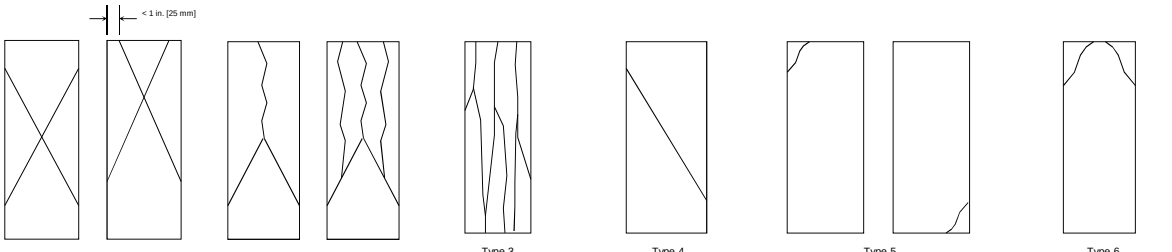
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 12, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-C	OPT-C	OPT-C
Client Identification	N/A	N/A	N/A
Casting Date	7/9/12 13:32	7/9/12 13:32	7/9/12 13:32
Test Date / Time	7/12/12 13:40	7/12/12 13:43	7/12/12 13:47
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.04	4.03
Diameter 2, in.	3.99	4.02	4.03
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.24	8.21	8.19
Average Diameter, in.	4.00	4.03	4.03
Length / Diameter (L/D)	2.06	2.04	2.03
Cross-Sectional Area, in^2	12.57	12.76	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	67,952	66,113	66,475
Compressive Strength, psi	5,410	5,180	5,210
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,267

Report Notes

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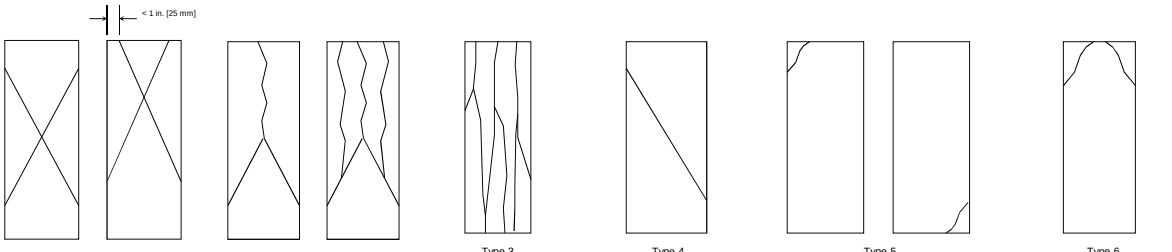
Schematic of Typical Fracture Patterns



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Type 2
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-C	OPT-C	OPT-C
Client Identification	N/A	N/A	N/A
Casting Date	7/9/12 13:32	7/9/12 13:32	7/9/12 13:32
Test Date / Time	7/16/12 14:33	7/16/12 14:38	7/16/12 14:43
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.04	4.03
Diameter 2, in.	4.01	4.03	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.16	8.17
Average Diameter, in.	4.01	4.03	4.02
Length / Diameter (L/D)	2.04	2.02	2.03
Cross-Sectional Area, in^2	12.63	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	81,828	82,502	81,517
Compressive Strength, psi	6,480	6,470	6,420
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,457

Report Notes

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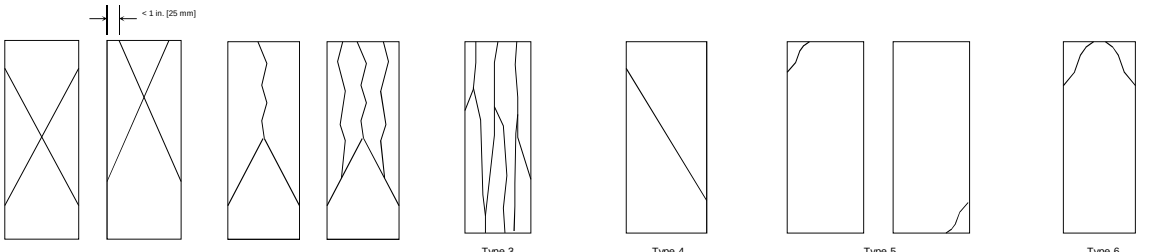
Schematic of Typical Fracture Patterns



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Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-C	OPT-C	OPT-C
Client Identification	N/A	N/A	N/A
Casting Date	7/9/12 13:32	7/9/12 13:32	7/9/12 13:32
Test Date / Time	8/6/12 13:40	8/6/12 13:44	8/6/12 13:50
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.04	4.03
Diameter 2, in.	3.99	4.02	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.23	8.22	8.20
Average Diameter, in.	4.00	4.03	4.02
Length / Diameter (L/D)	2.06	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	104,921	102,425	101,585
Compressive Strength, psi	8,350	8,030	8,010
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	8,130

Report Notes

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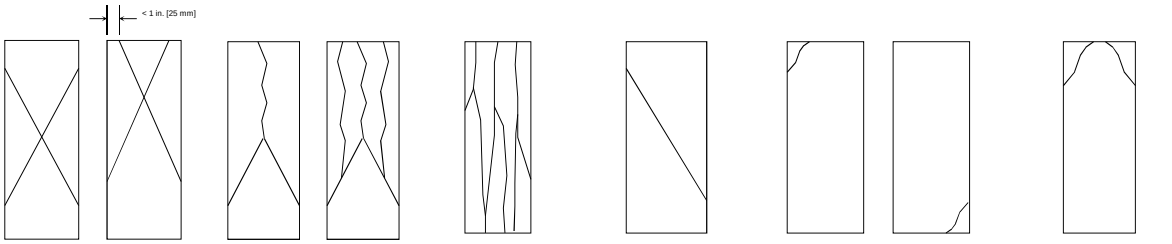
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-A	SLA-A	SLA-A
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 11:04	7/3/12 11:04	7/3/12 11:04
Test Date / Time	7/6/12 12:55	7/6/12 12:59	7/6/12 13:03
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.01	3.99	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.22	8.19
Average Diameter, in.	4.02	4.00	4.03
Length / Diameter (L/D)	2.04	2.06	2.03
Cross-Sectional Area, in^2	12.69	12.57	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

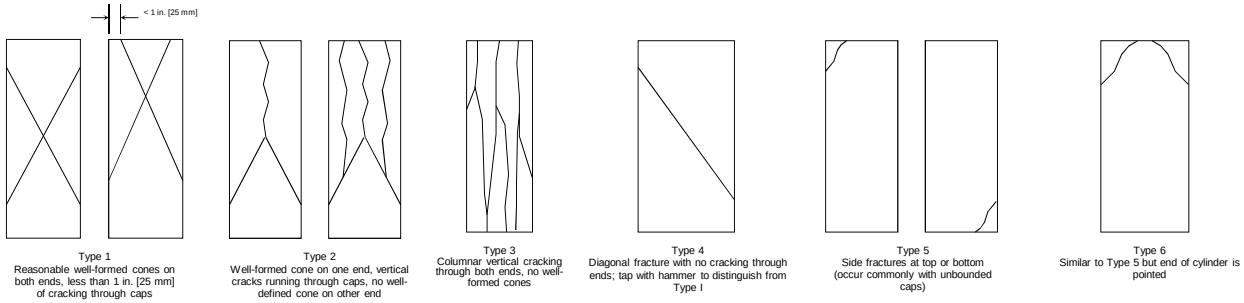
Maximum Load, lb	100,503	99,356	98,923
Compressive Strength, psi	7,920	7,900	7,750
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,857

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: W. Wilson
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-A	SLA-A	SLA-A
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 11:04	7/3/12 11:04	7/3/12 11:04
Test Date / Time	7/10/12 14:10	7/10/12 14:15	7/10/12 14:19
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.02	4.01
Diameter 2, in.	3.98	4.00	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.24	8.22	8.23
Average Diameter, in.	3.99	4.01	4.00
Length / Diameter (L/D)	2.07	2.05	2.06
Cross-Sectional Area, in^2	12.50	12.63	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	116,839	114,261	115,106
Compressive Strength, psi	9,350	9,050	9,160
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	9,187

Report Notes

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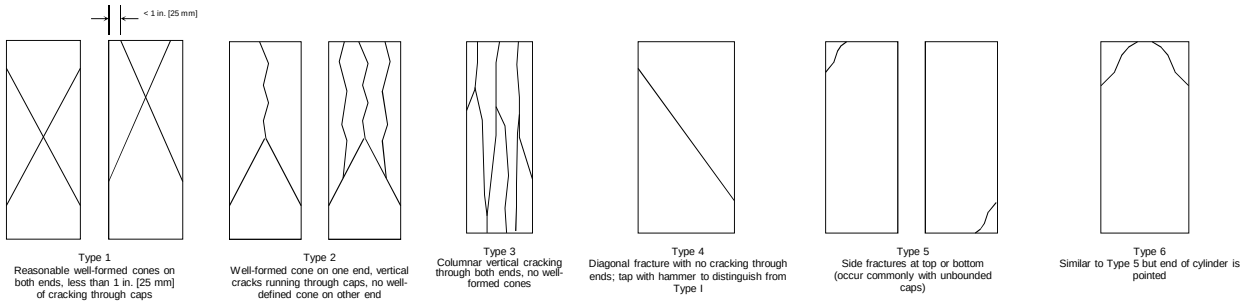
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-A	SLA-A	SLA-A
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 11:04	7/3/12 11:04	7/3/12 11:04
Test Date / Time	7/31/12 10:56	7/31/12 11:00	7/31/12 11:05
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.03	4.02
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.22	8.23	8.24
Average Diameter, in.	4.03	4.02	4.01
Length / Diameter (L/D)	2.04	2.05	2.05
Cross-Sectional Area, in^2	12.76	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	134,515	137,711	133,169
Compressive Strength, psi	10,540	10,850	10,540
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	10,643

Report Notes

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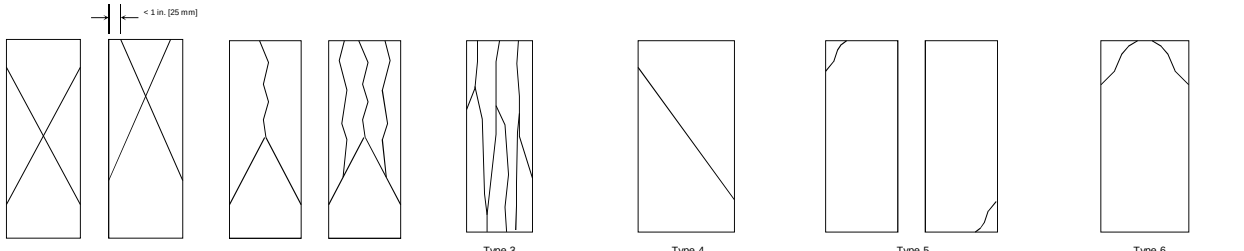
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 12, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-B	SLA-B	SLA-B
Client Identification	N/A	N/A	N/A
Casting Date	7/9/12 14:32	7/9/12 14:32	7/9/12 14:32
Test Date / Time	7/12/12 13:15	7/12/12 13:19	7/12/12 13:23
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.02
Diameter 2, in.	4.00	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.22	8.20	8.21
Average Diameter, in.	4.01	4.03	4.02
Length / Diameter (L/D)	2.05	2.03	2.04
Cross-Sectional Area, in^2	12.63	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	67,816	69,032	67,524
Compressive Strength, psi	5,370	5,410	5,320
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	5,367

Report Notes

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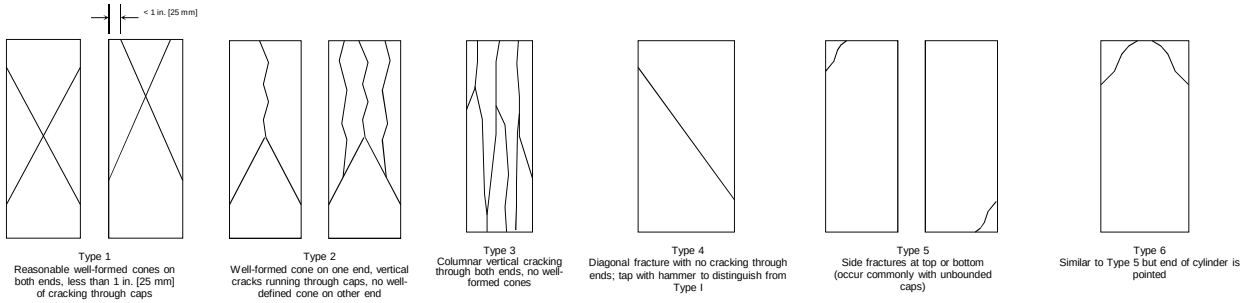
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-B	SLA-B	SLA-B
Client Identification	N/A	N/A	N/A
Casting Date	7/9/12 14:32	7/9/12 14:32	7/9/12 14:32
Test Date / Time	7/16/12 14:50	7/16/12 14:54	7/16/12 15:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.02
Diameter 2, in.	4.02	4.01	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.22	8.22	8.20
Average Diameter, in.	4.02	4.01	4.01
Length / Diameter (L/D)	2.05	2.05	2.05
Cross-Sectional Area, in^2	12.69	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	88,153	87,158	89,681
Compressive Strength, psi	6,950	6,900	7,100
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,983

Report Notes

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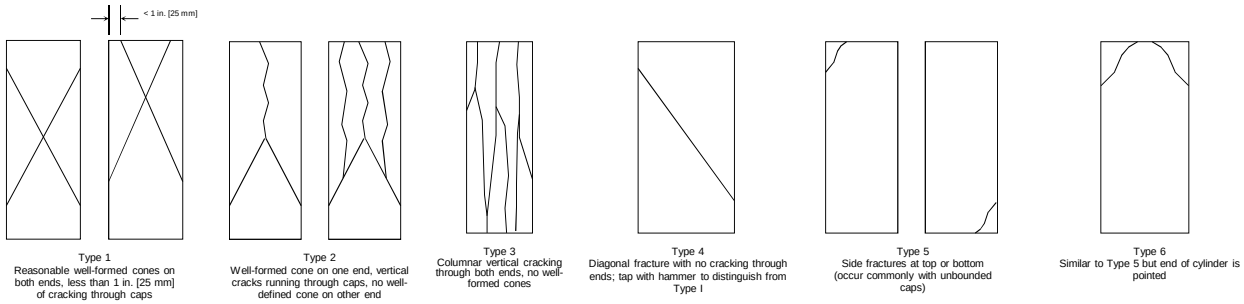
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-B	SLA-B	SLA-B
Client Identification	N/A	N/A	N/A
Casting Date	7/9/12 14:32	7/9/12 14:32	7/9/12 14:32
Test Date / Time	8/6/12 13:24	8/6/12 13:29	8/6/12 13:35
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.02
Diameter 2, in.	4.02	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.18	8.19
Average Diameter, in.	4.02	4.01	4.02
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.69	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	111,054	109,044	109,426
Compressive Strength, psi	8,750	8,630	8,620
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,667

Report Notes

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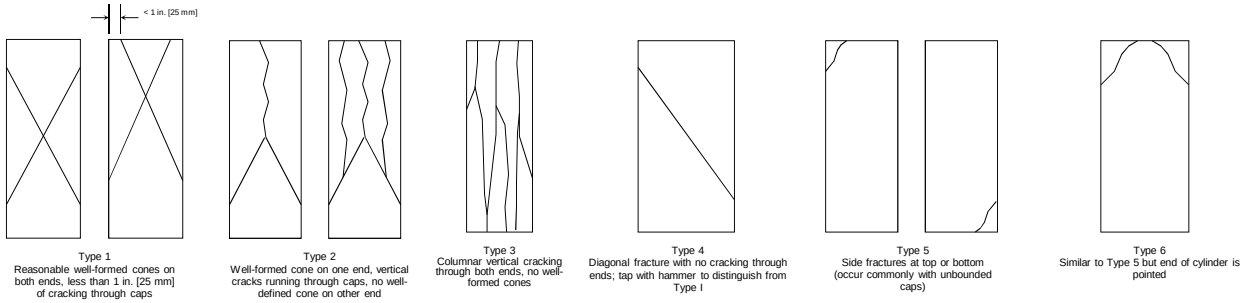
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: J. Pycz
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-C	SLA-C	SLA-C
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 8:56	7/11/12 8:56	7/11/12 8:56
Test Date / Time	7/14/12 11:15	7/14/12 11:20	7/14/12 11:24
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.02	4.01
Diameter 2, in.	3.97	4.01	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.24	8.22
Average Diameter, in.	3.99	4.01	4.01
Length / Diameter (L/D)	2.05	2.06	2.05
Cross-Sectional Area, in^2	12.50	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	64,000	65,488	62,583
Compressive Strength, psi	5,120	5,190	4,960
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,090

Report Notes

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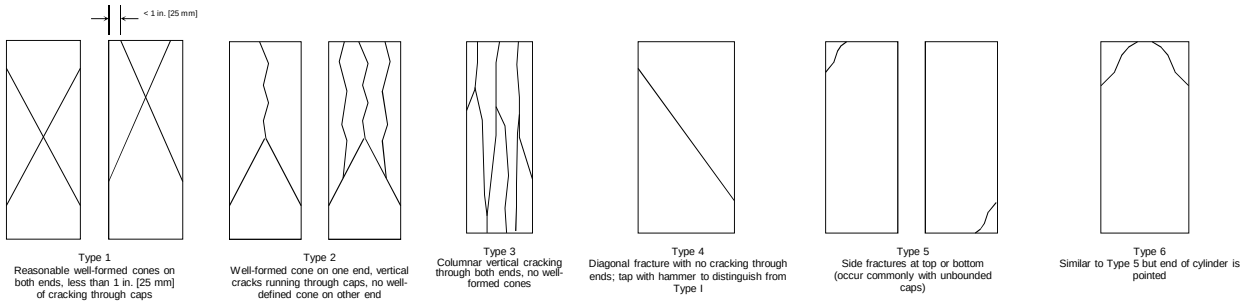
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-C	SLA-C	SLA-C
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 8:56	7/11/12 8:56	7/11/12 8:56
Test Date / Time	7/18/12 13:18	7/18/12 13:22	7/18/12 13:26
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.01	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.18	8.20
Average Diameter, in.	4.02	4.00	4.02
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.69	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	84,825	84,757	86,778
Compressive Strength, psi	6,680	6,740	6,840
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,753

Report Notes

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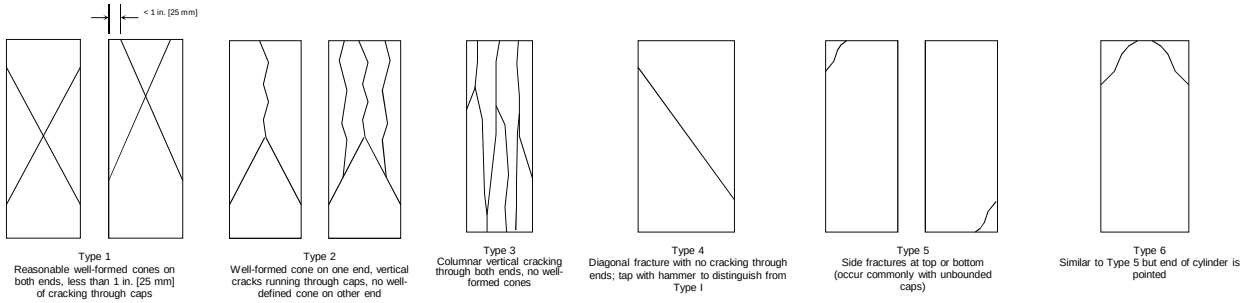
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 9, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-C	SLA-C	SLA-C
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 8:56	7/11/12 8:56	7/11/12 8:56
Test Date / Time	8/8/12 16:00	8/8/12 16:05	8/8/12 16:10
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.01
Diameter 2, in.	4.01	4.02	4.00
Length(without caps), in.	7.90	7.94	7.96
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.03	4.01
Length / Diameter (L/D)	1.97	1.97	1.99
Cross-Sectional Area, in^2	12.63	12.76	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	102,010	105,031	103,398
Compressive Strength, psi	8,080	8,230	8,190
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,167

Report Notes

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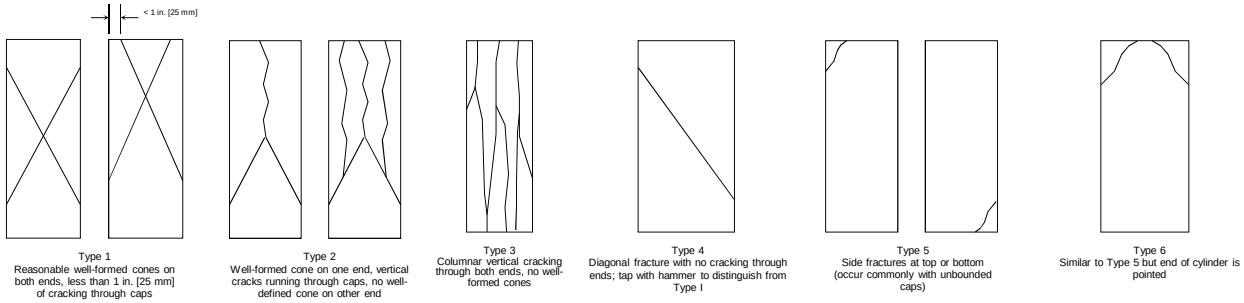
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-A	SRA-A	SRA-A
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 13:38	7/3/12 13:38	7/3/12 13:38
Test Date / Time	7/6/12 15:00	7/6/12 15:03	7/6/12 15:07
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.03
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.23	8.21
Average Diameter, in.	4.02	4.01	4.03
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.69	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	73,241	71,936	74,524
Compressive Strength, psi	5,770	5,700	5,840
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,770

Report Notes

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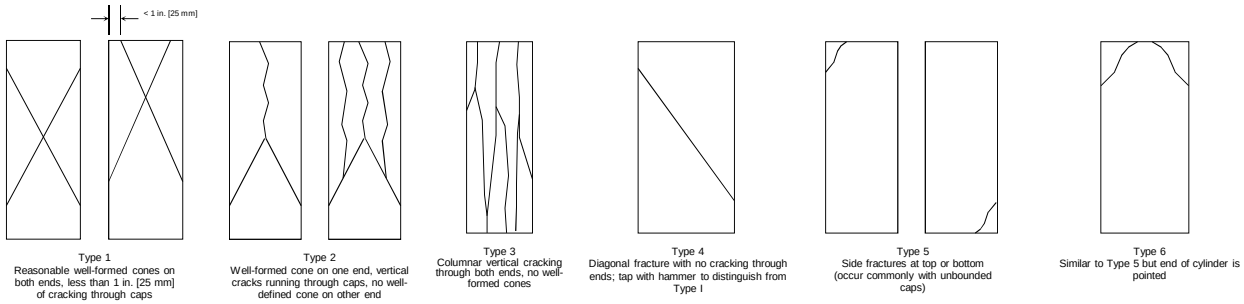
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date:

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician:
Analyst:
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-A	SRA-A	SRA-A
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 13:38	7/3/12 13:38	7/3/12 13:38
Test Date / Time	7/10/12 14:30	7/10/12 14:34	7/10/12 14:39
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	4.00	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.23	8.14	8.17
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	2.06	2.03	2.04
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

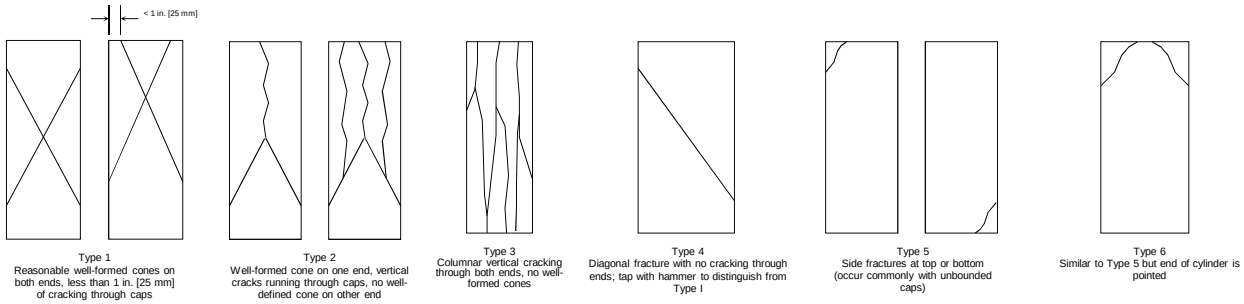
Maximum Load, lb	89,705	90,615	91,155
Compressive Strength, psi	7,140	7,140	7,220
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,167

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-A	SRA-A	SRA-A
Client Identification	N/A	N/A	N/A
Casting Date	7/3/12 13:38	7/3/12 13:38	7/3/12 13:38
Test Date / Time	7/31/12 14:32	7/31/12 14:37	7/31/12 14:42
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.02	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.21	8.22
Average Diameter, in.	4.03	4.00	4.01
Length / Diameter (L/D)	2.03	2.05	2.05
Cross-Sectional Area, in^2	12.76	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	109,020	112,268	109,361
Compressive Strength, psi	8,540	8,930	8,660
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,710

Report Notes

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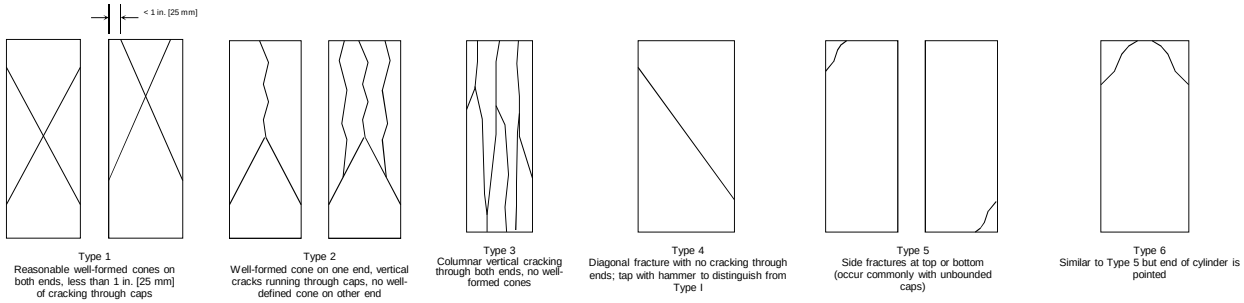
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: J. Pycz
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-B	SRA-B	SRA-B
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 10:16	7/11/12 10:16	7/11/12 10:16
Test Date / Time	7/14/12 11:30	7/14/12 11:33	7/14/12 11:36
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.01	4.01
Diameter 2, in.	4.00	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.16	8.23
Average Diameter, in.	4.00	4.01	4.02
Length / Diameter (L/D)	2.05	2.03	2.05
Cross-Sectional Area, in^2	12.57	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	61,609	62,273	60,123
Compressive Strength, psi	4,900	4,930	4,740
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,857

Report Notes

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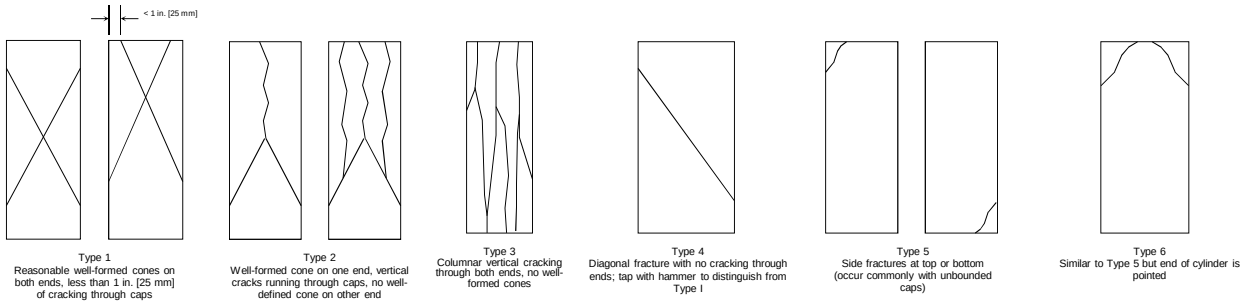
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-B	SRA-B	SRA-B
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 10:16	7/11/12 10:16	7/11/12 10:16
Test Date / Time	7/18/12 13:30	7/18/12 13:34	7/18/12 13:38
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.04	4.02	4.00
Diameter 2, in.	4.02	4.01	3.98
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.23	8.22	8.23
Average Diameter, in.	4.03	4.01	3.99
Length / Diameter (L/D)	2.04	2.05	2.06
Cross-Sectional Area, in^2	12.76	12.63	12.50
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	78,324	77,636	77,721
Compressive Strength, psi	6,140	6,150	6,220
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,170

Report Notes

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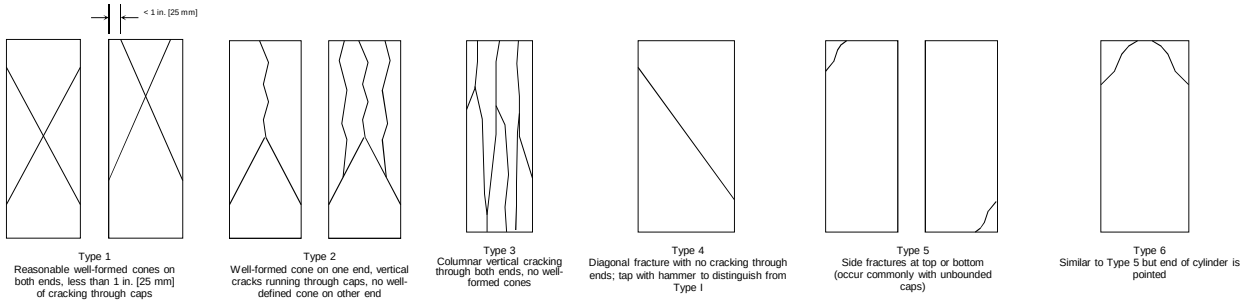
Schematic of Typical Fracture Patterns



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Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 9, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-B	SRA-B	SRA-B
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 10:16	7/11/12 10:16	7/11/12 10:16
Test Date / Time	8/8/12 16:30	8/8/12 16:35	8/8/12 16:40
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.03
Diameter 2, in.	4.02	4.01	4.03
Length(without caps), in.	7.94	7.93	7.96
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.01	4.03
Length / Diameter (L/D)	1.97	1.98	1.98
Cross-Sectional Area, in^2	12.69	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	92,923	95,798	94,681
Compressive Strength, psi	7,320	7,580	7,420
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,440

Report Notes

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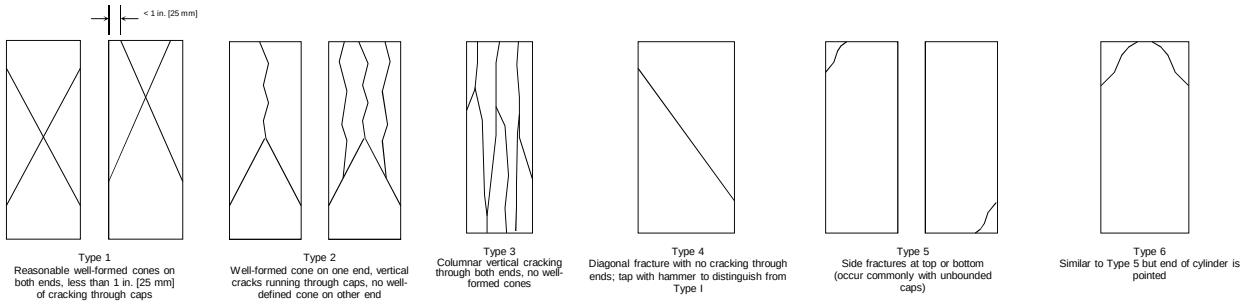
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: J. Pycz
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-C	SRA-C	SRA-C
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 11:07	7/11/12 11:07	7/11/12 11:07
Test Date / Time	7/14/12 11:39	7/14/12 11:43	7/14/12 11:47
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.00	4.01
Diameter 2, in.	4.01	3.97	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.12	8.17
Average Diameter, in.	4.00	3.98	4.01
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.44	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	57,284	56,053	54,881
Compressive Strength, psi	4,560	4,510	4,350
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,473

Report Notes

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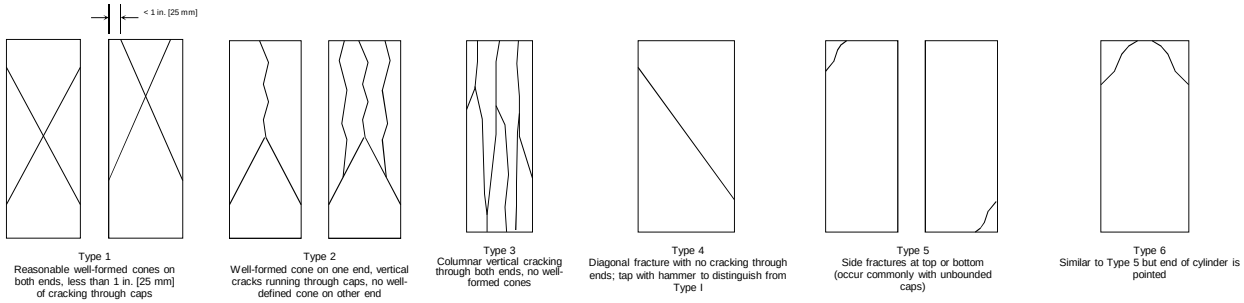
Schematic of Typical Fracture Patterns



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Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-C	SRA-C	SRA-C
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 11:07	7/11/12 11:07	7/11/12 11:07
Test Date / Time	7/18/12 13:42	7/18/12 13:46	7/18/12 13:50
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.00	4.03
Diameter 2, in.	4.01	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.18	8.23
Average Diameter, in.	4.01	4.00	4.02
Length / Diameter (L/D)	2.04	2.05	2.05
Cross-Sectional Area, in^2	12.63	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	67,932	70,647	70,375
Compressive Strength, psi	5,380	5,620	5,550
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,517

Report Notes

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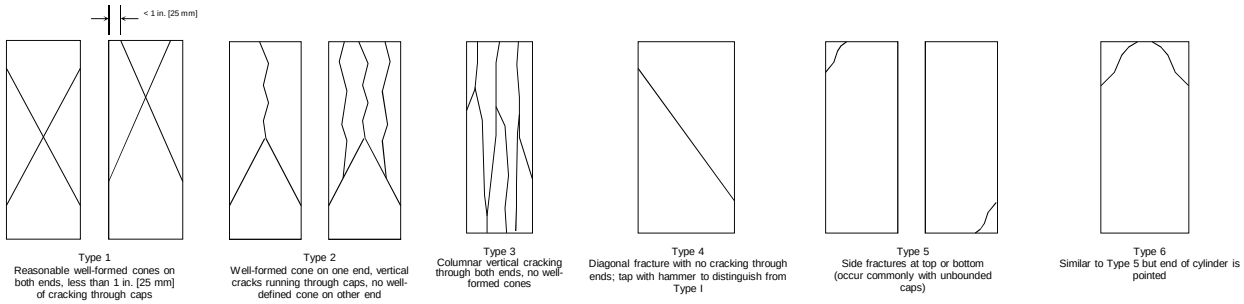
Schematic of Typical Fracture Patterns



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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 9, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-C	SRA-C	SRA-C
Client Identification	N/A	N/A	N/A
Casting Date	7/11/12 11:07	7/11/12 11:07	7/11/12 11:07
Test Date / Time	8/8/12 16:15	8/8/12 16:20	8/8/12 16:24
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.04	4.03
Diameter 2, in.	3.99	4.02	4.01
Length(without caps), in.	7.94	7.96	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.03	4.02
Length / Diameter (L/D)	1.99	1.98	1.96
Cross-Sectional Area, in^2	12.57	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	92,597	89,637	89,139
Compressive Strength, psi	7,370	7,020	7,020
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,137

Report Notes

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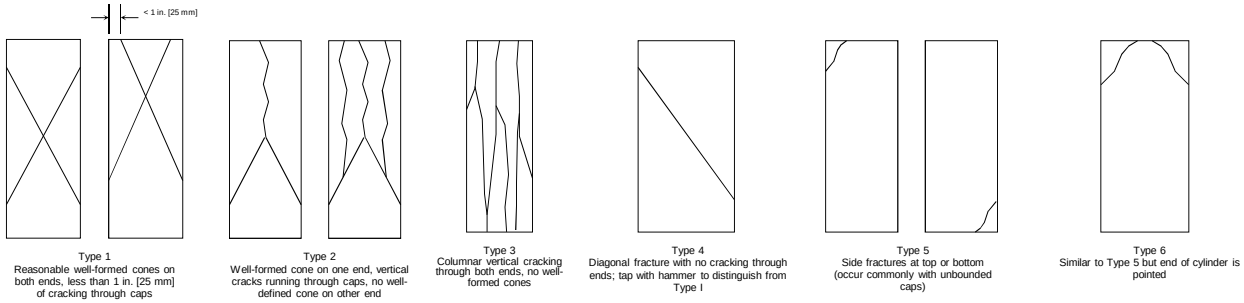
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-A	ULT-A	ULT-A
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 8:39	7/13/12 8:39	7/13/12 8:39
Test Date / Time	7/16/12 10:20	7/16/12 10:23	7/16/12 10:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.02
Diameter 2, in.	3.99	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.17	8.19
Average Diameter, in.	4.00	4.01	4.01
Length / Diameter (L/D)	2.05	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	60,609	60,348	61,832
Compressive Strength, psi	4,820	4,780	4,900
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,833

Report Notes

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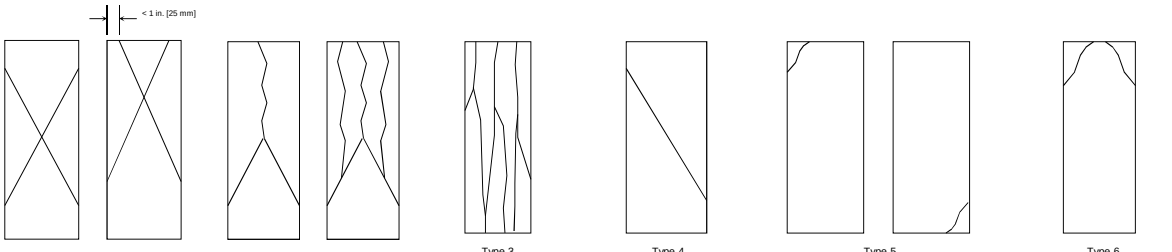
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 23, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-A	ULT-A	ULT-A
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 8:39	7/13/12 8:39	7/13/12 8:39
Test Date / Time	7/20/12 10:30	7/20/12 10:34	7/20/12 10:38
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.01	3.99	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.23	8.21	8.20
Average Diameter, in.	4.02	4.00	4.01
Length / Diameter (L/D)	2.05	2.05	2.04
Cross-Sectional Area, in^2	12.69	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	89,607	89,779	92,508
Compressive Strength, psi	7,060	7,140	7,320
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,173

Report Notes

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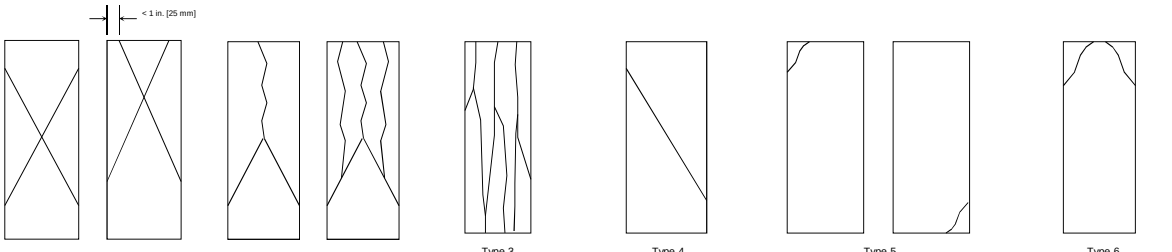
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-A	ULT-A	ULT-A
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 8:39	7/13/12 8:39	7/13/12 8:39
Test Date / Time	8/10/12 10:50	8/10/12 10:55	8/10/12 11:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.02
Diameter 2, in.	4.00	4.01	4.01
Length(without caps), in.	7.83	7.90	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.02
Length / Diameter (L/D)	1.95	1.97	1.96
Cross-Sectional Area, in^2	12.63	12.69	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	124,258	120,257	122,468
Compressive Strength, psi	9,840	9,480	9,650
Fracture Pattern	Type 1	Type 2	Type 2

Average Compressive Strength, psi	9,657

Report Notes

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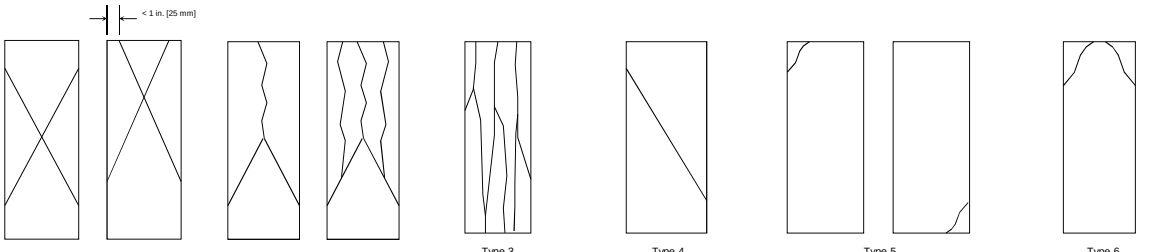
Schematic of Typical Fracture Patterns



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Type 2
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Type 3
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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-B	ULT-B	ULT-B
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 9:45	7/13/12 9:45	7/13/12 9:45
Test Date / Time	7/16/12 10:56	7/16/12 11:00	7/16/12 11:05
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.04	4.01	4.02
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.20	8.22
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	2.03	2.04	2.04
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	55,517	54,751	52,846
Compressive Strength, psi	4,350	4,330	4,160
Fracture Pattern	Type 1	Type 1	

Average Compressive Strength, psi	4,280

Report Notes

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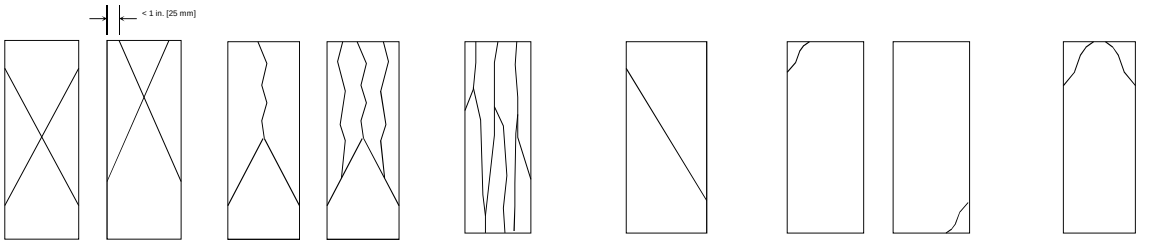
Schematic of Typical Fracture Patterns



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Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 23, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-B	ULT-B	ULT-B
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 9:45	7/13/12 9:45	7/13/12 9:45
Test Date / Time	7/20/12 10:45	7/20/12 10:49	7/20/12 10:53
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.04	4.01	4.03
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.18	8.19
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	2.03	2.04	2.04
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	82,817	81,348	82,049
Compressive Strength, psi	6,490	6,440	6,470
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,467

Report Notes

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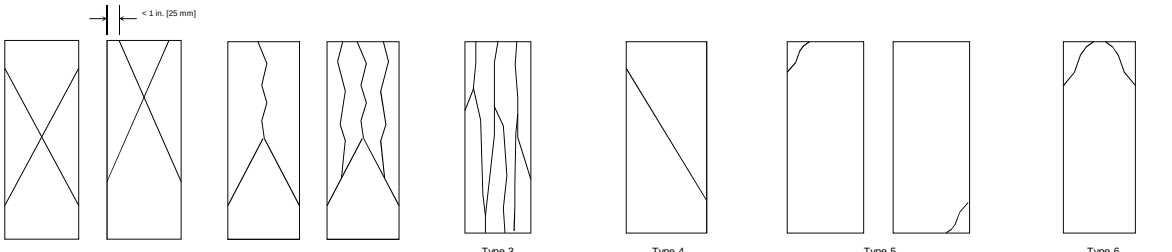
Schematic of Typical Fracture Patterns



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Report Date: August 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-B	ULT-B	ULT-B
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 9:45	7/13/12 9:45	7/13/12 9:45
Test Date / Time	8/10/12 11:20	8/10/12 11:25	8/10/12 11:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	3.99	4.01	4.00
Length(without caps), in.	7.96	7.93	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	1.99	1.97	1.97
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	113,180	113,761	115,801
Compressive Strength, psi	9,000	8,960	9,170
Fracture Pattern	Type 2	Type 2	Type 1

Average Compressive Strength, psi	9,043

Report Notes

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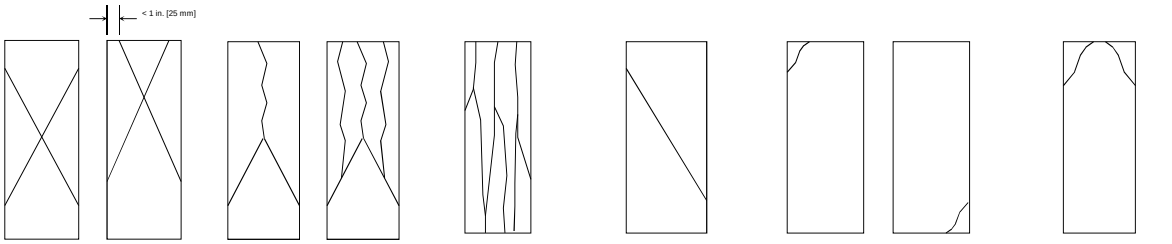
Schematic of Typical Fracture Patterns



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Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 16, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-C	ULT-C	ULT-C
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 10:59	7/13/12 10:59	7/13/12 10:59
Test Date / Time	7/16/12 11:09	7/16/12 11:13	7/16/12 11:17
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.01	4.03
Diameter 2, in.	3.98	4.01	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.20	8.21
Average Diameter, in.	3.99	4.01	4.03
Length / Diameter (L/D)	2.05	2.04	2.04
Cross-Sectional Area, in^2	12.50	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	47,364	48,533	49,484
Compressive Strength, psi	3,790	3,840	3,880
Fracture Pattern	Type 2	Type 1	Type 2

Average Compressive Strength, psi	3,837

Report Notes

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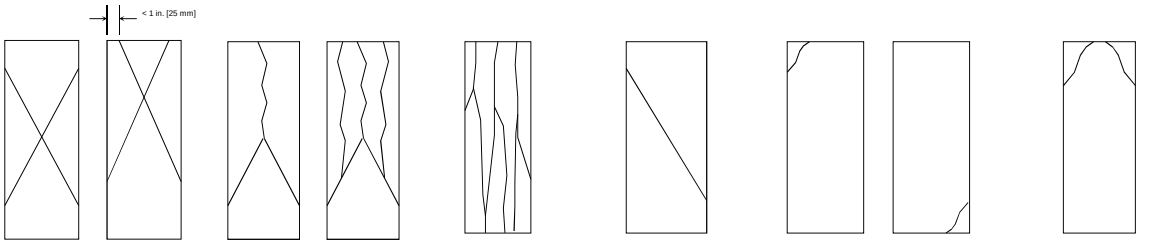
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 23, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-C	ULT-C	ULT-C
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 10:59	7/13/12 10:59	7/13/12 10:59
Test Date / Time	7/20/12 10:57	7/20/12 11:02	7/20/12 11:06
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.03	4.02
Diameter 2, in.	4.03	4.02	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.24	8.18
Average Diameter, in.	4.03	4.02	4.01
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.76	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	76,112	73,129	76,431
Compressive Strength, psi	5,960	5,760	6,050
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,923

Report Notes

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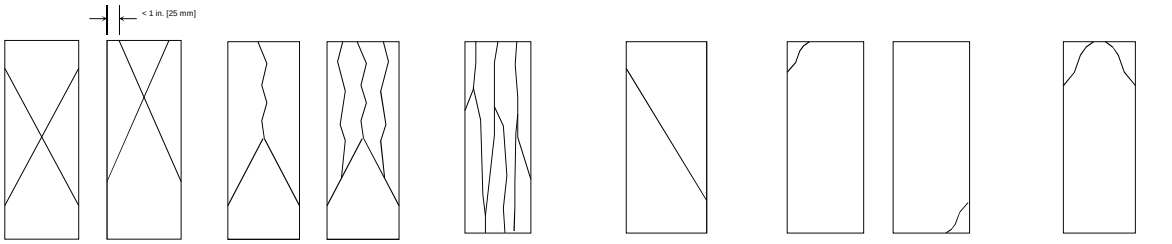
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-C	ULT-C	ULT-C
Client Identification	N/A	N/A	N/A
Casting Date	7/13/12 10:59	7/13/12 10:59	7/13/12 10:59
Test Date / Time	8/10/12 13:10	8/10/12 13:15	8/10/12 13:20
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.02
Diameter 2, in.	4.03	4.02	4.01
Length(without caps), in.	7.94	7.92	7.92
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.02	4.01
Length / Diameter (L/D)	1.97	1.97	1.98
Cross-Sectional Area, in^2	12.76	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	113,853	111,669	113,256
Compressive Strength, psi	8,920	8,800	8,970
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	8,897

Report Notes

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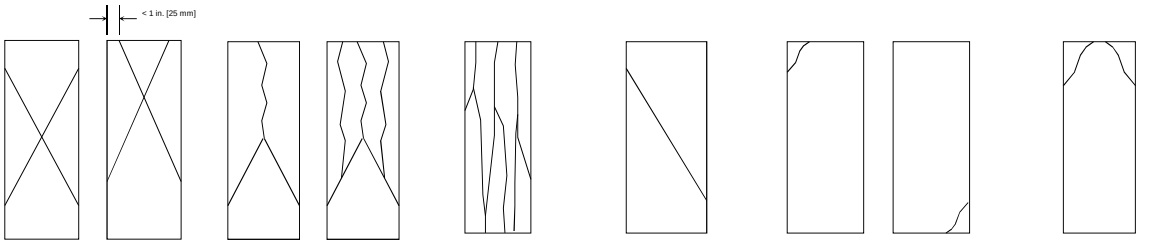
Schematic of Typical Fracture Patterns



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Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E.Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Date: March 26, 2013

CTLGroup Project No: 057122
Project Manager: M. D'Ambrosia
Technician: JP, BS
Approved: T. Van Dam

ASTM C192 Mixture Summary

Mix ID:			BS-F1	BS-F2	OPT-F1	OPT-F2	SLA-F1	SLA-F2	SRA-F1	SRA-F2	ULT-F1	ULT-F2
Date Fabricated:			7/23/2012	7/23/2012	7/24/2012	7/24/2012	7/26/2012	7/30/2012	7/24/2012	7/26/2012	7/31/2012	7/30/2012
Material		SG	lb/yd^3 (SSD)									
Cement	*ASTM C150 Type I*	3.15	515	515	375	375	409	409	403	403	313	313
Fly Ash	*ASTM C618*	2.75	0	0	125	125	0	0	134	134	111	111
Slag	*ASTM C989*	2.99	110	110	0	0	136	136	0	0	154	154
Coarse Aggregate	*CM-11 Crushed Limestone*	2.74	1875	1875	1501	1501	1714	1714	1840	1840	1245	1245
Coarse Aggregate	*CM-16 Crushed Limestone*	2.67	0	0	391	391	0	0	0	0	325	325
Saturated Lightweight	*Saturated Lightweight Fines*	2.11	0	0	0	0	364	364	0	0	0	0
Saturated Lightweight	*Saturated Lightweight Fines*	1.23	0	0	0	0	0	0	0	0	236	236
Fine Aggregate	*ASTM C33 Fine Aggregate*	2.68	1160	1160	1370	1370	986	986	1323	1323	1039	1039
Water	*Potable*	1.00	263	263	210	210	237	237	226	226	220	220
Total Cementitious Content			625	625	500	500	545	545	536	536	578	578
w/cm (including water in admixtures)			0.43	0.43	0.43	0.43	0.44	0.44	0.42	0.43	0.39	0.39
Paste Content Volume (including air), %			33.8%	33.7%	28.6%	28.6%	30.7%	30.7%	30.8%	30.8%	31.4%	31.4%
			fl. oz./cwt (100 lbs of cementitous material)									
Air Entraining Agent			0.25	0.47	0.52	0.52	0.48	0.48	0.93	0.97	0.66	0.66
Water Reducer			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Shrinkage Reducing Agent			0.0	0.0	0.0	0.0	0.0	0.0	35.8	35.8	33.2	33.2
Slump Retaining Admixture			0.0	0.0	8.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0
High Range Water Reducer			6.3	4.3	5.0	4.0	5.4	5.4	3.8	4.0	5.1	5.1
Hydration Stabilizer			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
			Target Fresh Properties									
Target Slump			6-8 inches									
Design Air Content			4-6%									
			Measured Fresh Properties									
Slump, in.	ASTM C143		6	8.25	6	6	8.25	7.25	8.25	8.25	6.25	8
Air Content, %	ASTM C231		6.2%	4.3%	5.6%	5.2%	6.2%	5.6%	4.7%	4.6%	4.2%	5.3%
Temperature, °F	ASTM C1064		82	78	79	78	79	77	80	77	80	76
Fresh Density, lb/ft^3	ASTM C138		147	149	148	148	144	144	149	149	145	144
Age, days			**Measured Compressive Strength, psi. - ASTM C39**									
1			---	3,690	---	2,940	---	2,693	---	1,923	---	1,480
3			---	5,950	---	5,700	---	5,273	---	4,173	---	4,287
7			---	7,147	---	6,983	---	6,703	---	5,577	---	6,180
14			---	7,877	---	7,513	---	7,293	---	6,057	---	7,807
28			8,433	8,217	8,503	8,570	8,107	8,500*	7,300	7,210	9,167	8,637
Test	**Test Method**		**Test Result**									
Initial Set, mins.	ASTM C403		300	---	458	---	350	---	537	---	514	---
Final Set, mins.	ASTM C403		374	---	543	---	426	---	638	---	642	---
Ring Test, days	ASTM C1581		16.3	---	+40 (one ring cracked)	---	+40 (one ring cracked)	---	+60 (none cracked)	---	+60 (none cracked)	---
Elastic Modulus, ksi	ASTM C469 28d		---	6,125	---	5,725	---	5,775	---	5,650	---	5,500
Length Change, %	ASTM C157 7d wet, 28d dry		---	-0.038	---	-0.033	---	-0.038	---	-0.035	---	-0.033
Freeze Thaw, RDM	ASTM C666 Procedure A		---	98	---	99	---	99	---	98	---	98
Rapid Chloride, coulombs	ASTM C1202 (28d accel)		---	1116	---	936	---	1047	---	763	---	355
Total Air, %	ASTM C457		4.1%	4.2%	3.9%	4.6%	3.7%	5.4%	3.6%	3.8%	3.4%	3.9%
Spacing Factor, in.	ASTM C457		0.012	0.011	0.006	0.008	0.007	0.009	0.010	0.011	0.014	0.014
Specific Surface, 1/in.	ASTM C457		432.0	491.6	747.7	565.1	687.6	499.7	530.0	472.9	413.5	373.6

*C39 after 39 days

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 20, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-F1	BS-F1	BS-F1
Client Identification	N/A	N/A	N/A
Casting Date	7/23/12 9:08	7/23/12 9:08	7/23/12 9:08
Test Date / Time	8/20/12 11:11	8/20/12 11:16	8/20/12 11:23
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.02
Diameter 2, in.	4.02	4.01	4.02
Length(without caps), in.	7.88	7.88	7.95
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.95	1.96	1.98
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

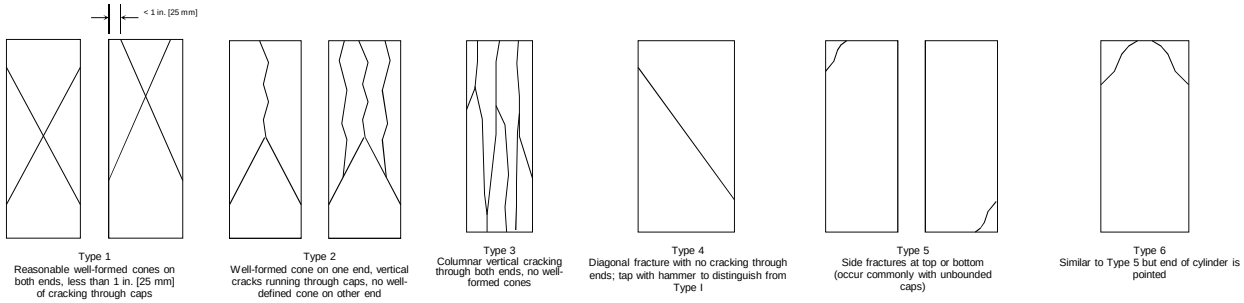
Maximum Load, lb	106,953	108,182	105,906
Compressive Strength, psi	8,380	8,570	8,350
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	8,433

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-F2	BS-F2	BS-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/23/12 10:31	7/23/12 10:31	7/23/12 10:31
Test Date / Time	7/24/12 10:30	7/24/12 10:33	7/24/12 10:36
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	in mold	in mold	in mold
Curing Conditions (Temp/RH)	mold, lab air	mold, lab air	mold, lab air
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.04	4.02
Diameter 2, in.	4.00	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.17	8.20
Average Diameter, in.	4.01	4.03	4.02
Length / Diameter (L/D)	2.05	2.03	2.04
Cross-Sectional Area, in^2	12.63	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

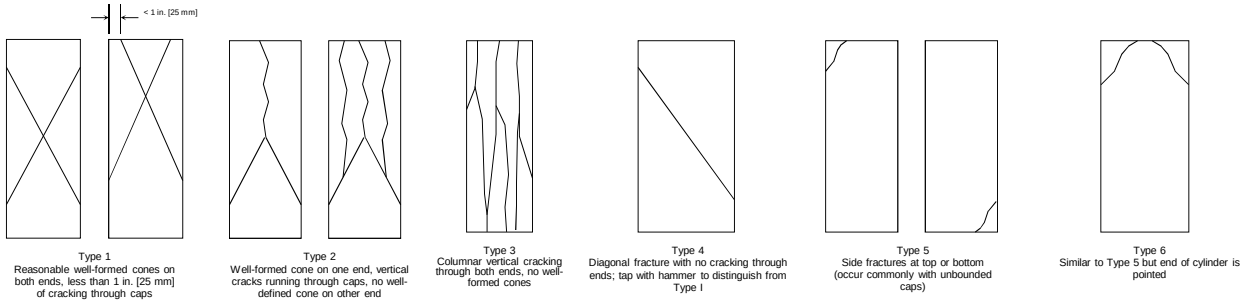
Maximum Load, lb	45,408	47,891	47,195
Compressive Strength, psi	3,600	3,750	3,720
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	3,690

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 26, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-F2	BS-F2	BS-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/23/12 10:31	7/23/12 10:31	7/23/12 10:31
Test Date / Time	7/26/12 10:49	7/26/12 10:53	7/26/12 10:57
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.02
Diameter 2, in.	4.00	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.19	8.16
Average Diameter, in.	4.01	4.01	4.01
Length / Diameter (L/D)	2.05	2.04	2.03
Cross-Sectional Area, in^2	12.63	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	73,672	74,176	77,681
Compressive Strength, psi	5,830	5,870	6,150
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	5,950

Report Notes

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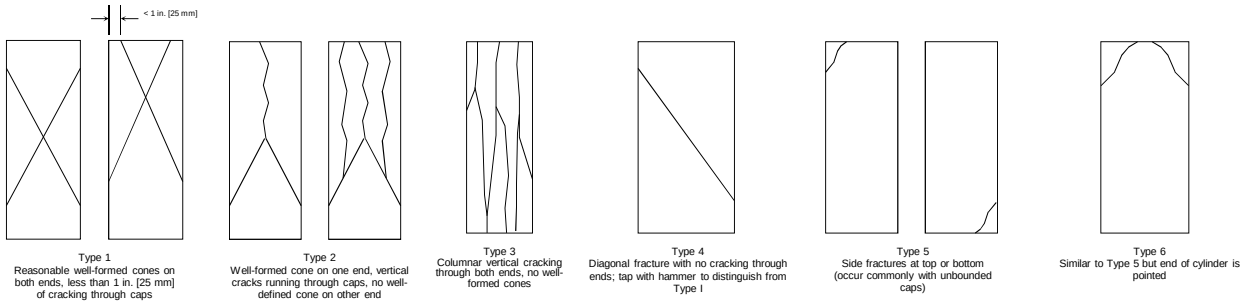
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 30, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-F2	BS-F2	BS-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/23/12 10:31	7/23/12 10:31	7/23/12 10:31
Test Date / Time	7/30/12 13:27	7/30/12 13:30	7/30/12 13:33
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	4.00	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.16	8.18
Average Diameter, in.	4.00	4.01	4.01
Length / Diameter (L/D)	2.05	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	88,462	91,386	90,453
Compressive Strength, psi	7,040	7,240	7,160
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,147

Report Notes

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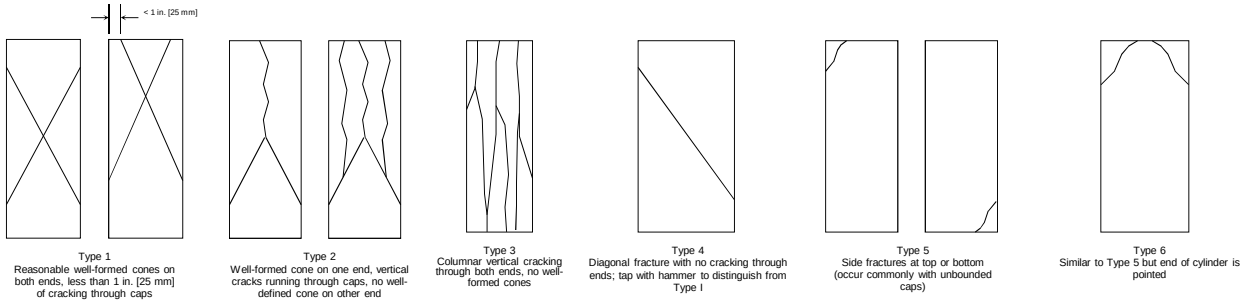
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS-F2	BS-F2	BS-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/23/12 10:31	7/23/12 10:31	7/23/12 10:31
Test Date / Time	8/6/12 13:54	8/6/12 13:59	8/6/12 14:04
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.00	3.99	4.03
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.20	8.23
Average Diameter, in.	4.01	4.00	4.03
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.63	12.57	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	99,798	98,430	100,805
Compressive Strength, psi	7,900	7,830	7,900
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	7,877

Report Notes

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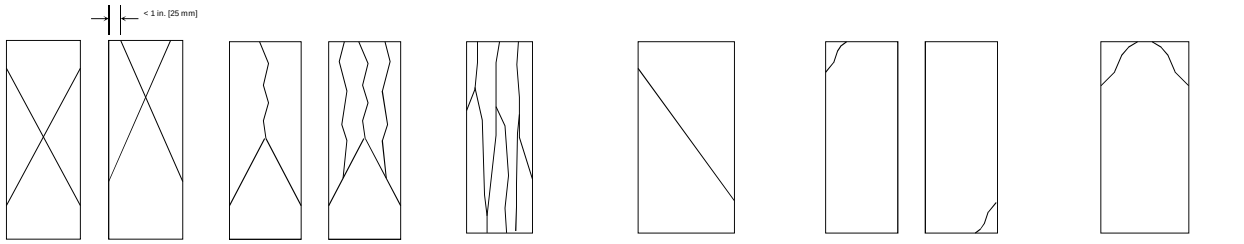
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-F1	OPT-F1	OPT-F1
Client Identification	N/A	N/A	N/A
Casting Date	7/24/12 10:25	7/24/12 10:25	7/24/12 10:25
Test Date / Time	8/21/12 16:20	8/21/12 16:25	8/21/12 16:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	4.01	4.02	3.99
Length(without caps), in.	7.95	7.92	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.00
Length / Diameter (L/D)	1.98	1.97	1.97
Cross-Sectional Area, in^2	12.63	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	106,676	106,992	108,491
Compressive Strength, psi	8,450	8,430	8,630
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,503

Report Notes

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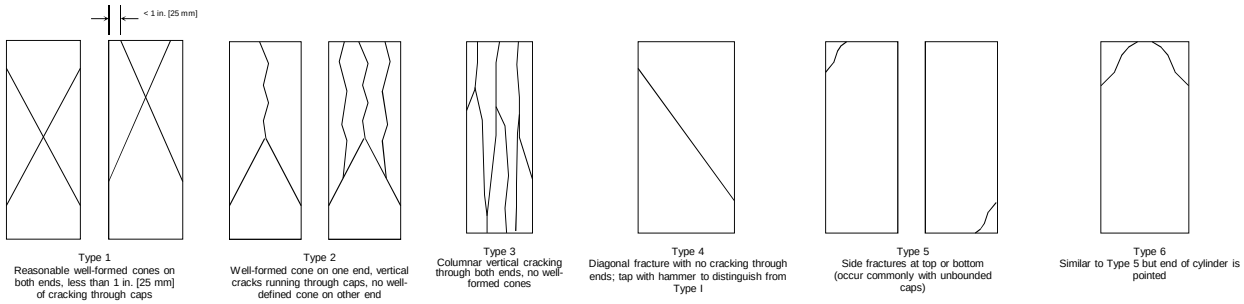
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 25, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-F2	OPT-F2	OPT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/24/12 8:35	7/24/12 8:35	7/24/12 8:35
Test Date / Time	7/25/12 8:50	7/25/12 8:53	7/25/12 8:57
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	in mold	in mold	in mold
Curing Conditions (Temp/RH)	mold, lab air	mold, lab air	mold, lab air
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.01	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.16	8.19
Average Diameter, in.	4.01	4.00	4.03
Length / Diameter (L/D)	2.05	2.04	2.03
Cross-Sectional Area, in^2	12.63	12.57	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	36,927	37,513	37,278
Compressive Strength, psi	2,920	2,980	2,920
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	2,940

Report Notes

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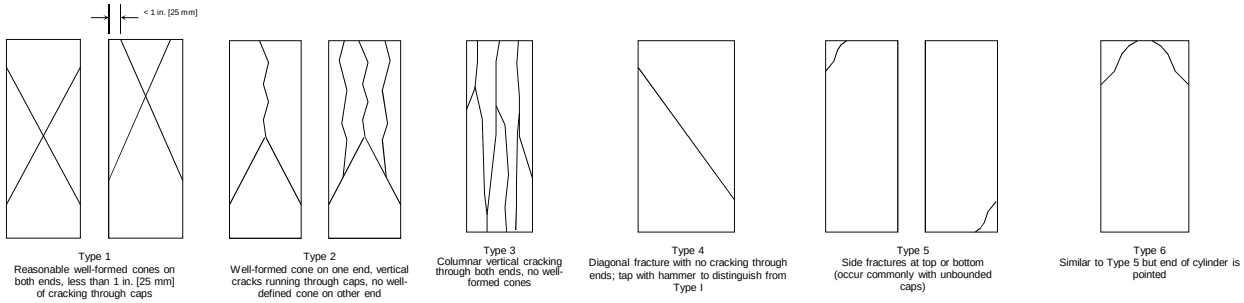
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 27, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-F2	OPT-F2	OPT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/24/12 8:35	7/24/12 8:35	7/24/12 8:35
Test Date / Time	7/27/12 10:15	7/27/12 10:19	7/27/12 10:24
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	4.01	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.18	8.22
Average Diameter, in.	4.01	4.02	4.01
Length / Diameter (L/D)	2.05	2.04	2.05
Cross-Sectional Area, in^2	12.63	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

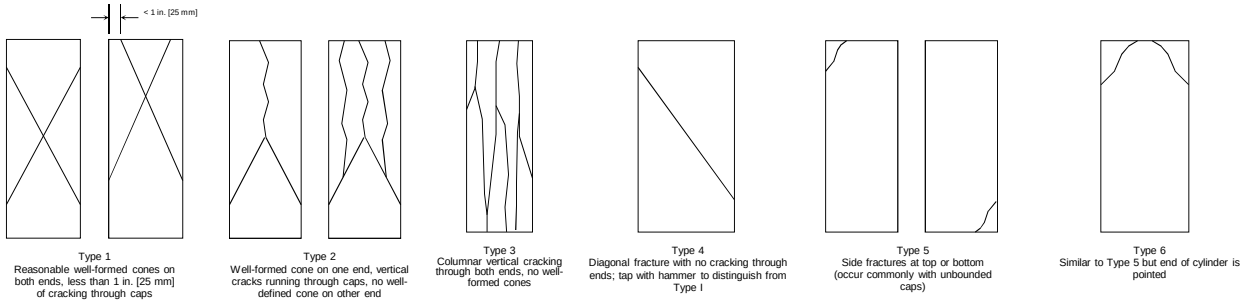
Maximum Load, lb	71,793	73,106	71,520
Compressive Strength, psi	5,680	5,760	5,660
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,700

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-F2	OPT-F2	OPT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/24/12 8:35	7/24/12 8:35	7/24/12 8:35
Test Date / Time	7/31/12 13:28	7/31/12 13:32	7/31/12 13:36
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.02
Diameter 2, in.	4.03	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.23	8.23
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	2.03	2.05	2.05
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	87,686	89,443	88,872
Compressive Strength, psi	6,870	7,080	7,000
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,983

Report Notes

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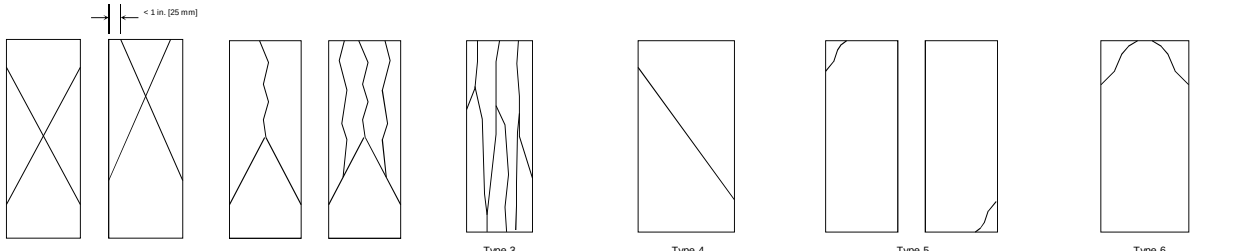
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 8, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-F2	OPT-F2	OPT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/24/12 8:35	7/24/12 8:35	7/24/12 8:35
Test Date / Time	8/7/12 16:25	8/7/12 16:30	8/7/12 16:34
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.00	4.02
Diameter 2, in.	4.02	3.99	4.02
Length(without caps), in.	7.95	7.93	8.00
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.00	4.02
Length / Diameter (L/D)	1.97	1.98	1.99
Cross-Sectional Area, in^2	12.76	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

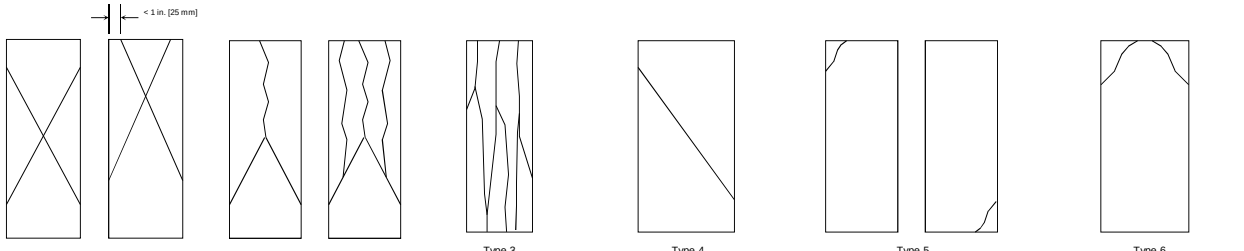
Maximum Load, lb	96,432	92,275	96,976
Compressive Strength, psi	7,560	7,340	7,640
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,513

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



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Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

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Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-F1	SLA-F1	SLA-F1
Client Identification	N/A	N/A	N/A
Casting Date	7/26/12 9:45	7/26/12 9:45	7/26/12 9:45
Test Date / Time	8/23/12 17:38	8/23/12 17:43	8/23/12 17:48
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.01
Diameter 2, in.	4.01	3.99	4.00
Length(without caps), in.	7.87	7.91	7.92
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.00	4.01
Length / Diameter (L/D)	1.96	1.98	1.97
Cross-Sectional Area, in^2	12.63	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	104,322	100,665	101,660
Compressive Strength, psi	8,260	8,010	8,050
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,107

Report Notes

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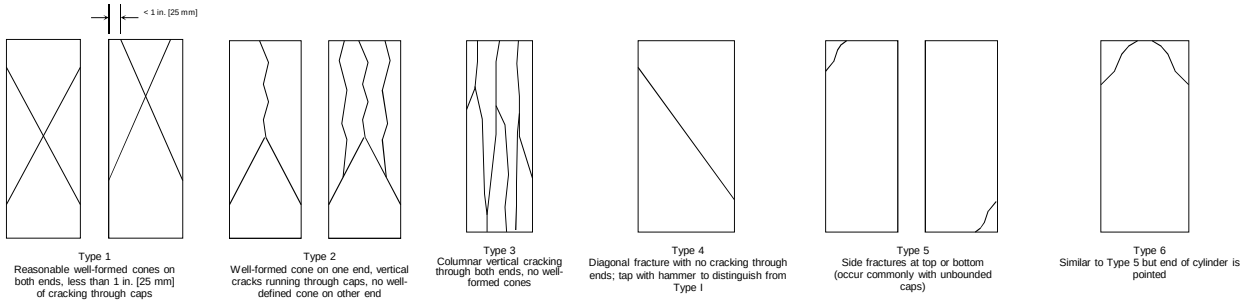
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-F2	SLA-F2	SLA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 10:40	7/30/12 10:40	7/30/12 10:40
Test Date / Time	7/31/12 10:15	7/31/12 10:18	7/31/12 10:21
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	in mold	in mold	in mold
Curing Conditions (Temp/RH)	mold, lab air	mold, lab air	mold, lab air
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.02
Diameter 2, in.	3.99	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.19	8.18
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	33,640	34,226	34,097
Compressive Strength, psi	2,680	2,700	2,700
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	2,693

Report Notes

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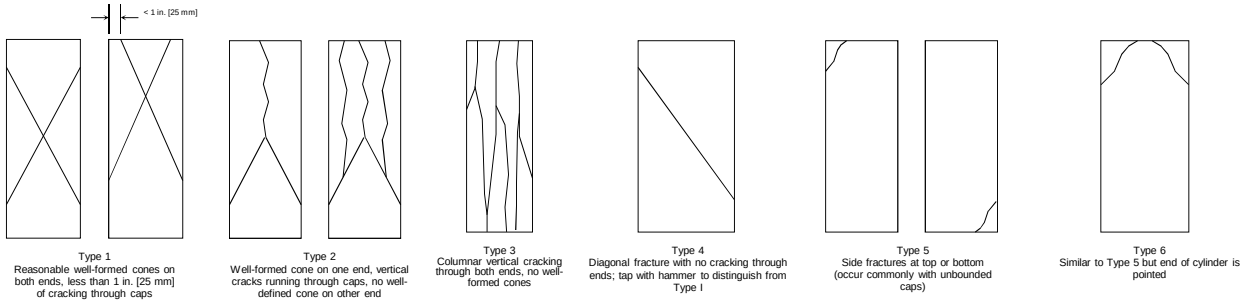
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 3, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-F2	SLA-F2	SLA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 10:40	7/30/12 10:40	7/30/12 10:40
Test Date / Time	8/2/12 11:08	8/2/12 11:13	8/2/12 11:18
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.00	4.02	4.04
Diameter 2, in.	3.99	4.00	4.03
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.22	8.18
Average Diameter, in.	4.00	4.01	4.03
Length / Diameter (L/D)	2.04	2.05	2.03
Cross-Sectional Area, in^2	12.57	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	67,677	66,385	66,105
Compressive Strength, psi	5,380	5,260	5,180
Fracture Pattern	Type 1	Type 1	Type 2

Average Compressive Strength, psi	5,273

Report Notes

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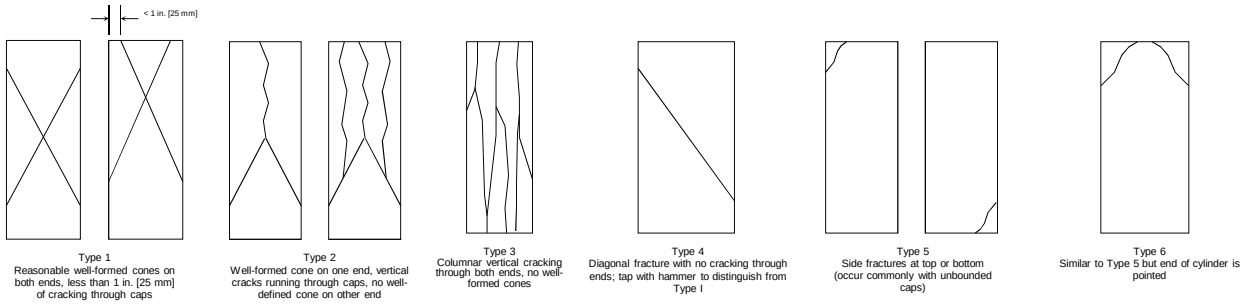
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-F2	SLA-F2	SLA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 10:40	7/30/12 10:40	7/30/12 10:40
Test Date / Time	8/6/12 14:08	8/6/12 14:13	8/6/12 14:16
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.01	4.01	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.19	8.19
Average Diameter, in.	4.01	4.01	4.02
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.63	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	83,819	85,843	84,604
Compressive Strength, psi	6,640	6,800	6,670
Fracture Pattern	Type 1	Type 1	Type 2

Average Compressive Strength, psi	6,703

Report Notes

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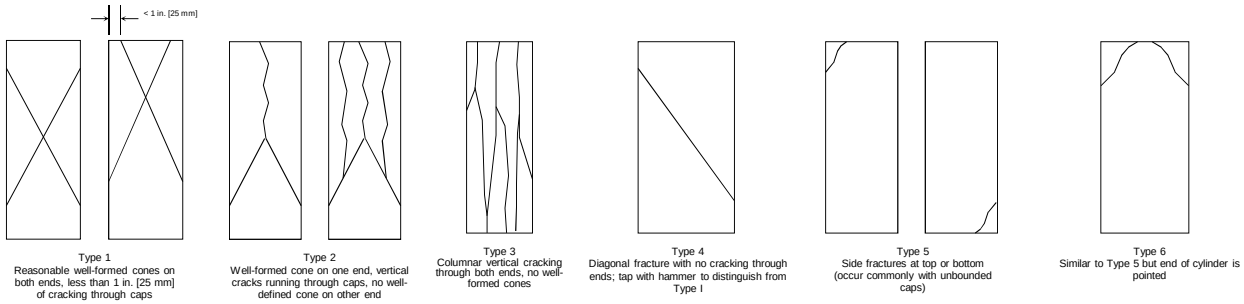
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 13, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-F2	SLA-F2	SLA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 10:40	7/30/12 10:40	7/30/12 10:40
Test Date / Time	8/13/12 12:45	8/13/12 12:50	8/13/12 12:54
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	4.01	4.03
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.95	7.93	7.93
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.97	1.98	1.97
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	93,172	92,828	91,686
Compressive Strength, psi	7,300	7,350	7,230
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	7,293

Report Notes

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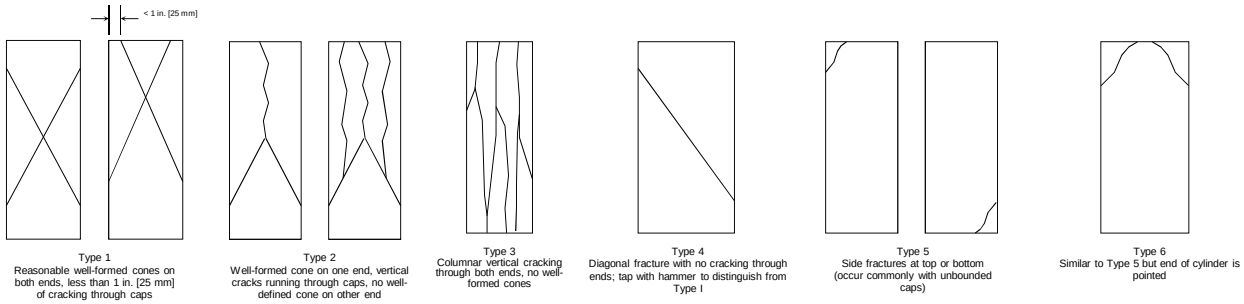
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: September 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA-F2	SLA-F2
Client Identification	N/A	N/A
Casting Date	7/30/12 10:40	7/30/12 10:40
Test Date / Time	9/7/12 14:56	9/7/12 15:02
Loading Rate, psi/sec	35	35

Concrete Description

Concrete Age at Test, days	39	39
Moisture Condition at Test	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02
Diameter 2, in.	3.99	4.01
Length(without caps), in.	7.90	7.90
Length(with caps), in.	N/A	N/A
Average Diameter, in.	4.00	4.02
Length / Diameter (L/D)	1.98	1.96
Cross-Sectional Area, in^2	12.57	12.69
Weight, lb. (in air)	N/A	N/A
Weight, lb. (in water)	N/A	N/A
Density	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	106,050	108,599
Compressive Strength, psi	8,440	8,560
Fracture Pattern	Type 1	Type 1

Average Compressive Strength, psi	8,500

Report Notes

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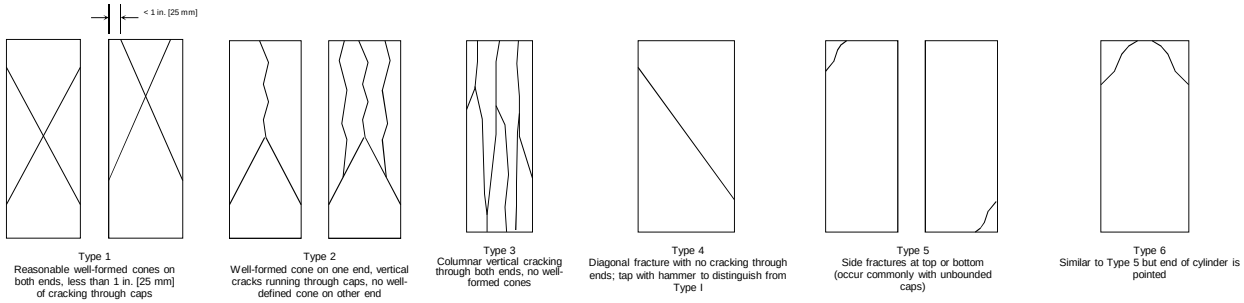
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-F1	SRA-F1	SRA-F1
Client Identification	N/A	N/A	N/A
Casting Date	7/24/12 12:00	7/24/12 12:00	7/24/12 12:00
Test Date / Time	8/21/12 16:05	8/21/12 16:10	8/21/12 16:15
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.03
Diameter 2, in.	4.00	4.02	4.02
Length(without caps), in.	7.90	7.87	7.93
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.03	4.02
Length / Diameter (L/D)	1.97	1.95	1.97
Cross-Sectional Area, in^2	12.63	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	91,807	93,023	93,143
Compressive Strength, psi	7,270	7,290	7,340
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,300

Report Notes

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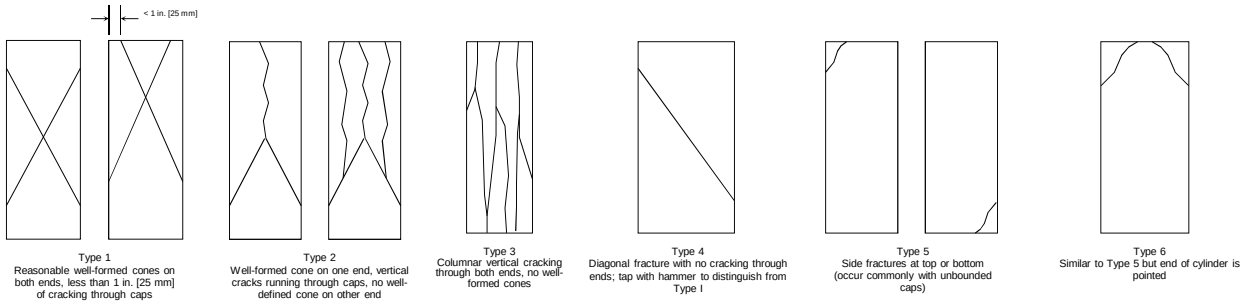
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 27, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-F2	SRA-F2	SRA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/26/12 13:09	7/26/12 13:09	7/26/12 13:09
Test Date / Time	7/27/12 13:24	7/27/12 13:27	7/27/12 13:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	in mold	in mold	in mold
Curing Conditions (Temp/RH)	mold, lab air	mold, lab air	mold, lab air
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.04	4.01	4.02
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.23	8.20	8.21
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	2.04	2.04	2.04
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	25,142	23,688	24,386
Compressive Strength, psi	1,970	1,880	1,920
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	1,923

Report Notes

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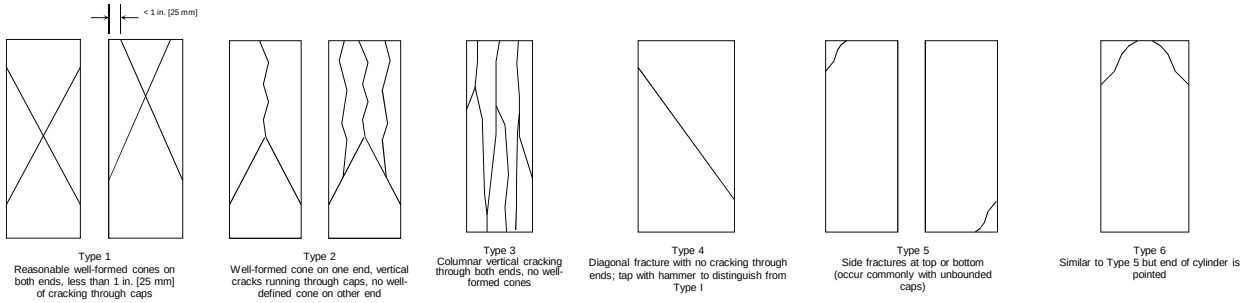
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: July 30, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-F2	SRA-F2	SRA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/26/12 13:09	7/26/12 13:09	7/26/12 13:09
Test Date / Time	7/29/12 11:11	7/29/12 11:15	7/29/12 11:19
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.01	4.00	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.18	8.19
Average Diameter, in.	4.02	4.00	4.03
Length / Diameter (L/D)	2.04	2.04	2.03
Cross-Sectional Area, in^2	12.69	12.57	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

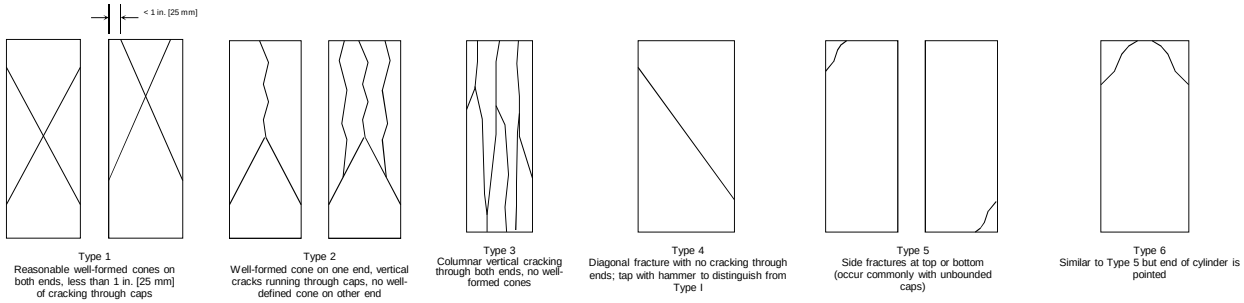
Maximum Load, lb	53,762	52,492	52,302
Compressive Strength, psi	4,240	4,180	4,100
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,173

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 3, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-F2	SRA-F2	SRA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/26/12 13:09	7/26/12 13:09	7/26/12 13:09
Test Date / Time	8/2/12 10:56	8/2/12 11:00	8/2/12 11:04
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.21	8.22
Average Diameter, in.	4.02	4.01	4.01
Length / Diameter (L/D)	2.04	2.05	2.05
Cross-Sectional Area, in^2	12.69	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	71,187	69,173	71,194
Compressive Strength, psi	5,610	5,480	5,640
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,577

Report Notes

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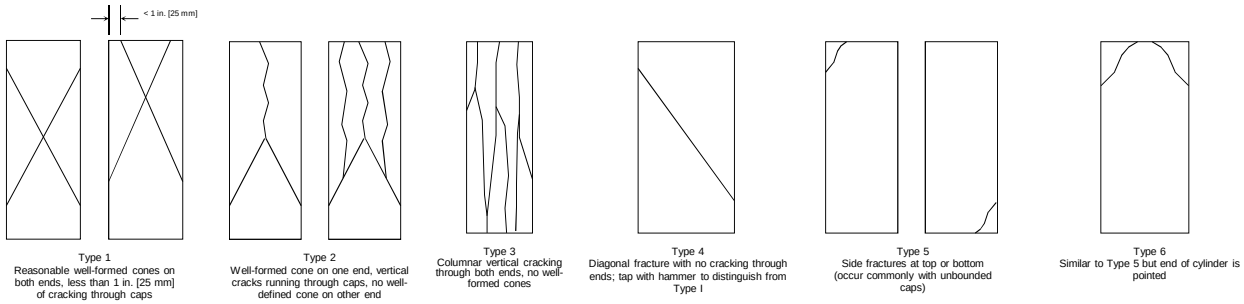
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 10, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA-F2	SRA-F2	SRA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/26/12 13:09	7/26/12 13:09	7/26/12 13:09
Test Date / Time	8/9/12 17:25	8/9/12 17:30	8/9/12 17:35
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.01
Diameter 2, in.	4.01	4.02	3.99
Length(without caps), in.	7.90	7.94	7.96
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.03	4.00
Length / Diameter (L/D)	1.97	1.97	1.99
Cross-Sectional Area, in^2	12.63	12.76	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	76,224	77,154	76,462
Compressive Strength, psi	6,040	6,050	6,080
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,057

Report Notes

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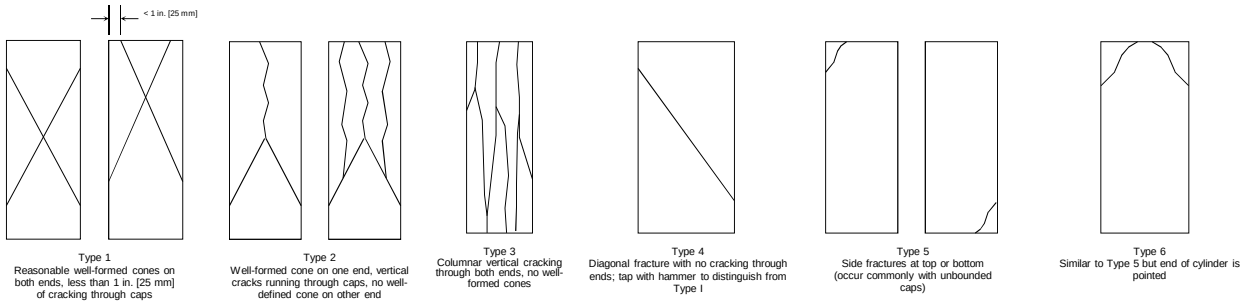
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 29, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-F1	ULT-F1	ULT-F1
Client Identification	N/A	N/A	N/A
Casting Date	7/31/12 9:10	7/31/12 9:10	7/31/12 9:10
Test Date / Time	8/28/12 17:00	8/28/12 17:04	8/28/12 17:09
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.04
Diameter 2, in.	4.01	4.02	4.03
Length(without caps), in.	7.93	7.90	7.92
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.03
Length / Diameter (L/D)	1.98	1.97	1.97
Cross-Sectional Area, in^2	12.63	12.69	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	117,860	116,031	115,208
Compressive Strength, psi	9,330	9,140	9,030
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	9,167

Report Notes

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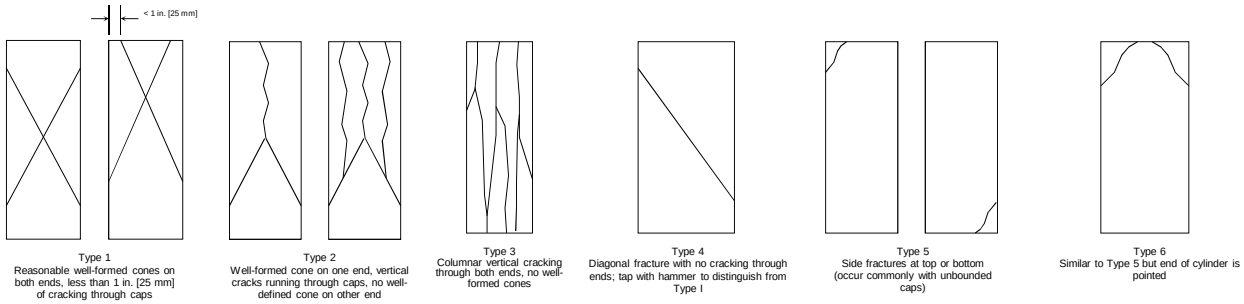
Schematic of Typical Fracture Patterns



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Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-F2	ULT-F2	ULT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 13:36	7/30/12 13:36	7/30/12 13:36
Test Date / Time	7/31/12 13:19	7/31/12 13:22	7/31/12 13:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	in mold	in mold	in mold
Curing Conditions (Temp/RH)	mold, lab air	mold, lab air	mold, lab air
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.01
Diameter 2, in.	4.01	4.03	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.20	8.17
Average Diameter, in.	4.02	4.03	4.01
Length / Diameter (L/D)	2.03	2.03	2.04
Cross-Sectional Area, in^2	12.69	12.76	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	18,526	19,408	18,427
Compressive Strength, psi	1,460	1,520	1,460
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	1,480

Report Notes

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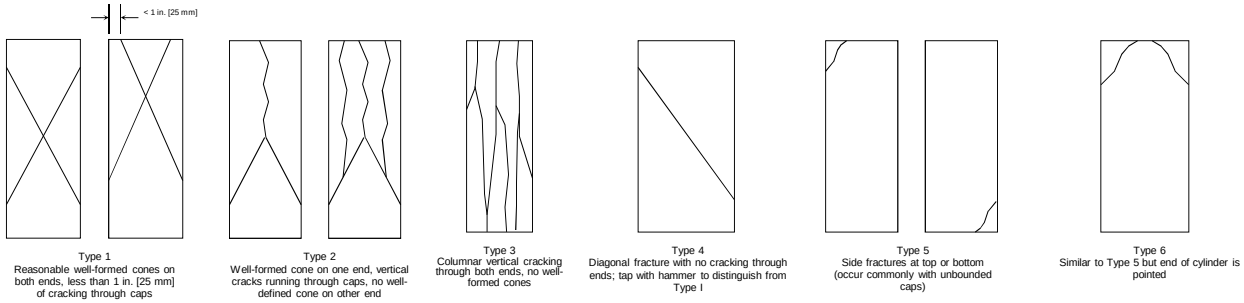
Schematic of Typical Fracture Patterns



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Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 3, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-F2	ULT-F2	ULT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 13:36	7/30/12 13:36	7/30/12 13:36
Test Date / Time	8/2/12 11:37	8/2/12 11:42	8/2/12 11:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.03
Diameter 2, in.	4.00	4.02	4.03
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.18	8.23
Average Diameter, in.	4.00	4.02	4.03
Length / Diameter (L/D)	2.04	2.03	2.04
Cross-Sectional Area, in^2	12.57	12.69	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	55,169	53,578	54,247
Compressive Strength, psi	4,390	4,220	4,250
Fracture Pattern	Type 2	Type 1	Type 2

Average Compressive Strength, psi	4,287

Report Notes

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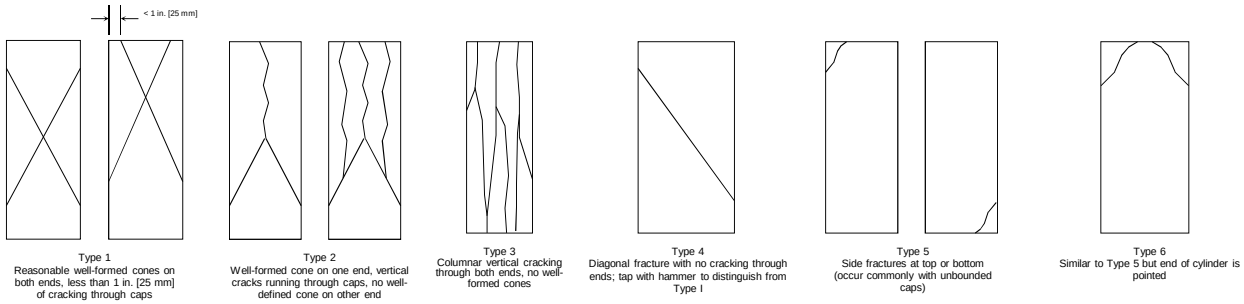
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 6, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-F2	ULT-F2	ULT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 13:36	7/30/12 13:36	7/30/12 13:36
Test Date / Time	8/6/12 14:20	8/6/12 14:24	8/6/12 14:28
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	sulfur	sulfur	sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.03
Diameter 2, in.	4.01	4.02	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.24	8.22	8.18
Average Diameter, in.	4.01	4.03	4.02
Length / Diameter (L/D)	2.05	2.04	2.03
Cross-Sectional Area, in^2	12.63	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	77,151	79,470	78,662
Compressive Strength, psi	6,110	6,230	6,200
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,180

Report Notes

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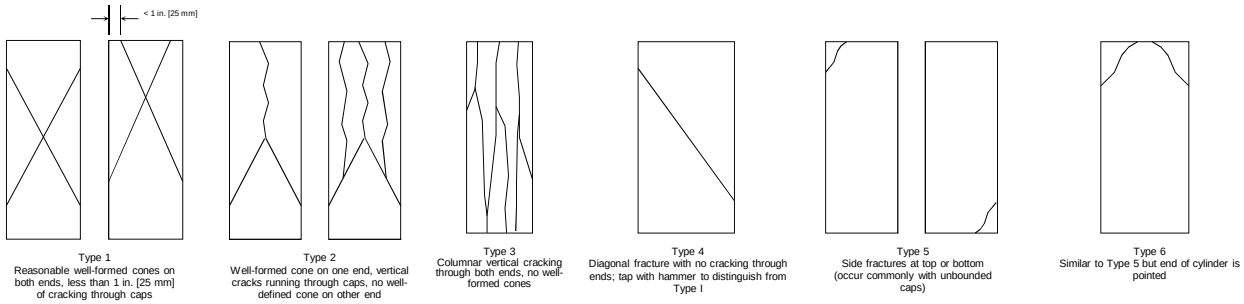
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Report Date: August 13, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-F2	ULT-F2	ULT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/30/12 13:36	7/30/12 13:36	7/30/12 13:36
Test Date / Time	8/13/12 11:10	8/13/12 11:14	8/13/12 11:19
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.02
Diameter 2, in.	3.99	4.01	4.01
Length(without caps), in.	7.92	7.93	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	1.98	1.97	1.97
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	97,575	98,760	99,531
Compressive Strength, psi	7,760	7,780	7,880
Fracture Pattern	Type 2	Type 2	Type 2

Average Compressive Strength, psi	7,807

Report Notes

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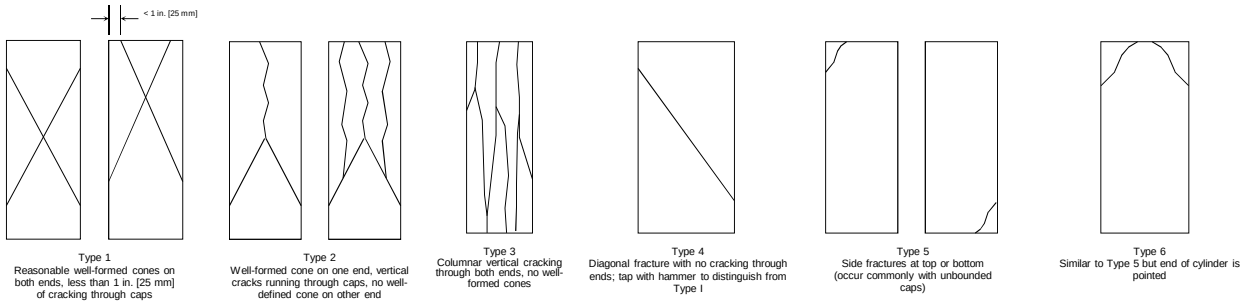
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: August 20, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS
ASTM C469 STATIC MODULUS OF ELASTICITY OF CYLINDRICAL CONCRETE SPECIMENS

Specimen Identification

CTLGroup Identification	BS-F2 1	BS-F2 2	BS-F2 3
Client Identification	N/A	N/A	N/A
Casting Date	7/23/2012	7/23/2012	7/23/2012
Test Date / Time	8/20/2012	8/20/2012	8/20/2012
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73°F 100% RH	73°F 100% RH	73°F 100% RH
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	3.99	4.01
Diameter 2, in.	3.99	4.03	4.01
Length, in.	7.87	7.85	7.89
Average Diameter, in.	4.02	4.01	4.01
Length / Diameter (L/D)	1.96	1.96	1.97
Cross-Sectional Area, in^2	12.69	12.63	12.63

Compressive Strength and Fracture Pattern

Maximum Load, lb	103,608	103,536	104,740
Compressive Strength, psi	8,160	8,200	8,290
Fracture Pattern	Type 2	Type 2	Type 2
Chord Modulus of Elasticity, ksi	---	6050	6200

Average Compressive Strength, psi	8,217
Average Elastic Modulus, ksi	6,125

;

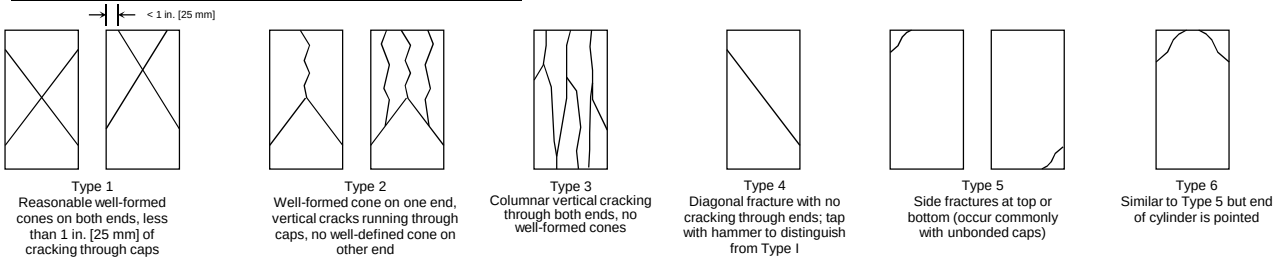
Notes:

1. Sample #1 was tested as a companion specimen for the determination of compressive strength only.

2. The compressive strength of samples #2 and #3 were determined after obtaining strain values for the modulus of elasticity.

4. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client:	S.T.A.T.E Testing / Illinois Tollway	**CTLGroup Project No.:**	057122
Project:	HPC for Bridge Decks	**CTLGroup Project Mgr.:**	M. D'Ambrosia
Contact:	Mr. Steve Gillen	**Technician:**	G. Neiweem
Report Date:	August 21, 2012	**Analyst:**	J. Slater
		Approved by:	T. Van Dam

ASTM C39 COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS
ASTM C469 STATIC MODULUS OF ELASTICITY OF CYLINDRICAL CONCRETE SPECIMENS

Specimen Identification

CTLGroup Identification	OPT-F2	OPT-F2	OPT-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/24/2012	7/24/2012	7/24/2012
Test Date / Time	8/21/2012	8/21/2012	8/21/2012
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73°F 100% RH	73°F 100% RH	73°F 100% RH
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	3.98	4.03
Diameter 2, in.	4.01	4.01	4.04
Length, in.	7.88	7.88	7.93
Average Diameter, in.	4.01	4.00	4.04
Length / Diameter (L/D)	1.97	1.97	1.96
Cross-Sectional Area, in^2	12.63	12.57	12.82

Compressive Strength and Fracture Pattern

Maximum Load, lb	108,202	111,552	105,983
Compressive Strength, psi	8,570	8,870	8,270
Fracture Pattern	Type 2	Type 2	Type 2
Chord Modulus of Elasticity, ksi	---	5700	5750

Average Compressive Strength, psi	8,570
Average Elastic Modulus, ksi	5,725

Notes:

1. Sample #1 was tested as a companion specimen for the determination of compressive strength only.

2. The compressive strength of samples #2 and #3 were determined after obtaining strain values for the modulus of elasticity.

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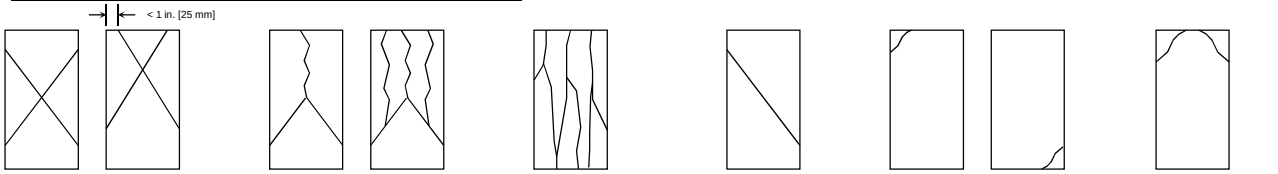
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: August 27, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS
ASTM C469 STATIC MODULUS OF ELASTICITY OF CYLINDRICAL CONCRETE SPECIMENS

Specimen Identification

CTLGroup Identification	SLA-F2 1	SLA-F2 2	SLA-F2 3
Client Identification	N/A	N/A	N/A
Casting Date	7/24/2012	7/24/2012	7/24/2012
Test Date / Time	8/27/2012	8/27/2012	8/27/2012
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	34	34	34
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73°F 100% RH	73°F 100% RH	73°F 100% RH
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.04	4.01
Diameter 2, in.	4.00	4.02	4.04
Length, in.	7.86	7.91	7.90
Average Diameter, in.	4.01	4.03	4.03
Length / Diameter (L/D)	1.96	1.96	1.96
Cross-Sectional Area, in^2	12.63	12.76	12.76

Compressive Strength and Fracture Pattern

Maximum Load, lb	92,725	85,179	81,842
Compressive Strength, psi	7,340	6,680	6,410
Fracture Pattern	Type 1	Type 3	Type 3
Chord Modulus of Elasticity, ksi	---	5850	5700

Average Compressive Strength, psi	6,810
Average Elastic Modulus, ksi	5,775

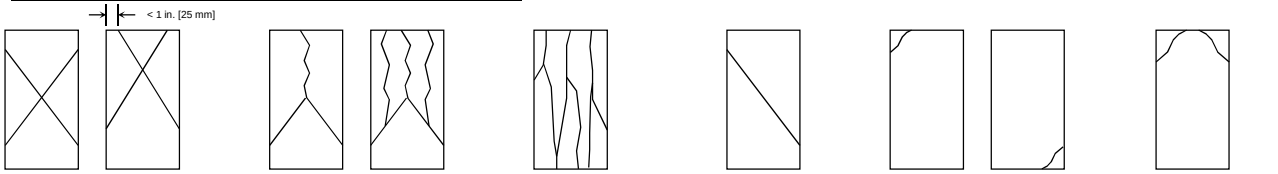
Notes:

1. Sample #1 was tested as a companion specimen for the determination of compressive strength only.

2. The compressive strength of samples #2 and #3 were determined after obtaining strain values for the modulus of elasticity.

4. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: August 23, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS
ASTM C469 STATIC MODULUS OF ELASTICITY OF CYLINDRICAL CONCRETE SPECIMENS

Specimen Identification

CTLGroup Identification	SRA-F2	SRA-F2	SRA-F2
Client Identification	N/A	N/A	N/A
Casting Date	7/26/2012	7/26/2012	7/26/2012
Test Date / Time	8/23/2012	8/23/2012	8/23/2012
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73°F 100% RH	73°F 100% RH	73°F 100% RH
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.00	3.96
Diameter 2, in.	4.01	4.03	4.04
Length, in.	7.89	7.91	7.92
Average Diameter, in.	4.01	4.02	4.00
Length / Diameter (L/D)	1.97	1.97	1.98
Cross-Sectional Area, in^2	12.63	12.69	12.57

Compressive Strength and Fracture Pattern

Maximum Load, lb	90,991	92,078	90,140
Compressive Strength, psi	7,200	7,260	7,170
Fracture Pattern	Type 1	Type 2	Type 2
Chord Modulus of Elasticity, ksi	---	5600	5700

Average Compressive Strength, psi	7,210
Average Elastic Modulus, ksi	5,650

Notes:

1. Sample #1 was tested as a companion specimen for the determination of compressive strength only.

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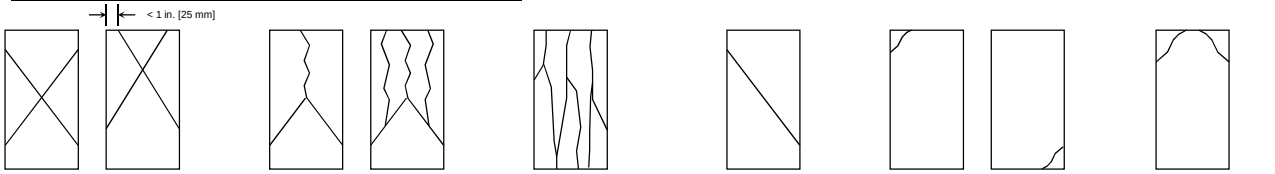
Schematic of Typical Fracture Patterns



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Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
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ASTM C39 COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS
ASTM C469 STATIC MODULUS OF ELASTICITY OF CYLINDRICAL CONCRETE SPECIMENS

Specimen Identification

CTLGroup Identification	ULT-F2 1	ULT-F2 2	ULT-F2 3
Client Identification	N/A	N/A	N/A
Casting Date	7/30/2012	7/30/2012	7/30/2012
Test Date / Time	8/27/2012	8/27/2012	8/27/2012
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73°F 100% RH	73°F 100% RH	73°F 100% RH
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.00	4.06	4.03
Diameter 2, in.	4.01	3.99	3.99
Length, in.	7.93	7.92	7.95
Average Diameter, in.	4.01	4.03	4.01
Length / Diameter (L/D)	1.98	1.97	1.98
Cross-Sectional Area, in^2	12.63	12.76	12.63

Compressive Strength and Fracture Pattern

Maximum Load, lb	119,447	111,468	97,351
Compressive Strength, psi	9,460	8,740	7,710
Fracture Pattern	Type 1	Type 3	Type 3
Chord Modulus of Elasticity, ksi	---	5800	5200

Average Compressive Strength, psi	8,637
Average Elastic Modulus, ksi	5,500

Notes:

1. Sample #1 was tested as a companion specimen for the determination of compressive strength only.

2. The compressive strength of samples #2 and #3 were determined after obtaining strain values for the modulus of elasticity.

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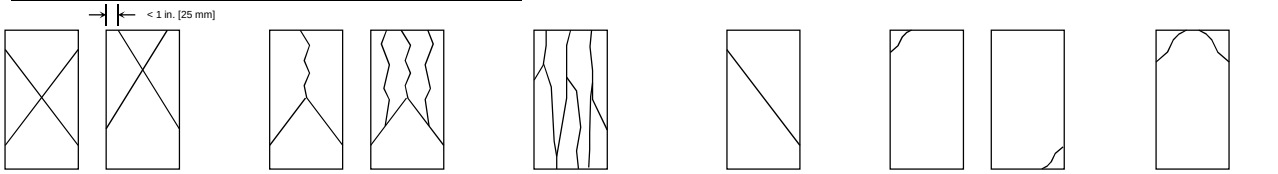
Schematic of Typical Fracture Patterns



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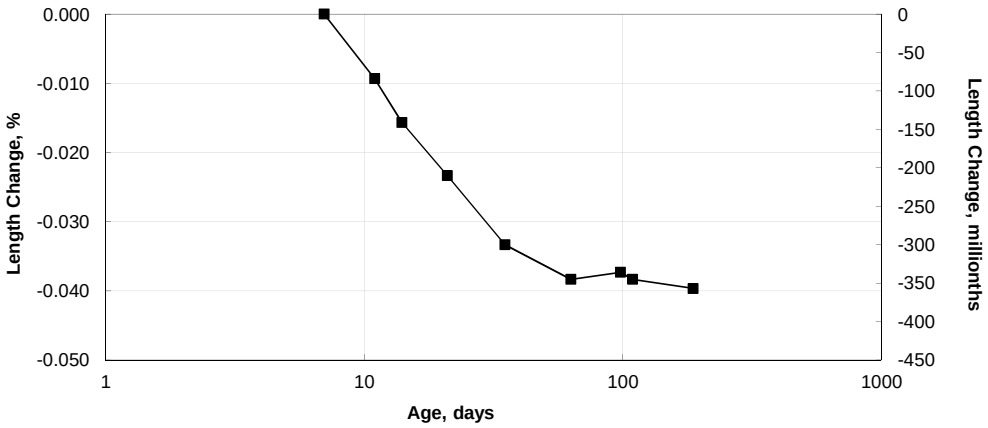
Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

BS-F2



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
7/24/2012	1	--	Initial	-0.0293	0.1008	-0.0052								
7/30/2012	7	0	Start dry	-0.0292	0.1008	-0.0051	0.000	0.000	0.000	**0.000**	0	0	0	**0**
8/3/2012	11	4	dry	-0.0303	0.0999	-0.0059	-0.011	-0.009	-0.008	**-0.009**	-110	-90	-80	**-93**
8/6/2012	14	7	dry	-0.0309	0.0993	-0.0066	-0.017	-0.015	-0.015	**-0.016**	-170	-150	-150	**-157**
8/13/2012	21	14	dry	-0.0317	0.0986	-0.0074	-0.025	-0.022	-0.023	**-0.023**	-250	-220	-230	**-233**
8/27/2012	35	28	dry	-0.0327	0.0976	-0.0084	-0.035	-0.032	-0.033	**-0.033**	-350	-320	-330	**-333**
9/24/2012	63	56	dry	-0.0331	0.0972	-0.0091	-0.039	-0.036	-0.040	**-0.038**	-390	-360	-400	**-383**
10/29/2012	98	91	dry	-0.0330	0.0972	-0.0089	-0.038	-0.036	-0.038	**-0.037**	-380	-360	-380	**-373**
11/9/2012	109	102	dry	-0.0331	0.0972	-0.0091	-0.039	-0.036	-0.040	**-0.038**	-390	-360	-400	**-383**
1/26/2013	187	180	dry	-0.0333	0.0971	-0.0092	-0.041	-0.037	-0.041	**-0.040**	-410	-370	-410	**-397**

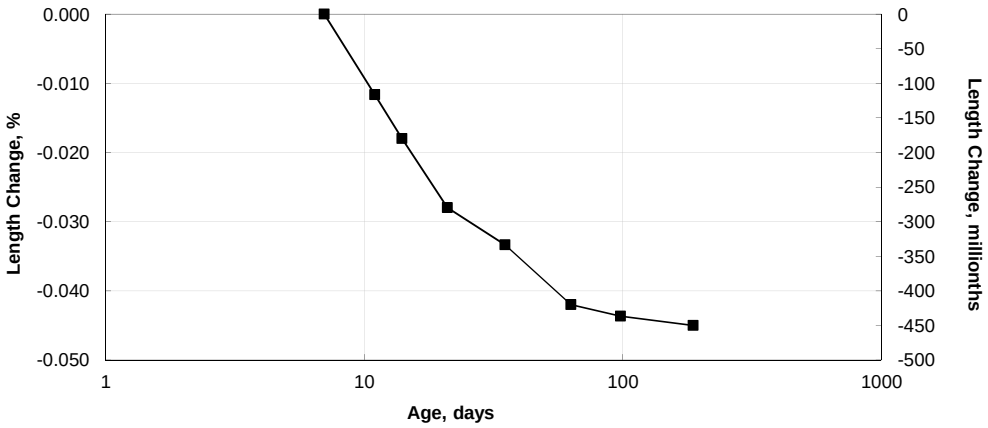
Notes:

1. Specimens fabricated at CTLGroup on July 23, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
OPT-F2



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
7/25/2012	1	--	Initial	0.0007	-0.0152	0.0857								
7/31/2012	7	0	Start dry	0.0007	-0.0152	0.0857	0.000	0.000	0.000	**0.000**	0	0	0	**0**
8/4/2012	11	4	dry	-0.0004	-0.0168	0.0849	-0.011	-0.016	-0.008	**-0.012**	-110	-160	-80	**-117**
8/7/2012	14	7	dry	-0.0010	-0.0172	0.0840	-0.017	-0.020	-0.017	**-0.018**	-170	-200	-170	**-180**
8/14/2012	21	14	dry	-0.0020	-0.0182	0.0830	-0.027	-0.030	-0.027	**-0.028**	-270	-300	-270	**-280**
8/28/2012	35	28	dry	-0.0025	-0.0188	0.0825	-0.032	-0.036	-0.032	**-0.033**	-320	-360	-320	**-333**
9/25/2012	63	56	dry	-0.0036	-0.0194	0.0816	-0.043	-0.042	-0.041	**-0.042**	-430	-420	-410	**-420**
10/30/2012	98	91	dry	-0.0032	-0.0199	0.0812	-0.039	-0.047	-0.045	**-0.044**	-390	-470	-450	**-437**
1/27/2013	187	180	dry	-0.0036	-0.0199	0.0812	-0.043	-0.047	-0.045	**-0.045**	-430	-470	-450	**-450**

Notes:

1. Specimens fabricated at CTLGroup on July 24, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

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Project: HPC for Bridge Decks
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CTLGroup Project No. 057122
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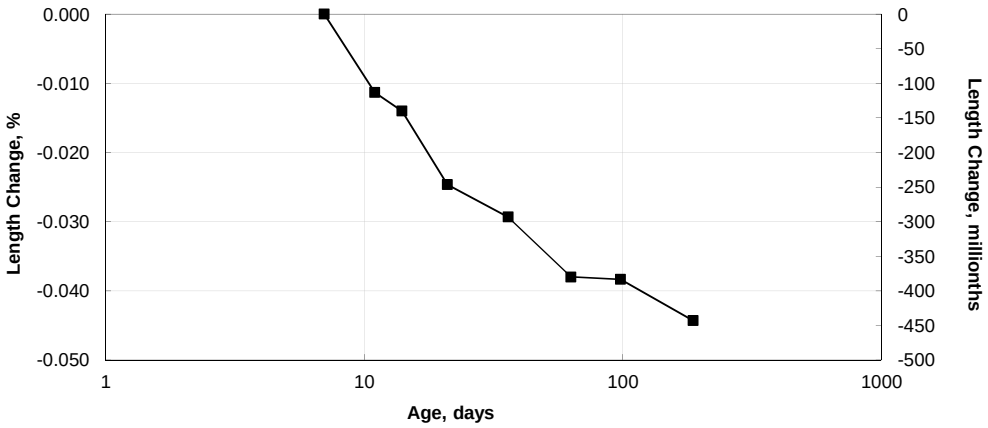
AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

SLA-F2



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
7/31/2012	1	--	Initial	0.0428	0.0334	-0.0272								
8/6/2012	7	0	Start dry	0.0428	0.0334	-0.0272	0.000	0.000	0.000	**0.000**	0	0	0	**0**
8/10/2012	11	4	dry	0.0417	0.0325	-0.0286	-0.011	-0.009	-0.014	**-0.011**	-110	-90	-140	**-113**
8/13/2012	14	7	dry	0.0413	0.0321	-0.0286	-0.015	-0.013	-0.014	**-0.014**	-150	-130	-140	**-140**
8/20/2012	21	14	dry	0.0403	0.0310	-0.0297	-0.025	-0.024	-0.025	**-0.025**	-250	-240	-250	**-247**
9/4/2012	36	29	dry	0.0398	0.0305	-0.0301	-0.030	-0.029	-0.029	**-0.029**	-300	-290	-290	**-293**
10/1/2012	63	56	dry	0.0389	0.0296	-0.0309	-0.039	-0.038	-0.037	**-0.038**	-390	-380	-370	**-380**
11/5/2012	98	91	dry	0.0389	0.0295	-0.0309	-0.039	-0.039	-0.037	**-0.038**	-390	-390	-370	**-383**
2/2/2013	187	180	dry	0.0383	0.0289	-0.0315	-0.045	-0.045	-0.043	**-0.044**	-450	-450	-430	**-443**

Notes:

1. Specimens fabricated at CTLGroup on July 30, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
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Project: HPC for Bridge Decks
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CTLGroup Project No. 057122
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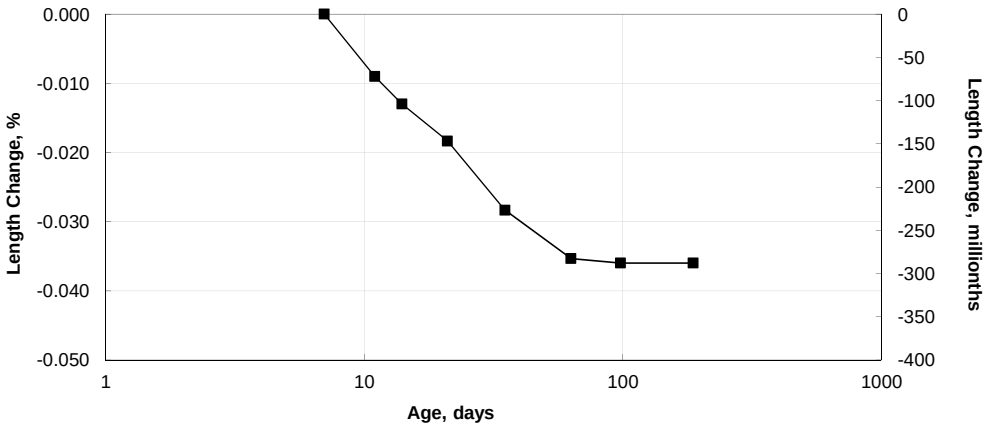
AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

SRA-F2



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
7/27/2012	1	--	Initial	-0.0296	0.0663	0.0985								
8/2/2012	7	0	Start dry	-0.0296	0.0664	0.0985	0.000	0.000	0.000	**0.000**	0	0	0	**0**
8/6/2012	11	4	dry	-0.0305	0.0655	0.0976	-0.009	-0.009	-0.009	**-0.009**	-90	-90	-90	**-90**
8/9/2012	14	7	dry	-0.0309	0.0651	0.0972	-0.013	-0.013	-0.013	**-0.013**	-130	-130	-130	**-130**
8/16/2012	21	14	dry	-0.0313	0.0645	0.0966	-0.017	-0.019	-0.019	**-0.018**	-170	-190	-190	**-183**
8/30/2012	35	28	dry	-0.0322	0.0635	0.0955	-0.026	-0.029	-0.030	**-0.028**	-260	-290	-300	**-283**
9/27/2012	63	56	dry	-0.0329	0.0628	0.0948	-0.033	-0.036	-0.037	**-0.035**	-330	-360	-370	**-353**
11/1/2012	98	91	dry	-0.0331	0.0627	0.0949	-0.035	-0.037	-0.036	**-0.036**	-350	-370	-360	**-360**
1/29/2013	187	180	dry	-0.0331	0.0627	0.0949	-0.035	-0.037	-0.036	**-0.036**	-350	-370	-360	**-360**

Notes:

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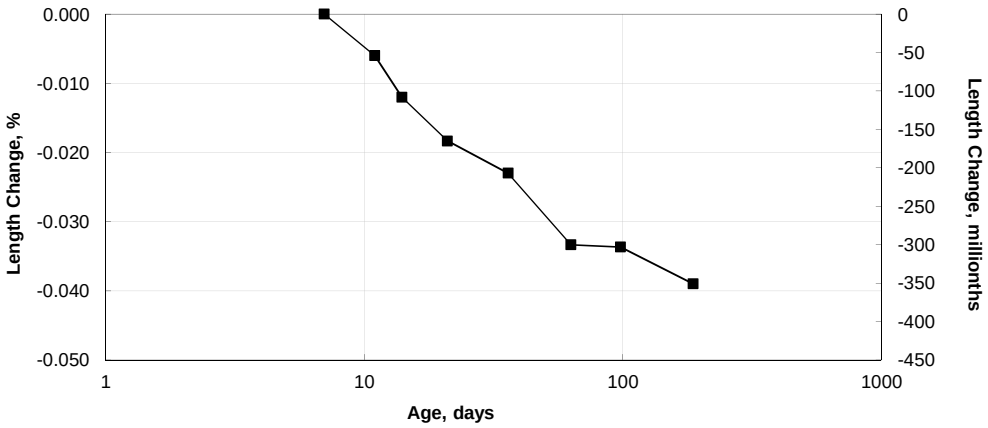

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Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
7/31/2012	1	--	Initial	-0.0096	-0.0464	-0.0162								
8/6/2012	7	0	Start dry	-0.0095	-0.0462	-0.0160	0.000	0.000	0.000	**0.000**	0	0	0	**0**
8/10/2012	11	4	dry	-0.0101	-0.0468	-0.0166	-0.006	-0.006	-0.006	**-0.006**	-60	-60	-60	**-60**
8/13/2012	14	7	dry	-0.0107	-0.0474	-0.0172	-0.012	-0.012	-0.012	**-0.012**	-120	-120	-120	**-120**
8/20/2012	21	14	dry	-0.0113	-0.0481	-0.0178	-0.018	-0.019	-0.018	**-0.018**	-180	-190	-180	**-183**
9/4/2012	36	29	dry	-0.0118	-0.0486	-0.0182	-0.023	-0.024	-0.022	**-0.023**	-230	-240	-220	**-230**
10/1/2012	63	56	dry	-0.0128	-0.0496	-0.0193	-0.033	-0.034	-0.033	**-0.033**	-330	-340	-330	**-333**
11/5/2012	98	91	dry	-0.0128	-0.0496	-0.0194	-0.033	-0.034	-0.034	**-0.034**	-330	-340	-340	**-337**
2/2/2013	187	180	dry	-0.0134	-0.0501	-0.0199	-0.039	-0.039	-0.039	**-0.039**	-390	-390	-390	**-390**

Notes:

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Project:	HPC for Bridge Decks	CTLGroup Project Mgr.:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	W. Demharter
Test Duration:	8/9/12 to 12/10/12	Analyst:	J. Slater
Report Date:	March 26, 2013	Approved by:	T. Van Dam

AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water

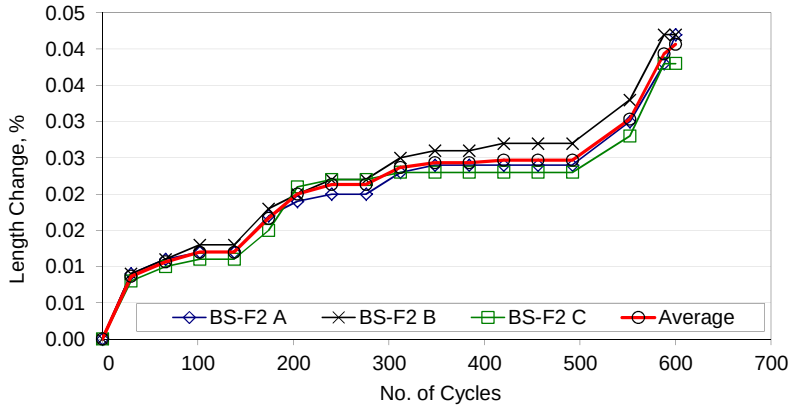
Freeze-Thaw	Length Change, %			
Cycles	BS-F2 A	BS-F2 B	BS-F2 C	Average
0	0.00	0.00	0.00	0.00
30	0.01	0.01	0.01	0.01
66	0.01	0.01	0.01	0.01
102	0.01	0.01	0.01	0.01
138	0.01	0.01	0.01	0.01
174	0.02	0.02	0.02	0.02
204	0.02	0.02	0.02	0.02
240	0.02	0.02	0.02	0.02
276	0.02	0.02	0.02	0.02
312	0.02	0.03	0.02	0.02
348	0.02	0.03	0.02	0.02
384	0.02	0.03	0.02	0.02
420	0.02	0.03	0.02	0.02
456	0.02	0.03	0.02	0.02
492	0.02	0.03	0.02	0.02
552	0.03	0.03	0.03	0.03
588	0.04	0.04	0.04	0.04
600	0.04	0.04	0.04	0.04

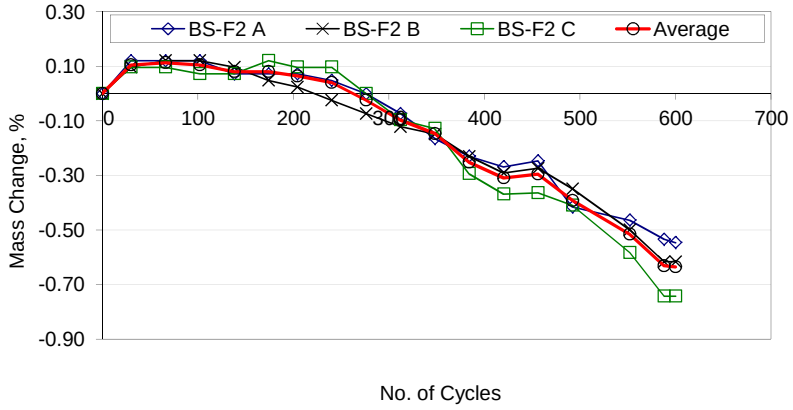
Freeze-Thaw	Mass Change, %			
Cycles	BS-F2 A	BS-F2 B	BS-F2 C	Average
0	0.00	0.00	0.00	0.00
30	0.12	0.10	0.10	0.10
66	0.12	0.12	0.10	0.11
102	0.12	0.12	0.07	0.10
138	0.07	0.10	0.07	0.08
174	0.07	0.05	0.12	0.08
204	0.07	0.02	0.10	0.06
240	0.05	-0.02	0.10	0.04
276	0.00	-0.07	0.00	-0.02
312	-0.07	-0.12	-0.10	-0.10
348	-0.16	-0.15	-0.13	-0.15
384	-0.23	-0.23	-0.29	-0.25
420	-0.27	-0.29	-0.37	-0.31
456	-0.25	-0.27	-0.36	-0.29
492	-0.42	-0.35	-0.41	-0.39
552	-0.46	-0.50	-0.58	-0.52
588	-0.53	-0.62	-0.74	-0.63
600	-0.55	-0.62	-0.74	-0.64

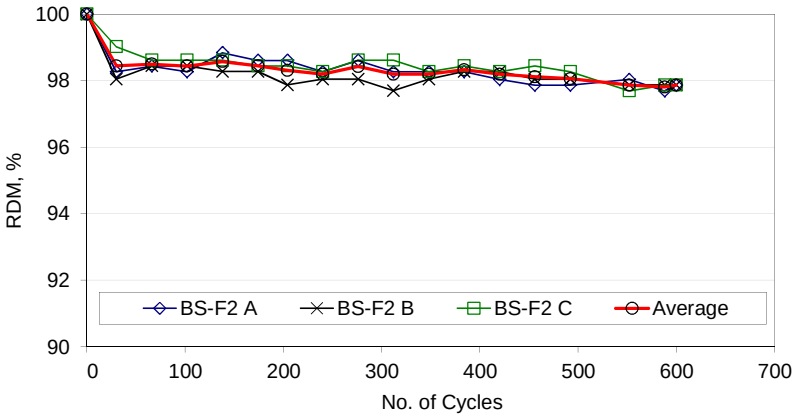
Freeze-Thaw	Relative Dynamic Modulus, %			
Cycles	BS-F2 A	BS-F2 B	BS-F2 C	Average
0	100	100	100	100
30	98	98	99	98
66	98	98	99	98
102	98	98	99	98
138	99	98	99	99
174	99	98	98	98
204	99	98	98	98
240	98	98	98	98
276	99	98	99	98
312	98	98	99	98
348	98	98	98	98
384	98	98	98	98
420	98	98	98	98
456	98	98	98	98
492	98	98	98	98
552	98	98	98	98
588	98	98	98	98
600	98	98	98	98

Client:	S.T.A.T.E Testing / Illinois Tollway	CTLGroup Project No.:	057122
Project:	HPC for Bridge Decks	CTLGroup Project Mgr.:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	W. Demharter
Test Duration:	8/9/12 to 12/10/12	Analyst:	J. Slater
Report Date:	March 26, 2013	Approved by:	T. Van Dam

AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water







Notes:

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2.

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AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water

Freeze-Thaw	Length Change, %			
Cycles	OPT-F2 A	OPT-F2 B	OPT-F2 C	Average
0	0.00	0.00	0.00	0.00
30	0.01	0.01	0.01	0.01
66	0.01	0.01	0.01	0.01
102	0.01	0.02	0.02	0.02
138	0.01	0.02	0.02	0.02
174	0.02	0.02	0.02	0.02
204	0.02	0.02	0.02	0.02
240	0.02	0.02	0.02	0.02
276	0.02	0.02	0.02	0.02
312	0.02	0.03	0.02	0.02
348	0.02	0.03	0.02	0.02
384	0.02	0.03	0.02	0.02
420	0.03	0.03	0.02	0.02
456	0.03	0.03	0.02	0.03
492	0.03	0.03	0.02	0.03
552	0.03	0.03	0.03	0.03
588	0.04	0.04	0.04	0.04
600	0.04	0.04	0.04	0.04

Freeze-Thaw	Mass Change, %			
Cycles	OPT-F2 A	OPT-F2 B	OPT-F2 C	Average
0	0.00	0.00	0.00	0.00
30	0.12	0.12	0.17	0.14
66	0.32	0.32	0.27	0.30
102	0.40	0.37	0.32	0.36
138	0.42	0.37	0.34	0.38
174	0.37	0.37	0.37	0.37
204	0.37	0.37	0.37	0.37
240	0.32	0.34	0.34	0.34
276	0.30	0.34	0.32	0.32
312	0.25	0.27	0.29	0.27
348	0.16	0.28	0.23	0.22
384	0.10	0.13	0.19	0.14
420	0.07	0.07	0.12	0.09
456	0.07	0.08	0.12	0.09
492	0.00	0.02	0.06	0.03
552	-0.12	-0.12	-0.03	-0.09
588	-0.21	-0.21	-0.15	-0.19
600	-0.21	-0.26	-0.16	-0.21

Freeze-Thaw	Relative Dynamic Modulus, %			
Cycles	OPT-F2 A	OPT-F2 B	OPT-F2 C	Average
0	100	100	100	100
30	100	99	100	99
66	99	99	100	99
102	99	99	100	99
138	99	99	99	99
174	99	99	99	99
204	100	100	100	100
240	99	99	99	99
276	99	99	99	99
312	100	99	100	99
348	100	99	100	99
384	100	99	100	100
420	100	99	100	99
456	100	99	100	100
492	100	99	101	100
552	99	98	100	99
588	100	98	100	100
600	100	98	101	100

Client:	S.T.A.T.E Testing / Illinois Tollway	CTLGroup Project No.:	057122
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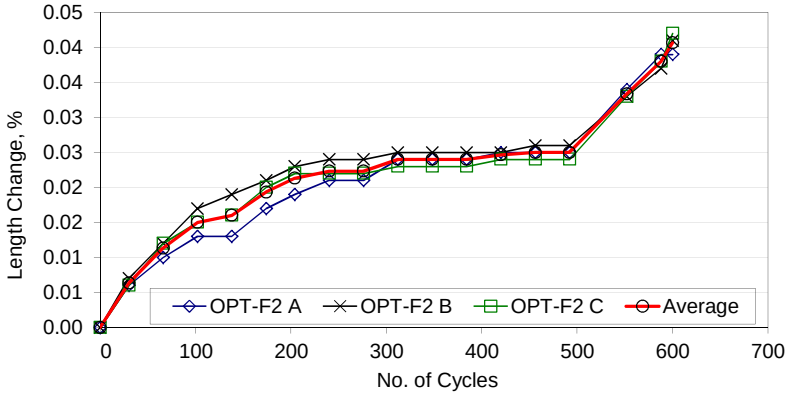
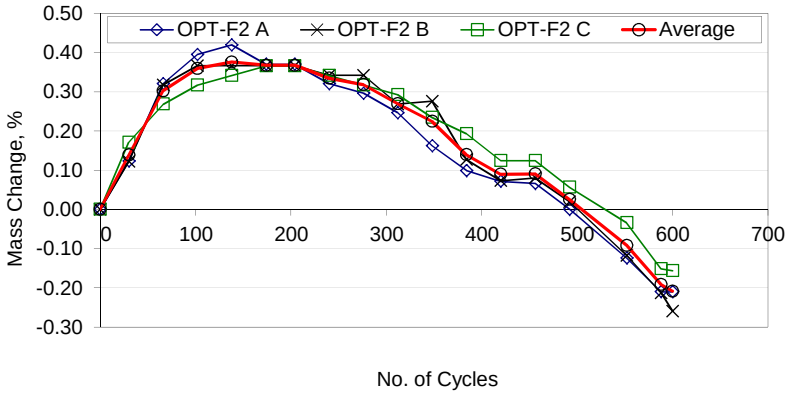
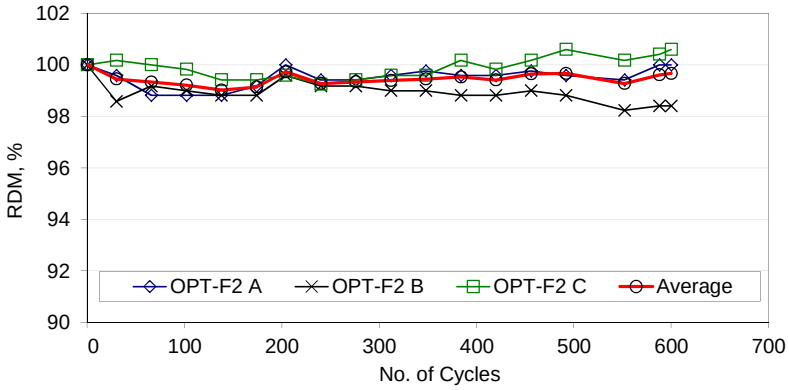
AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water







Notes:

1. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for 7 days prior to freeze-thaw cycles.
2. This report may not be reproduced except in its entirety.

Client:	S.T.A.T.E Testing / Illinois Tollway	CTLGroup Project No.:	057122
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Contact:	Mr. Steve Gillen	Technician:	W. Demharter
Test Duration:	8/14/12 to 12/10/12	Analyst:	J. Slater
Report Date:	March 26, 2013	Approved by:	T. Van Dam

AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water

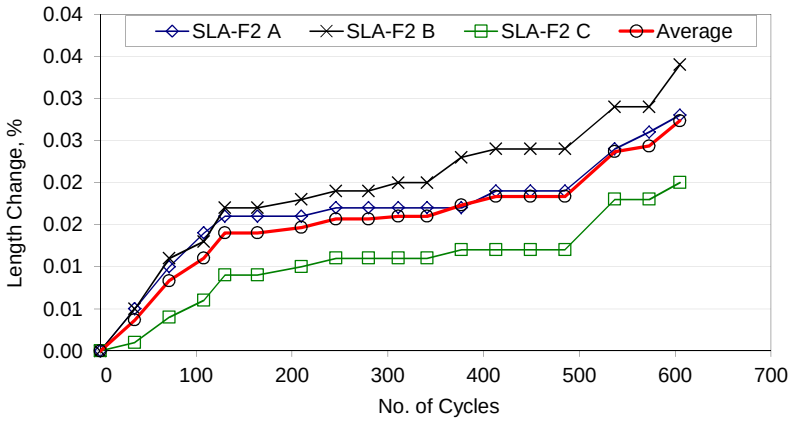
Freeze-Thaw	Length Change, %			
Cycles	SLA-F2 A	SLA-F2 B	SLA-F2 C	Average
0	0.00	0.00	0.00	0.00
36	0.01	0.01	0.00	0.00
72	0.01	0.01	0.00	0.01
108	0.01	0.01	0.01	0.01
130	0.02	0.02	0.01	0.01
164	0.02	0.02	0.01	0.01
210	0.02	0.02	0.01	0.01
246	0.02	0.02	0.01	0.02
280	0.02	0.02	0.01	0.02
311	0.02	0.02	0.01	0.02
341	0.02	0.02	0.01	0.02
377	0.02	0.02	0.01	0.02
413	0.02	0.02	0.01	0.02
449	0.02	0.02	0.01	0.02
485	0.02	0.02	0.01	0.02
537	0.02	0.03	0.02	0.02
573	0.03	0.03	0.02	0.02
605	0.03	0.03	0.02	0.03

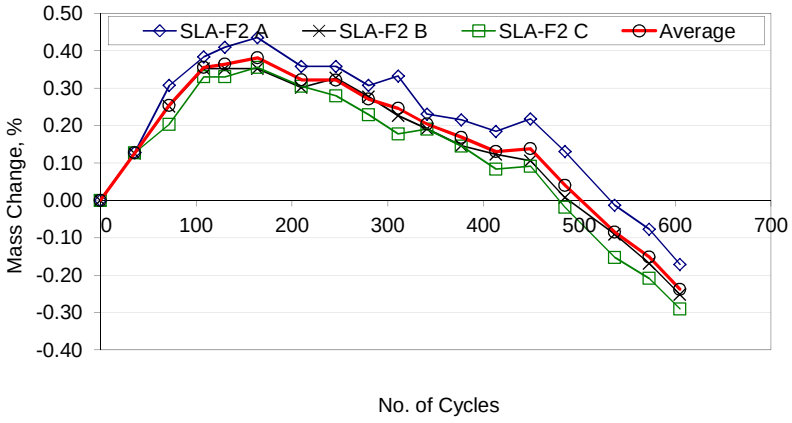
Freeze-Thaw	Mass Change, %			
Cycles	SLA-F2 A	SLA-F2 B	SLA-F2 C	Average
0	0.00	0.00	0.00	0.00
36	0.13	0.13	0.13	0.13
72	0.31	0.25	0.20	0.25
108	0.38	0.35	0.33	0.36
130	0.41	0.35	0.33	0.36
164	0.44	0.35	0.36	0.38
210	0.36	0.30	0.31	0.32
246	0.36	0.33	0.28	0.32
280	0.31	0.28	0.23	0.27
311	0.33	0.23	0.18	0.25
341	0.23	0.19	0.19	0.20
377	0.22	0.15	0.14	0.17
413	0.18	0.12	0.08	0.13
449	0.22	0.11	0.09	0.14
485	0.13	0.01	-0.02	0.04
537	-0.01	-0.09	-0.15	-0.09
573	-0.08	-0.17	-0.21	-0.15
605	-0.17	-0.25	-0.29	-0.24

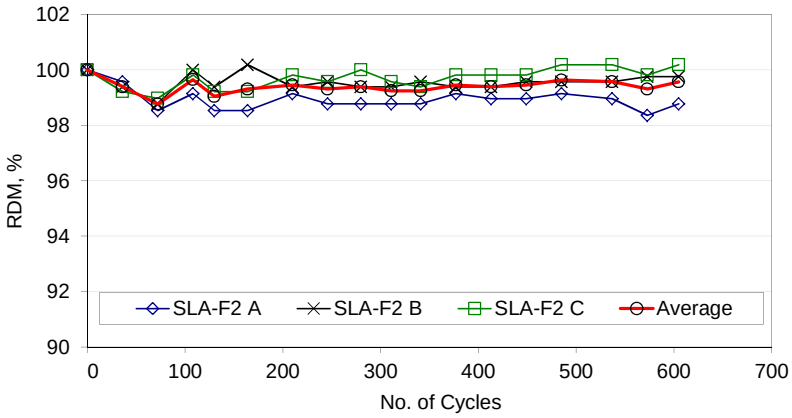
Freeze-Thaw	Relative Dynamic Modulus, %			
Cycles	SLA-F2 A	SLA-F2 B	SLA-F2 C	Average
0	100	100	100	100
36	100	99	99	99
72	99	99	99	99
108	99	100	100	100
130	99	99	99	99
164	99	100	99	99
210	99	99	100	99
246	99	100	100	99
280	99	99	100	99
311	99	99	100	99
341	99	100	99	99
377	99	99	100	99
413	99	99	100	99
449	99	100	100	99
485	99	100	100	100
537	99	100	100	100
573	98	100	100	99
605	99	100	100	100

Client: S.T.A.T.E Testing / Illinois Tollway	CTLGroup Project No.: 057122
Project: HPC for Bridge Decks	CTLGroup Project Mgr.: M. D'Ambrosia
Contact: Mr. Steve Gillen	Technician: W. Demharter
Test Duration: 8/14/12 to 12/10/12	Analyst: J. Slater
Report Date: March 26, 2013	Approved by: T. Van Dam

AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water







Notes:

1. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for 7 days prior to freeze-thaw cycles.

Client:	S.T.A.T.E Testing / Illinois Tollway	CTLGroup Project No.:	057122
Project:	HPC for Bridge Decks	CTLGroup Project Mgr.:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	W. Demharter
Test Duration:	8/14/12 to 12/10/12	Analyst:	J. Slater
Report Date:	March 26, 2013	Approved by:	T. Van Dam

AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water

Freeze-Thaw	Length Change, %			
Cycles	SRA-F2 A	SRA-F2 B	SRA-F2 C	Average
0	0.00	0.00	0.00	0.00
36	0.01	0.01	0.01	0.01
72	0.01	0.01	0.01	0.01
108	0.01	0.01	0.01	0.01
130	0.02	0.01	0.02	0.02
164	0.02	0.01	0.02	0.02
210	0.02	0.01	0.02	0.02
246	0.02	0.02	0.02	0.02
280	0.02	0.02	0.02	0.02
311	0.02	0.02	0.02	0.02
341	0.02	0.02	0.02	0.02
377	0.02	0.02	0.02	0.02
413	0.02	0.02	0.02	0.02
449	0.02	0.02	0.02	0.02
485	0.02	0.02	0.02	0.02
537	0.02	0.02	0.02	0.02
573	0.02	0.02	0.02	0.02
605	0.03	0.02	0.03	0.02

Freeze-Thaw	Mass Change, %			
Cycles	SRA-F2 A	SRA-F2 B	SRA-F2 C	Average
0	0.00	0.00	0.00	0.00
36	0.10	0.12	0.15	0.12
72	0.15	0.05	0.15	0.11
108	0.05	0.12	0.15	0.11
130	0.02	0.07	0.12	0.07
164	0.10	0.07	0.12	0.10
210	0.05	0.02	0.10	0.06
246	0.02	0.05	0.07	0.05
280	-0.05	-0.02	0.02	-0.02
311	-0.02	-0.05	0.02	-0.02
341	-0.05	-0.06	-0.19	-0.10
377	-0.27	-0.23	-0.37	-0.29
413	-0.29	-0.24	-0.38	-0.30
449	-0.34	-0.24	-0.38	-0.32
485	-0.50	-0.38	-0.56	-0.48
537	-0.71	-0.47	-0.74	-0.64
573	-0.88	-0.54	-0.85	-0.76
605	-1.17	-0.67	-0.91	-0.92

Freeze-Thaw	Relative Dynamic Modulus, %			
Cycles	SRA-F2 A	SRA-F2 B	SRA-F2 C	Average
0	100	100	100	100
36	99	99	99	99
72	98	99	98	98
108	98	99	99	99
130	98	98	99	98
164	98	99	99	99
210	98	98	99	99
246	98	98	99	98
280	98	98	98	98
311	98	98	98	98
341	97	99	99	98
377	97	98	99	98
413	98	98	99	98
449	97	98	98	98
485	97	98	98	98
537	97	98	99	98
573	97	98	99	98
605	97	98	98	98

Client:	S.T.A.T.E Testing / Illinois Tollway	CTLGroup Project No.:	057122
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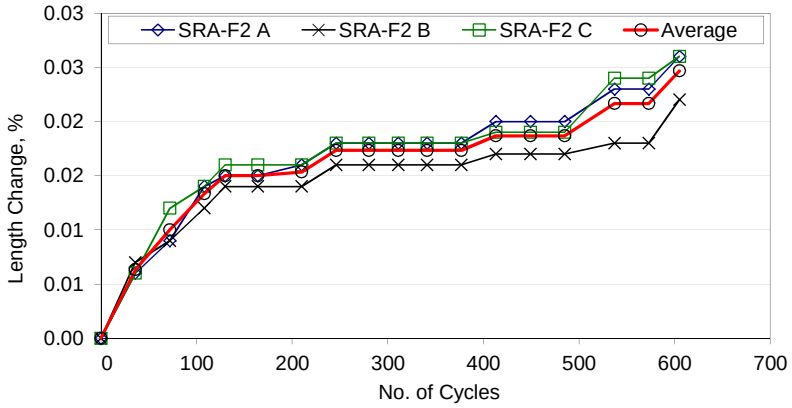
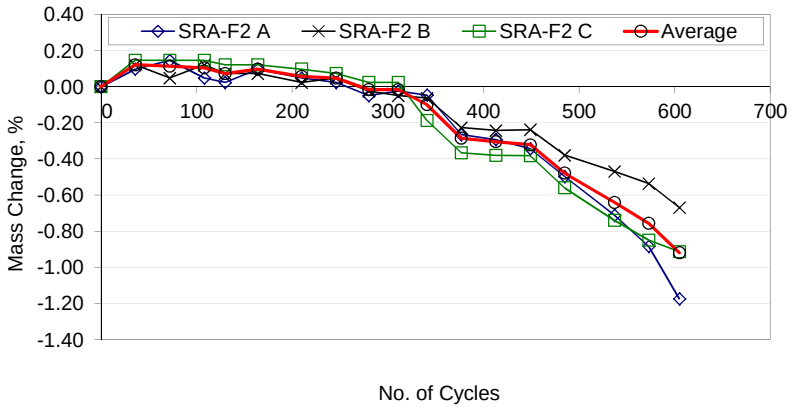
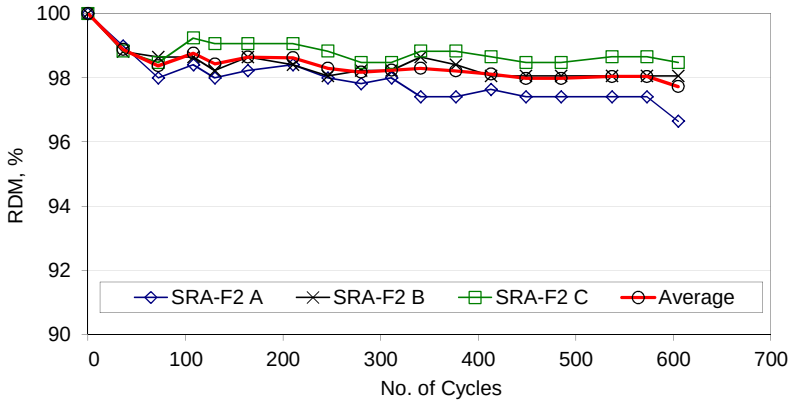
Resistance of Concrete to Rapid Freezing and Thawing in Water







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Resistance of Concrete to Rapid Freezing and Thawing in Water

Freeze-Thaw	Length Change, %			
Cycles	ULT-F2 A	ULT-F2 B	ULT-F2 C	Average
0	0.00	0.00	0.00	0.00
36	0.00	0.01	0.01	0.00
72	0.01	0.01	0.01	0.01
108	0.01	0.01	0.02	0.01
130	0.01	0.01	0.02	0.02
164	0.01	0.01	0.02	0.02
210	0.02	0.01	0.02	0.02
246	0.02	0.02	0.02	0.02
280	0.02	0.02	0.02	0.02
311	0.02	0.02	0.02	0.02
341	0.02	0.02	0.02	0.02
377	0.02	0.02	0.02	0.02
413	0.02	0.02	0.02	0.02
449	0.02	0.02	0.02	0.02
485	0.02	0.02	0.02	0.02
537	0.03	0.02	0.02	0.02
573	0.03	0.02	0.03	0.03
605	0.03	0.03	0.03	0.03

Freeze-Thaw	Mass Change, %			
Cycles	ULT-F2 A	ULT-F2 B	ULT-F2 C	Average
0	0.00	0.00	0.00	0.00
36	0.15	0.10	0.15	0.14
72	0.28	0.28	0.23	0.26
108	0.40	0.36	0.33	0.36
130	0.40	0.33	0.36	0.36
164	0.38	0.33	0.28	0.33
210	0.35	0.31	0.25	0.30
246	0.38	0.28	0.23	0.30
280	0.33	0.23	0.15	0.24
311	0.28	0.15	0.15	0.19
341	0.33	0.25	0.06	0.21
377	0.30	0.33	0.03	0.22
413	0.26	0.31	0.03	0.20
449	0.27	0.31	0.04	0.21
485	0.05	0.18	-0.04	0.06
537	-0.09	0.13	-0.04	0.00
573	-0.25	0.00	-0.13	-0.13
605	-0.32	-0.10	-0.20	-0.21

Freeze-Thaw	Relative Dynamic Modulus, %			
Cycles	ULT-F2 A	ULT-F2 B	ULT-F2 C	Average
0	100	100	100	100
36	98	98	99	98
72	98	98	99	98
108	98	99	99	99
130	98	98	99	98
164	98	98	99	98
210	98	98	99	98
246	97	98	99	98
280	97	98	99	98
311	97	98	99	98
341	97	98	99	98
377	97	98	98	98
413	97	98	98	98
449	97	98	98	98
485	98	98	99	98
537	97	98	99	98
573	97	98	99	98
605	97	98	99	98

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Test Duration: 8/14/12 to 12/10/12	Analyst: J. Slater
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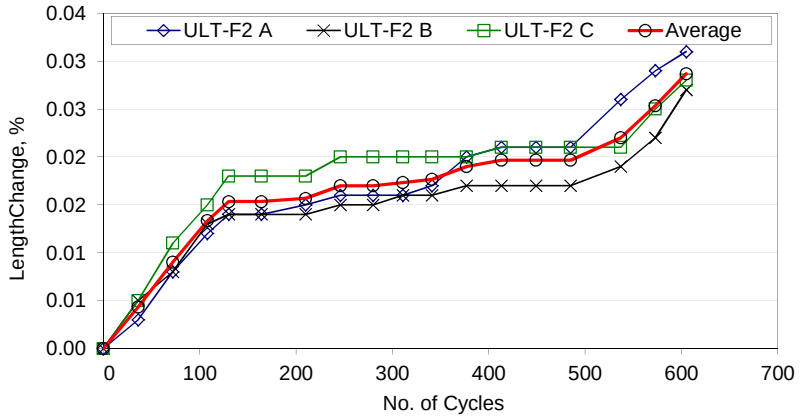
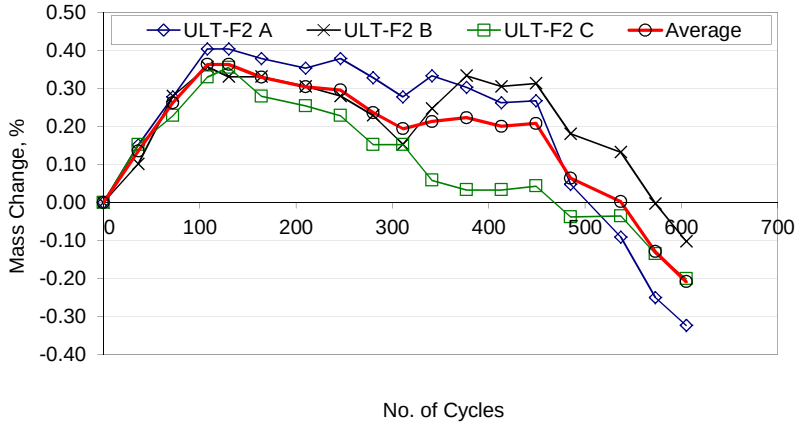
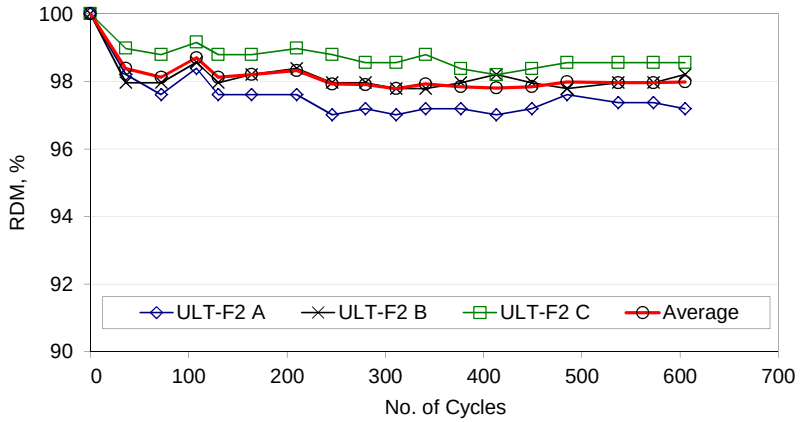
AASHTO T161-08, ASTM C666 / C666M – 03 (08), Procedure A
Resistance of Concrete to Rapid Freezing and Thawing in Water







Notes:

1. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for 7 days prior to freeze-thaw cycles.

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	August 22, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
BS-F2 A	7/23/2012	8/20/2012	28	955	Very Low
BS-F2 B	7/23/2012	8/20/2012	28	1134	Low
BS-F2 C	7/23/2012	8/20/2012	28	1258	Low
Average				**1116**	Low

Notes:

1. Cylinders cast by CTLGroup on July 23, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the bottom of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days.
4. This report may not be reproduced except in its entirety.
5. ASTM C1202 Precision Statement: "The single operator coefficient of variation of a single test result has been found to be 12.3%. Therefore the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not vary by more than 42%."

Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	August 23, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
OPT-F2 A	7/24/2012	8/21/2012	28	907	Very Low
OPT-F2 B	7/24/2012	8/21/2012	28	982	Very Low
OPT-F2 C	7/24/2012	8/21/2012	28	919	Very Low
Average				**936**	Very Low

Notes:

1. Cylinders cast by CTLGroup on July 24, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the bottom of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days.
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1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	August 29, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SLA-F2 A	7/30/2012	8/27/2012	28	1006	Low
SLA-F2 B	7/30/2012	8/27/2012	28	1090	Low
SLA-F2 C	7/30/2012	8/27/2012	28	1044	Low
Average				**1047**	Low

Notes:

1. Cylinders cast by CTLGroup on July 30, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the bottom of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

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>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	August 27, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SRA-F2 A	7/26/2012	8/23/2012	28	717	Very Low
SRA-F2 B	7/26/2012	8/23/2012	28	796	Very Low
SRA-F2 C	7/26/2012	8/23/2012	28	777	Very Low
Average				**763**	Very Low

Notes:

1. Cylinders cast by CTLGroup on July 26, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the bottom of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days.
4. This report may not be reproduced except in its entirety.
5. ASTM C1202 Precision Statement: "The single operator coefficient of variation of a single test result has been found to be 12.3%. Therefore the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not vary by more than 42%."

Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

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>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	August 29, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
ULT-F2 A	7/30/2012	8/27/2012	28	363	Very Low
ULT-F2 B	7/30/2012	8/27/2012	28	332	Very Low
ULT-F2 C	7/30/2012	8/27/2012	28	371	Very Low
Average				**355**	Very Low

Notes:

1. Cylinders cast by CTLGroup on July 30, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the bottom of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days.
4. This report may not be reproduced except in its entirety.
5. ASTM C1202 Precision Statement: "The single operator coefficient of variation of a single test result has been found to be 12.3%. Therefore the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not vary by more than 42%."

Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client: S.T.A.T.E.Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Date: March 26, 2013

CTLGroup Project No: 057122
Project Manager: M. D'Ambrosia
Technician: JP, BS
Approved: T. Van Dam

ASTM C192 Mixture Summary

Mix ID:			ULT	ULT	BS T1L	BS T1L	BS OPC	BS OPC	SRA T1L	SRA T1L	SRA OPC	SRA OPC	SLA	SLA	OPT	OPT	ULT
Source:			**Ozinga**	**Lab**	**Meyer**	**Lab**	**Meyer**	**Lab**	**Meyer**	**Lab**	**Meyer**	**Lab**	**Prairie**	**Lab**	**Ozinga**	**Lab**	**Ozinga**
Date Fabricated:			9/21/2012	10/17/2012	10/17/2012	11/7/2012	10/17/2012	11/7/2012	10/17/2012	12/19/2012	10/17/2012	12/19/2012	11/14/2012	11/28/2012	12/27/2012	1/7/2013	12/27/2012
Material										lb/yd^3 (SSD)							
Cement	*ASTM C150 Type I*		313	313	519	515	516	515	411	403	411	403	420	409	378	375	316
Fly Ash	*ASTM C618*		112	111	0	0	0	0	131	134	134	134	0	0	125	125	116
Slag	*ASTM C989*		153	154	114	110	110	110	0	0	0	0	132	136	0	0	154
Coarse Aggregate	*CM-11 Crushed Limestone*		1400	1400	1861	1875	1865	1875	1833	1840	1809	1840	1738	1714	1365	1369	1503
Coarse Aggregate	*CM-16 Crushed Limestone*		393	375	0	0	0	0	0	0	0	0	0	0	420	410	446
Saturated Lightweight	*Saturated Lightweight Fines*		234	229	0	0	0	0	0	0	0	0	364	364	0	0	234
Fine Aggregate	*ASTM C33 Fine Aggregate*		980	986	1220	1219	1220	1219	1485	1406	1485	1406	1011	986	1399	1400	989
Water	*Potable*		204	220	263	263	260	263	209	226	219	226	230	234	191	210	**246**
Total Cementitious Content			578	578	633	625	626	625	543	537	545	537	552	545	503	500	586
w/cm			0.35	0.38	0.42	0.42	0.41	0.42	0.38	0.42	0.40	0.42	0.42	0.43	0.38	0.42	0.42
Paste Content Volume (including air), %			31.1%	32.1%	33.9%	33.7%	33.6%	33.7%	30.2%	31.1%	30.9%	31.2%	30.4%	30.6%	28.0%	29.0%	33.0%
										fl. oz./cwt (100 lbs of cementitous material)							
Air Entraining Agent			1.03	1.03	0.32	0.24	0.32	0.24	0.28	0.28	0.37	0.28	0.79	0.79	0.30	0.30	0.22
Water Reducer			3.9	4.0	3.0	3.0	3.0	3.0	2.3	2.3	3.0	3.0	3.0	3.0	3.5	3.5	3.6
Shrinkage Reducing Agent			33.2	33.2	0.0	0.0	0.0	0.0	35.8	35.8	35.2	35.8	0.0	0.0	0.0	0.0	0.0
High Range Water Reducer			2.9	4.1	3.0	3.0	3.0	3.0	3.0	3.0	3.9	4.0	5.0	6.7	3.0	3.0	3.8
Hydration Stabilizer			3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.9	3.0	2.0	2.0	3.0	3.0	2.9
										Target Fresh Properties							
Target Slump										6-8 inches							
Design Air Content										4-6%							
										Measured Fresh Properties							
Slump, in. (1 hr)	ASTM C143	Initial	6.5	8.25	8.5	6.0	7.5	7.0	8.0	4.5	8.0	5.5	8.0	5.5	8.0	4.0	9.25
		Final	4.25	4.0	5.0	2.5	6.5	3.75	4.3	2.0	5.25	2.25	7.0	2.5	6.75	1.75	8.25
Air Content, % (1 hr)	ASTM C231	Initial	9.0%	9.0%	6.2%	6.8%	7.5%	7.4%	5.5%	7.2%	7.3%	6.6%	7.9%	9.5%	7.5%	7.8%	7.0%
		Final	7.4%	7.6%	4.7%	3.9%	6.5%	4.4%	5.5%	4.7%	5.5%	4.4%	5.9%	6.3%	6.4%	5.5%	5.6%
Temperature, °F	ASTM C1064	Final	65	75	70	75	73	74	72	74	72	74	56	73	57	72	---
Fresh Density, lb/ft^3	ASTM C138	Final	---	140	145	150	142	150	146	150	146	151	146	146	---	149	140
Age, days										**Measured Compressive Strength, psi. - ASTM C39**							
1			473	713	3667	3557	2693	3437	2090	1917	1627	2353	2137	3330	557	1470	193
3			1703	2553	5810	5790	4737	5680	4977	4487	4437	3597	4370	5867	3597	4403	1977
7			2570	3777	6563	7173	5493	6940	5963	5717	4103	6510	5877	7653	4763	5887	2507
14			3500	5023	---	7473	---	7830	---	6503	---	7507	6923	8093	5870	7120	3797
28			5317	7307	8307	8590	7380	8617	7727	7407	7060	7873	6930	7680	7187	7960	---
Test	**Test Method**									**Test Result**							
Ring Test, days	ASTM C1581		---	No cracking	---	One ring cracked	---	Three rings cracked (16.6 days)	---	No cracking	---	No cracking	---	One ring cracked	---	One ring cracked	---
Length Change, %	ASTM C157 (7d soak, 28d dry)		---	-0.024	---	-0.034	---	-0.034	---	-0.026	---	-0.025	---	-0.022	---	**-0.038**	---
Rapid Chloride, coulombs	ASTM C1202 (28d accel)		703	559	1325	1209	1492	1227	1042	1045	1451	1019	1110	796	**1897**	1356	---
Total Air, %	ASTM C457		7.48%	6.44%	4.67%	**2.29%**	4.52%	**3.72%**	4.15%	**3.63%**	4.73%	**3.77%**	4.49%	5.11%	5.03%	**3.16%**	---
Spacing Factor, in.	ASTM C457		0.0036	0.0041	0.0079	0.0060	0.0057	0.0070	0.0054	0.0061	0.0062	0.0063	0.0070	0.0077	0.0051	0.0038	---
Specific Surface, 1/in.	ASTM C457		921.9	896.5	625.7	1095.4	878.3	729.0	910.7	897.5	783.0	827.0	691.8	**581.7**	877.9	1458.6	---

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: September 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Field	ULT-Field	ULT-Field
Client Identification	N/A	N/A	N/A
Casting Date	9/21/12 12:50	9/21/12 12:50	9/21/12 12:50
Test Date / Time	9/22/12 13:05	9/22/12 13:10	9/22/12 13:19
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.01	4.03
Diameter 2, in.	4.02	4.01	3.99
Length(without caps), in.	8.04	8.03	8.06
Length(with caps), in.	8.17	8.21	8.24
Average Diameter, in.	4.01	4.01	4.01
Length / Diameter (L/D)	2.04	2.05	2.06
Cross-Sectional Area, in^2	12.63	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	5,769	6,143	5,881
Compressive Strength, psi	460	490	470
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	473

Report Notes

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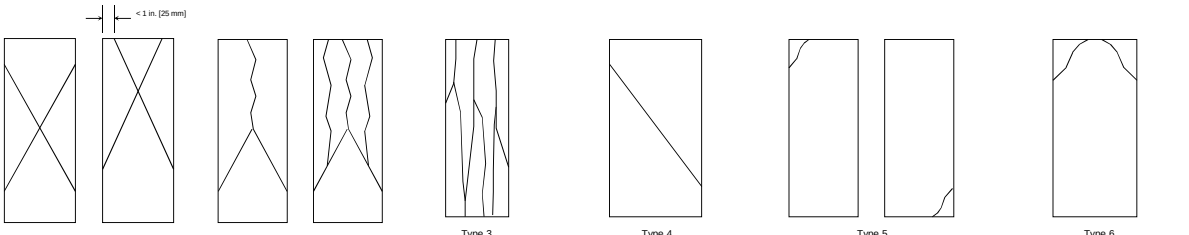
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: September 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Field	ULT-Field	ULT-Field
Client Identification	N/A	N/A	N/A
Casting Date	9/21/12 12:50	9/21/12 12:50	9/21/12 12:50
Test Date / Time	9/24/12 13:10	9/24/12 13:13	9/24/12 13:17
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.02
Diameter 2, in.	4.02	4.00	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.17	8.15	8.18
Average Diameter, in.	4.02	4.00	4.01
Length / Diameter (L/D)	2.03	2.04	2.04
Cross-Sectional Area, in^2	12.69	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	21,443	22,065	20,960
Compressive Strength, psi	1,690	1,760	1,660
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	1,703

Report Notes

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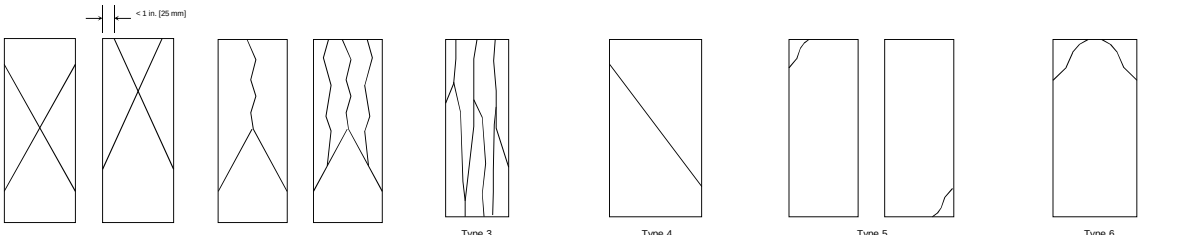
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: September 28, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Field	ULT-Field	ULT-Field
Client Identification	N/A	N/A	N/A
Casting Date	9/21/12 12:50	9/21/12 12:50	9/21/12 12:50
Test Date / Time	9/28/12 13:45	9/28/12 13:49	9/28/12 13:54
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.01
Diameter 2, in.	4.01	3.99	4.00
Length(without caps), in.	7.81	7.86	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.00	4.01
Length / Diameter (L/D)	1.94	1.97	1.97
Cross-Sectional Area, in^2	12.69	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

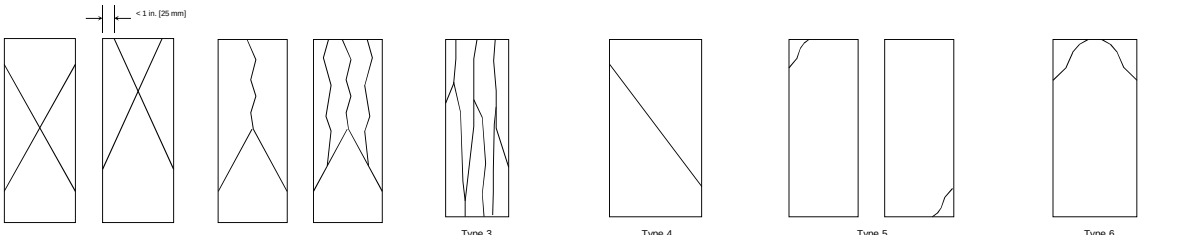
Maximum Load, lb	32,369	32,630	32,367
Compressive Strength, psi	2,550	2,600	2,560
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	2,570

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 19, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Field	ULT-Field	ULT-Field
Client Identification	N/A	N/A	N/A
Casting Date	9/21/12 12:50	9/21/12 12:50	9/21/12 12:50
Test Date / Time	10/19/12 15:25	10/19/12 15:30	10/19/12 15:35
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	SSD	SSD	SSD
Curing Conditions (Temp/RH)	Moist 74/100	Moist 74/100	Moist 74/100
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.01
Diameter 2, in.	4.01	3.99	4.01
Length(without caps), in.	7.88	7.90	7.91
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.00	4.01
Length / Diameter (L/D)	1.96	1.97	1.97
Cross-Sectional Area, in^2	12.69	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	67,465	66,381	67,631
Compressive Strength, psi	5,320	5,280	5,350
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,317

Report Notes

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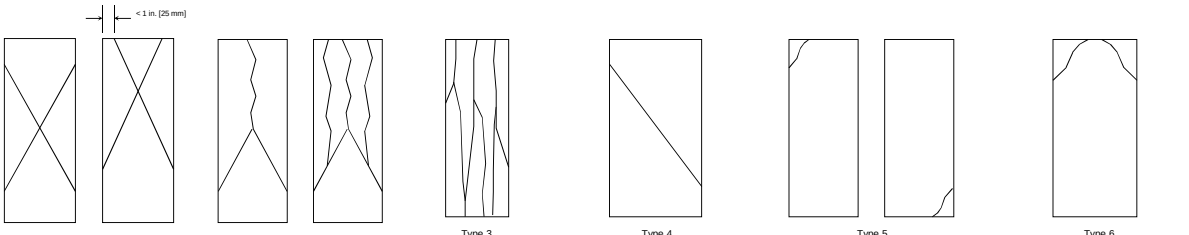
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Ozinga	ULT-Ozinga	ULT-Ozinga
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:13	10/17/12 10:13	10/17/12 10:13
Test Date / Time	10/18/12 10:20	10/18/12 10:23	10/18/12 10:26
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.01	4.02
Diameter 2, in.	4.01	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.19	8.20	8.18
Average Diameter, in.	4.01	4.01	4.02
Length / Diameter (L/D)	2.04	2.04	2.03
Cross-Sectional Area, in^2	12.63	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	9,142	9,001	8,985
Compressive Strength, psi	720	710	710
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	713

Report Notes

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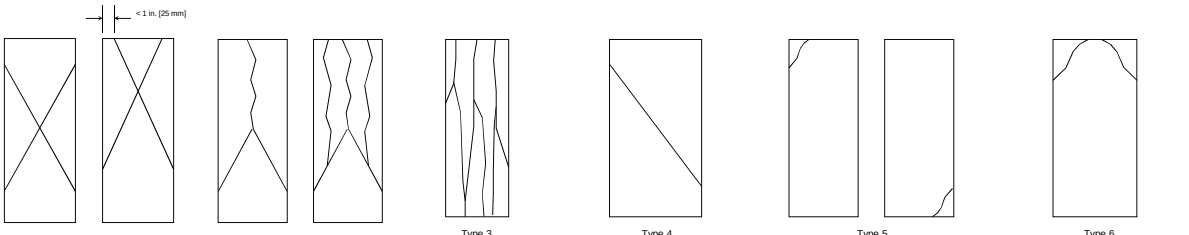
Schematic of Typical Fracture Patterns



Type 1
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Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Ozinga	ULT-Ozinga	ULT-Ozinga
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:13	10/17/12 10:13	10/17/12 10:13
Test Date / Time	10/20/12 10:05	10/20/12 10:10	10/20/12 10:15
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	3.99	4.03	4.03
Diameter 2, in.	4.01	4.01	3.98
Length(without caps), in.	7.91	7.88	7.83
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.00
Length / Diameter (L/D)	1.98	1.96	1.96
Cross-Sectional Area, in^2	12.57	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	32,087	32,135	32,393
Compressive Strength, psi	2,550	2,530	2,580
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	2,553

Report Notes

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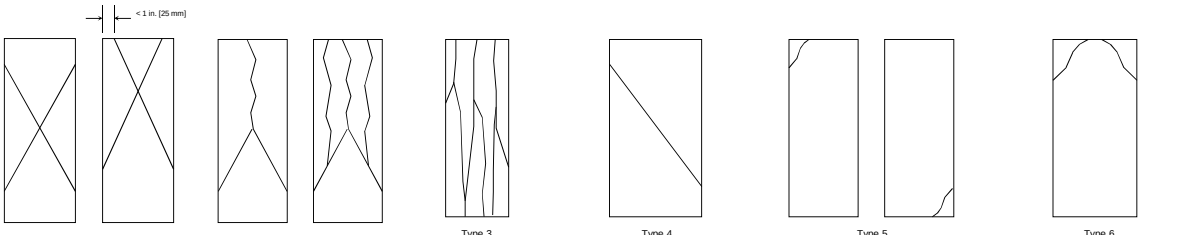
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Ozinga	ULT-Ozinga	ULT-Ozinga
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:13	10/17/12 10:13	10/17/12 10:13
Test Date / Time	10/24/12 13:07	10/24/12 13:11	10/24/12 13:15
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	3.99	4.02	3.99
Diameter 2, in.	4.01	4.00	4.01
Length(without caps), in.	7.87	7.90	7.91
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.01	4.00
Length / Diameter (L/D)	1.97	1.97	1.98
Cross-Sectional Area, in^2	12.57	12.63	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	45,739	46,916	50,045
Compressive Strength, psi	3,640	3,710	3,980
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	3,777

Report Notes

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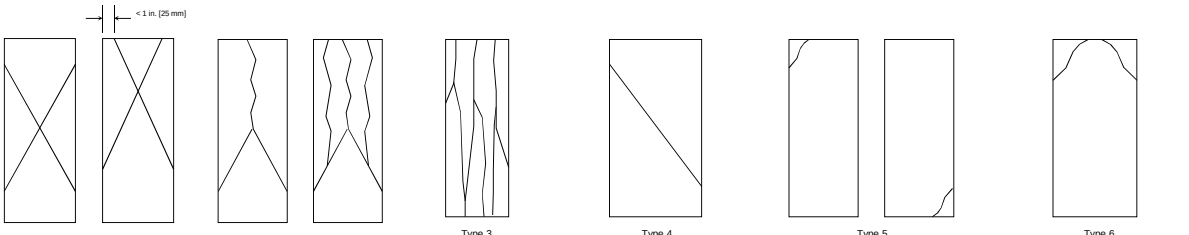
Schematic of Typical Fracture Patterns



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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 1, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Ozinga	ULT-Ozinga	ULT-Ozinga
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:13	10/17/12 10:13	10/17/12 10:13
Test Date / Time	10/31/12 16:15	10/31/12 16:19	10/31/12 16:24
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.04
Diameter 2, in.	4.01	3.99	4.02
Length(without caps), in.	7.82	7.85	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.00	4.03
Length / Diameter (L/D)	1.95	1.96	1.96
Cross-Sectional Area, in^2	12.69	12.57	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	64,200	62,000	64,800
Compressive Strength, psi	5,060	4,930	5,080
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,023

Report Notes

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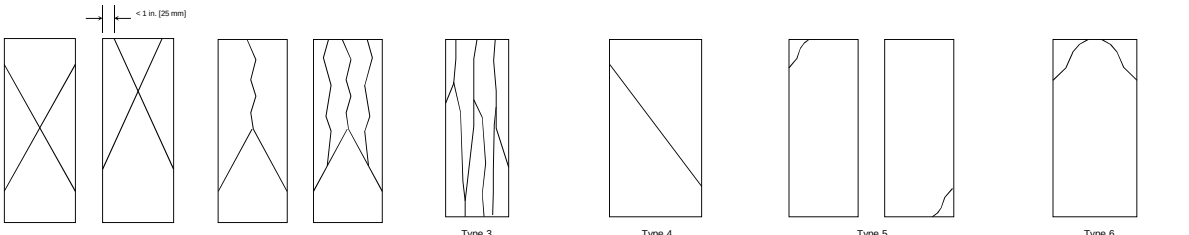
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-Ozinga	ULT-Ozinga	ULT-Ozinga
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:13	10/17/12 10:13	10/17/12 10:13
Test Date / Time	11/14/12 14:58	11/14/12 15:02	11/14/12 15:07
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.02
Diameter 2, in.	4.01	4.02	4.01
Length(without caps), in.	7.83	7.85	7.84
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.01
Length / Diameter (L/D)	1.95	1.95	1.96
Cross-Sectional Area, in^2	12.63	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	95,000	91,200	91,000
Compressive Strength, psi	7,520	7,190	7,210
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,307

Report Notes

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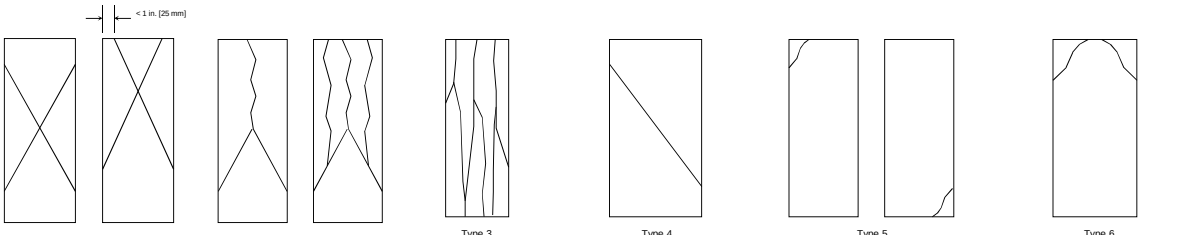
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 T1L	Toll BS-F2 T1L	Toll BS-F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 9:04	10/17/12 9:04	10/17/12 9:04
Test Date / Time	10/18/12 11:37	10/18/12 11:41	10/18/12 11:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.04	4.02	4.02
Diameter 2, in.	4.02	4.01	4.00
Length(without caps), in.	8.07	8.04	8.08
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.02	4.01
Length / Diameter (L/D)	2.00	2.00	2.01
Cross-Sectional Area, in^2	12.76	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	47,600	46,200	45,800
Compressive Strength, psi	3,730	3,640	3,630
Fracture Pattern	Type 5	Type 5	Type 5

Average Compressive Strength, psi	3,667

Report Notes

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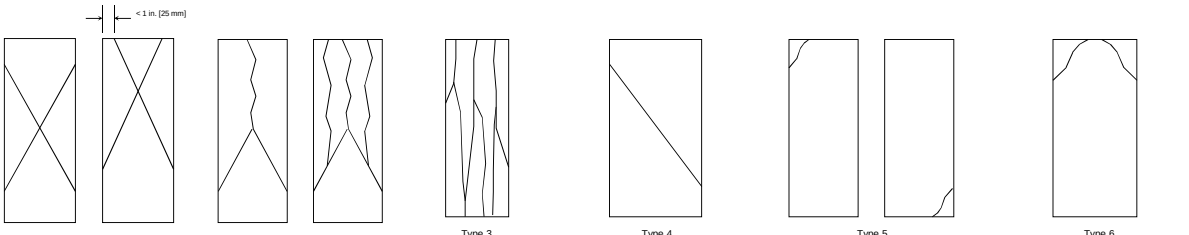
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 T1L	Toll BS-F2 T1L	Toll BS-F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 9:04	10/17/12 9:04	10/17/12 9:04
Test Date / Time	10/20/12 10:25	10/20/12 10:25	10/20/12 10:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	4.00	4.05
Diameter 2, in.	4.02	4.05	4.01
Length(without caps), in.	7.91	7.87	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.02	4.03
Length / Diameter (L/D)	1.96	1.96	1.95
Cross-Sectional Area, in^2	12.76	12.69	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	73,729	73,916	74,352
Compressive Strength, psi	5,780	5,820	5,830
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,810

Report Notes

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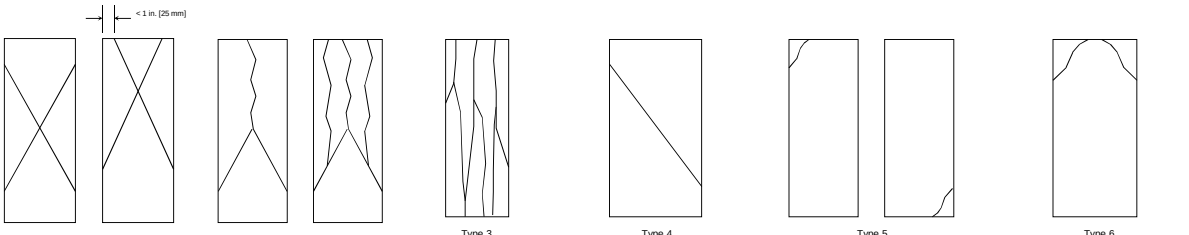
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 T1L	Toll BS-F2 T1L	Toll BS-F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 9:04	10/17/12 9:04	10/17/12 9:04
Test Date / Time	10/24/12 13:20	10/24/12 13:25	10/24/12 13:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	4.01	4.02
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.85	7.94	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.95	1.98	1.96
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

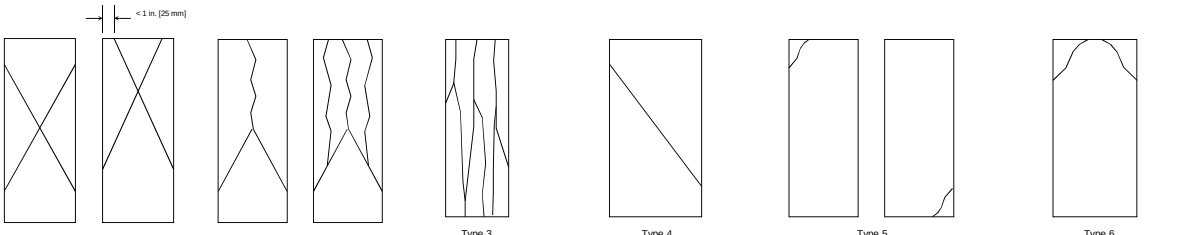
Maximum Load, lb	86,501	66,033	97,415
Compressive Strength, psi	6,780	5,230	7,680
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,563

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 T1L	Toll BS-F2 T1L	Toll BS-F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 9:04	10/17/12 9:04	10/17/12 9:04
Test Date / Time	11/14/12 15:11	11/14/12 15:16	11/14/12 15:20
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.02
Diameter 2, in.	4.01	3.99	4.01
Length(without caps), in.	7.77	7.82	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.00	4.02
Length / Diameter (L/D)	1.94	1.95	1.96
Cross-Sectional Area, in^2	12.63	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	102,800	108,800	103,000
Compressive Strength, psi	8,140	8,660	8,120
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,307

Report Notes

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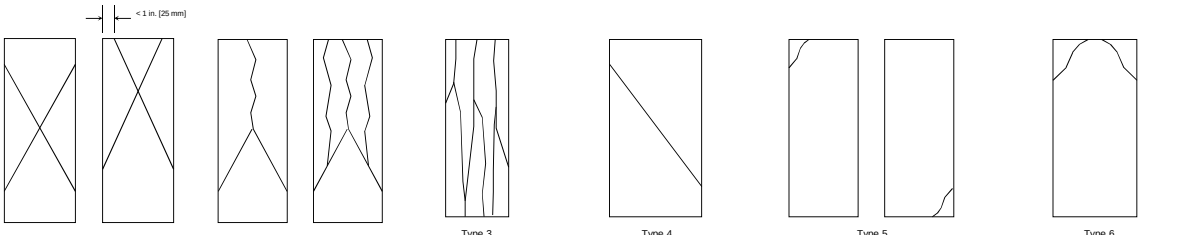
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 9, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS T1L	BS T1L	BS T1L
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 8:59	11/7/12 8:59	11/7/12 8:59
Test Date / Time	11/8/12 8:45	11/8/12 8:50	11/8/12 8:55
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.02
Diameter 2, in.	4.03	4.02	4.01
Length(without caps), in.	8.10	8.02	8.08
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.03	4.01
Length / Diameter (L/D)	2.01	1.99	2.01
Cross-Sectional Area, in^2	12.69	12.76	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

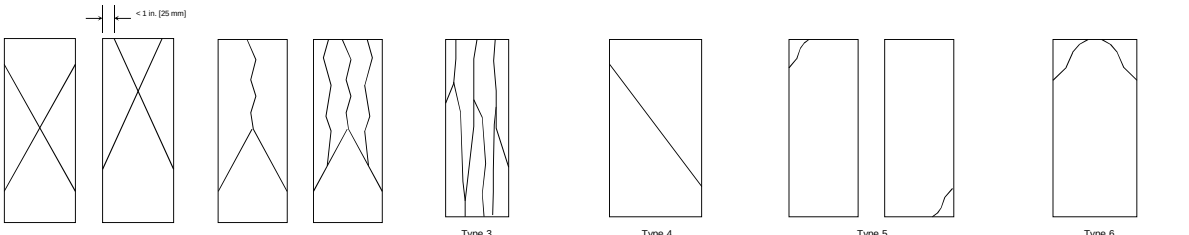
Maximum Load, lb	44,800	46,000	44,600
Compressive Strength, psi	3,530	3,610	3,530
Fracture Pattern	Type 2	Type 2	Type 2

Average Compressive Strength, psi	3,557

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 12, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS T1L	BS T1L	BS T1L
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 8:59	11/7/12 8:59	11/7/12 8:59
Test Date / Time	11/10/12 10:15	11/10/12 10:20	11/10/12 10:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	3.96
Diameter 2, in.	3.96	4.02	4.00
Length(without caps), in.	7.86	7.95	7.84
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	3.99	4.02	3.98
Length / Diameter (L/D)	1.97	1.98	1.97
Cross-Sectional Area, in^2	12.50	12.69	12.44
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	72,800	74,800	70,400
Compressive Strength, psi	5,820	5,890	5,660
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,790

Report Notes

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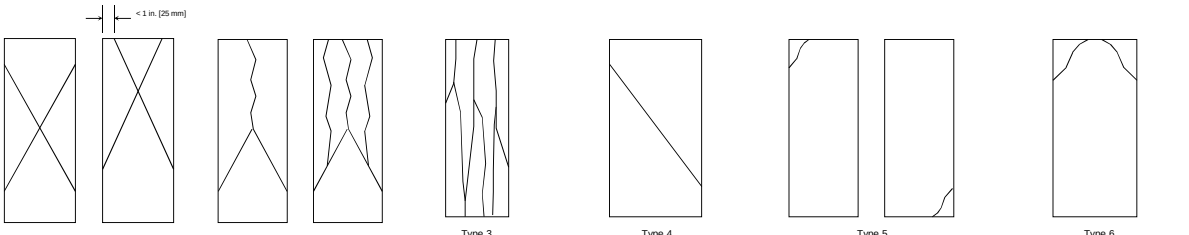
Schematic of Typical Fracture Patterns



Client:	S.T.A.T.E Testing / Illinois Tollway	**CTLGroup Project No.:**	057122
Project:	HPC for Bridge Decks	**CTLGroup Project Mgr.:**	M. D'Ambrosia
Contact:	Mr. Steve Gillen	**Technician:**	W. Demharter
Report Date:	November 15, 2012	**Analyst:**	J. Slater
		Approved by:	T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS T1L	BS T1L	BS T1L
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 8:59	11/7/12 8:59	11/7/12 8:59
Test Date / Time	11/14/12 10:08	11/14/12 10:12	11/14/12 10:16
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.87	7.89	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.01	4.03
Length / Diameter (L/D)	1.96	1.97	1.95
Cross-Sectional Area, in^2	12.69	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	92,200	90,600	90,400
Compressive Strength, psi	7,270	7,170	7,080
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,173

Report Notes

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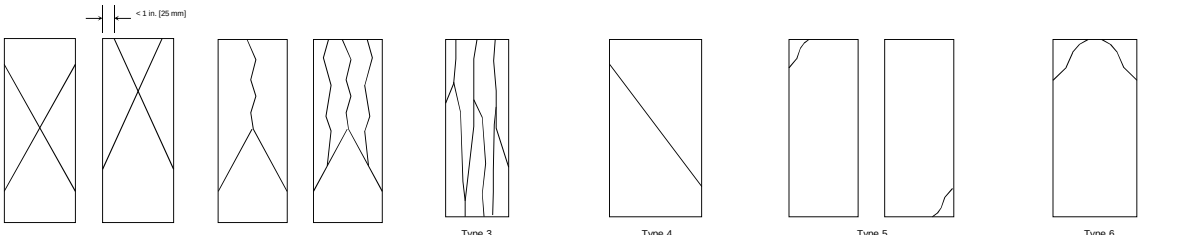
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 26, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter / B. Szczerowski
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS T1L	BS T1L	BS T1L
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 8:59	11/7/12 8:59	11/7/12 8:59
Test Date / Time	11/21/12 15:02	11/21/12 15:05	11/21/12 15:11
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.00	4.03
Diameter 2, in.	4.01	3.99	4.02
Length(without caps), in.	7.85	7.87	7.91
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.00	4.03
Length / Diameter (L/D)	1.96	1.97	1.96
Cross-Sectional Area, in^2	12.63	12.57	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	99,200	83,600	101,000
Compressive Strength, psi	7,850	6,650	7,920
Fracture Pattern	Type 1	Type 3	Type 3

Average Compressive Strength, psi	7,473

Report Notes

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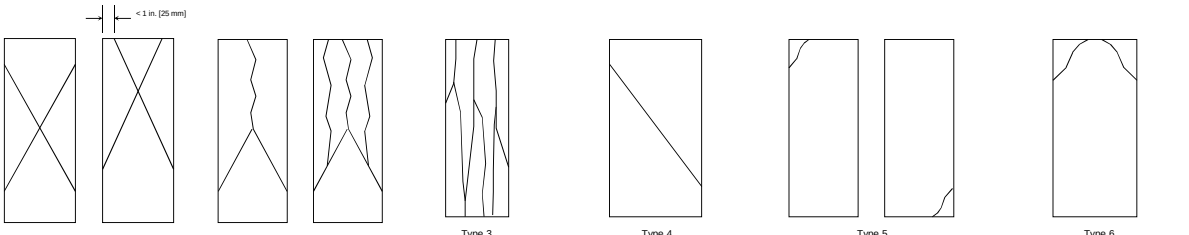
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 5, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS T1L	BS T1L	BS T1L
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 8:59	11/7/12 8:59	11/7/12 8:59
Test Date / Time	12/5/12 11:04	12/5/12 11:08	12/5/12 11:12
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	4.00	4.02	3.99
Length(without caps), in.	7.86	7.88	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.00
Length / Diameter (L/D)	1.96	1.96	1.97
Cross-Sectional Area, in^2	12.63	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	108,000	110,500	107,000
Compressive Strength, psi	8,550	8,710	8,510
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	8,590

Report Notes

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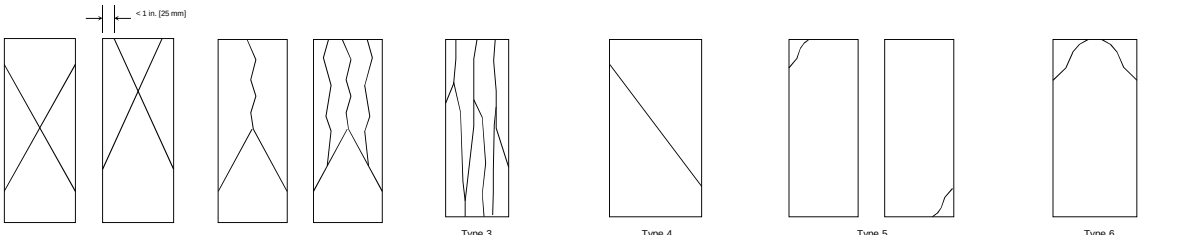
Schematic of Typical Fracture Patterns



Type 1
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 OPC	Toll BS-F2 OPC	Toll BS-F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 12:46	10/17/12 12:46	10/17/12 12:46
Test Date / Time	10/18/12 13:03	10/18/12 13:06	10/18/12 13:10
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.02	4.02	4.01
Diameter 2, in.	4.00	4.01	3.99
Length(without caps), in.	8.08	8.10	8.06
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.00
Length / Diameter (L/D)	2.01	2.01	2.01
Cross-Sectional Area, in^2	12.63	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	33,600	34,000	34,400
Compressive Strength, psi	2,660	2,680	2,740
Fracture Pattern	Type 5	Type 4	Type 5

Average Compressive Strength, psi	2,693

Report Notes

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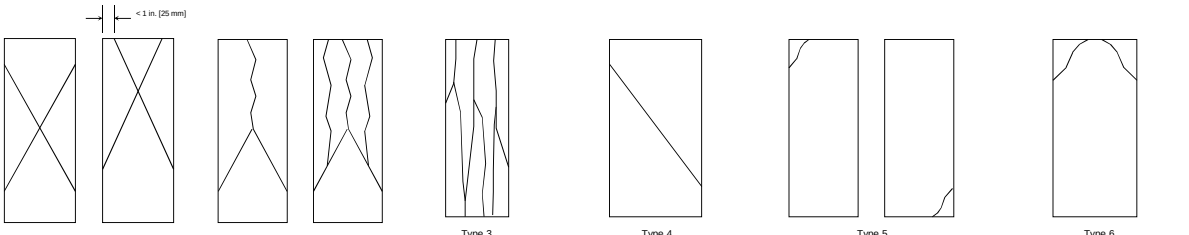
Schematic of Typical Fracture Patterns



Type 1
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Type 3
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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 OPC	Toll BS-F2 OPC	Toll BS-F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 12:46	10/17/12 12:46	10/17/12 12:46
Test Date / Time	10/20/12 10:45	10/20/12 10:50	10/20/12 10:55
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	4.01	4.03
Diameter 2, in.	4.01	4.04	4.01
Length(without caps), in.	7.83	7.80	7.84
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.03	4.02
Length / Diameter (L/D)	1.95	1.94	1.95
Cross-Sectional Area, in^2	12.69	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	64,180	61,460	54,956
Compressive Strength, psi	5,060	4,820	4,330
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,737

Report Notes

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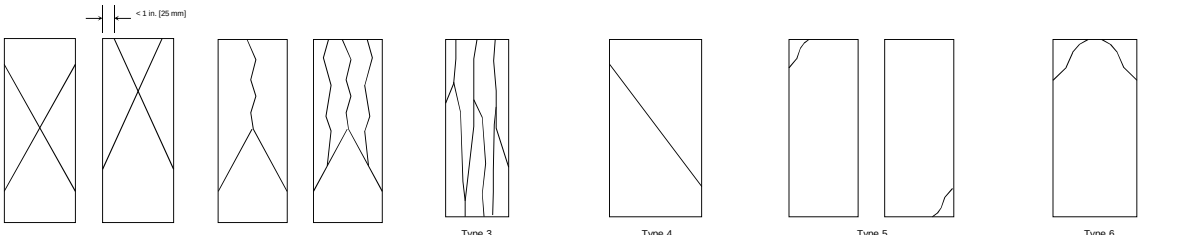
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 OPC	Toll BS-F2 OPC	Toll BS-F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 12:46	10/17/12 12:46	10/17/12 12:46
Test Date / Time	10/24/12 13:51	10/24/12 13:54	10/24/12 13:58
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.03
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.91	7.87	7.86
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.00	4.02
Length / Diameter (L/D)	1.96	1.97	1.96
Cross-Sectional Area, in^2	12.76	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	76,191	69,239	63,416
Compressive Strength, psi	5,970	5,510	5,000
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,493

Report Notes

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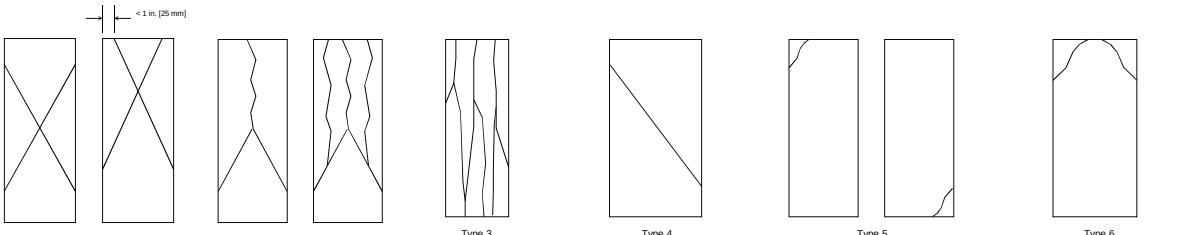
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll BS-F2 OPC	Toll BS-F2 OPC	Toll BS-F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 12:46	10/17/12 12:46	10/17/12 12:46
Test Date / Time	11/14/12 15:36	11/14/12 15:40	11/14/12 15:44
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	4.02	4.03
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	7.91	7.89	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.96	1.97	1.96
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

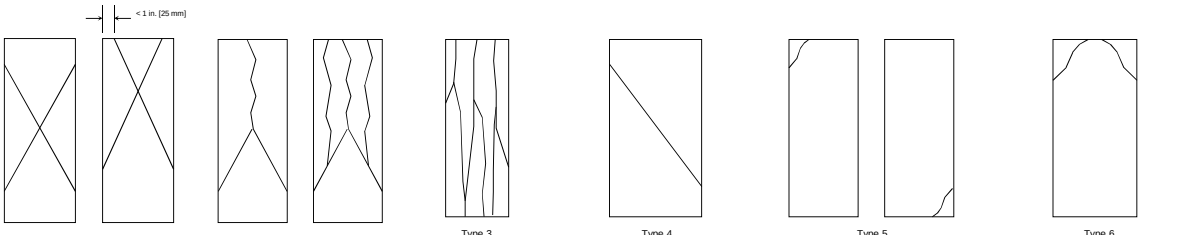
Maximum Load, lb	95,000	92,000	94,000
Compressive Strength, psi	7,450	7,280	7,410
Fracture Pattern	Type 1	Type 1	Type 2

Average Compressive Strength, psi	7,380

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 9, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS OPC	BS OPC	BS OPC
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 10:33	11/7/12 10:33	11/7/12 10:33
Test Date / Time	11/8/12 10:03	11/8/12 10:07	11/8/12 10:12
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.01
Diameter 2, in.	4.01	4.02	4.00
Length(without caps), in.	8.07	8.05	8.07
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.03	4.00
Length / Diameter (L/D)	2.01	2.00	2.02
Cross-Sectional Area, in^2	12.63	12.76	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	44,000	44,200	42,400
Compressive Strength, psi	3,480	3,460	3,370
Fracture Pattern	Type 2	Type 2	Type 2

Average Compressive Strength, psi	3,437

Report Notes

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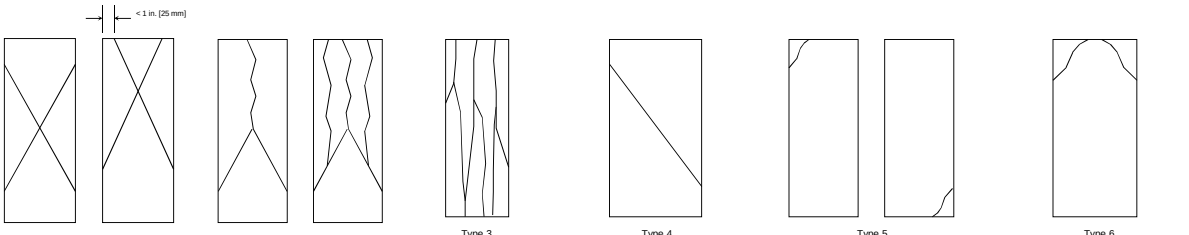
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 12, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS OPC	BS OPC	BS OPC
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 10:33	11/7/12 10:33	11/7/12 10:33
Test Date / Time	11/10/12 10:30	11/10/12 10:35	11/10/12 10:40
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.01	3.98
Diameter 2, in.	4.00	4.01	4.00
Length(without caps), in.	7.92	7.90	7.93
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.01	3.99
Length / Diameter (L/D)	1.98	1.97	1.99
Cross-Sectional Area, in^2	12.63	12.63	12.50
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	71,200	70,800	72,400
Compressive Strength, psi	5,640	5,610	5,790
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,680

Report Notes

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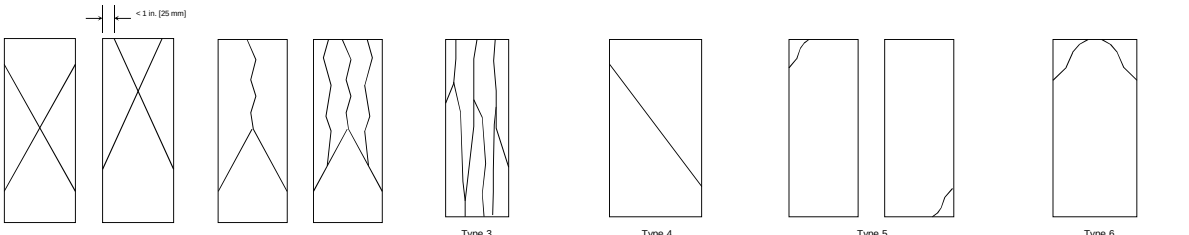
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS OPC	BS OPC	BS OPC
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 10:33	11/7/12 10:33	11/7/12 10:33
Test Date / Time	11/14/12 9:55	11/14/12 10:00	11/14/12 10:04
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.04	4.01
Diameter 2, in.	4.01	4.02	4.00
Length(without caps), in.	7.84	7.81	7.83
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.03	4.00
Length / Diameter (L/D)	1.95	1.94	1.96
Cross-Sectional Area, in^2	12.63	12.76	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	86,200	88,800	88,400
Compressive Strength, psi	6,830	6,960	7,030
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,940

Report Notes

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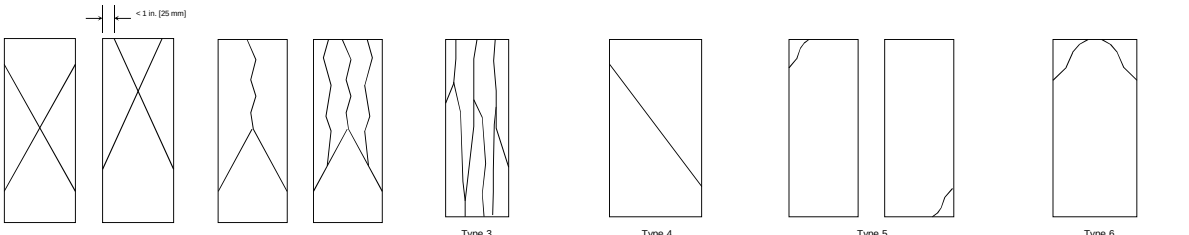
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 26, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter / B. Szczerowski
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS OPC	BS OPC	BS OPC
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 10:33	11/7/12 10:33	11/7/12 10:33
Test Date / Time	11/21/12 15:16	11/21/12 15:20	11/21/12 15:27
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.03	3.99	4.01
Length(without caps), in.	7.82	7.84	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.00	4.01
Length / Diameter (L/D)	1.94	1.96	1.96
Cross-Sectional Area, in^2	12.76	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	101,000	97,800	98,400
Compressive Strength, psi	7,920	7,780	7,790
Fracture Pattern	Type 3	Type 3	Type 1

Average Compressive Strength, psi	7,830

Report Notes

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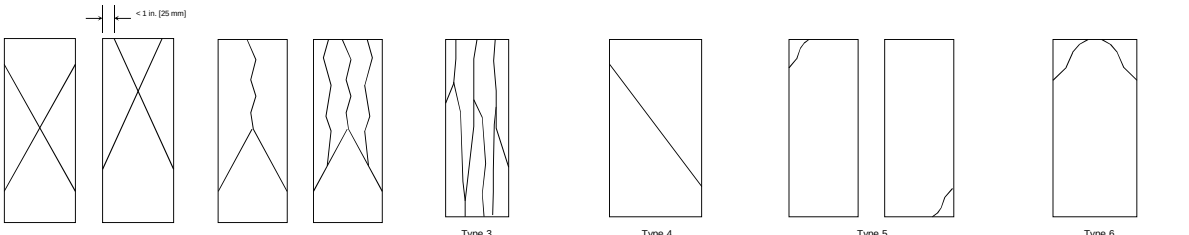
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 5, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	BS OPC	BS OPC	BS OPC
Client Identification	N/A	N/A	N/A
Casting Date	11/7/12 10:33	11/7/12 10:33	11/7/12 10:33
Test Date / Time	12/5/12 11:16	12/5/12 11:20	12/5/12 11:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.03
Diameter 2, in.	4.00	4.01	4.01
Length(without caps), in.	7.91	7.87	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.02
Length / Diameter (L/D)	1.97	1.96	1.96
Cross-Sectional Area, in^2	12.63	12.69	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	110,000	108,000	109,500
Compressive Strength, psi	8,710	8,510	8,630
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	8,617

Report Notes

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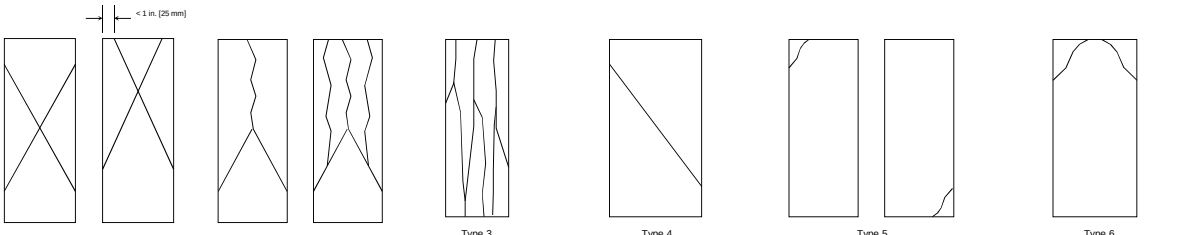
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 T1L	Toll SRA -F2 T1L	Toll SRA -F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:33	10/17/12 10:33	10/17/12 10:33
Test Date / Time	10/18/12 11:50	10/18/12 11:55	10/18/12 12:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	3.98	4.00	4.02
Diameter 2, in.	4.01	4.02	4.00
Length(without caps), in.	8.04	8.05	8.03
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	3.99	4.01	4.01
Length / Diameter (L/D)	2.02	2.01	2.00
Cross-Sectional Area, in^2	12.50	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	26,800	26,200	26,000
Compressive Strength, psi	2,140	2,070	2,060
Fracture Pattern	Type 5	Type 5	Type 5

Average Compressive Strength, psi	2,090

Report Notes

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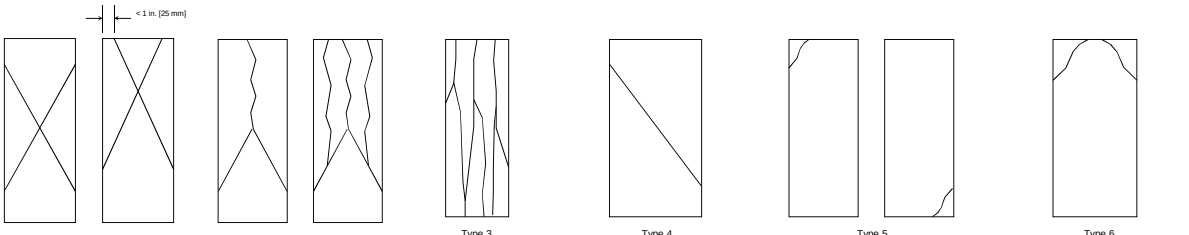
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 T1L	Toll SRA -F2 T1L	Toll SRA -F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:33	10/17/12 10:33	10/17/12 10:33
Test Date / Time	10/20/12 10:25	10/20/12 10:30	10/20/12 10:40
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.00	4.04
Diameter 2, in.	4.02	4.03	3.98
Length(without caps), in.	7.89	7.88	7.86
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.02	4.01
Length / Diameter (L/D)	1.96	1.96	1.96
Cross-Sectional Area, in^2	12.69	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	63,687	62,254	63,149
Compressive Strength, psi	5,020	4,910	5,000
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,977

Report Notes

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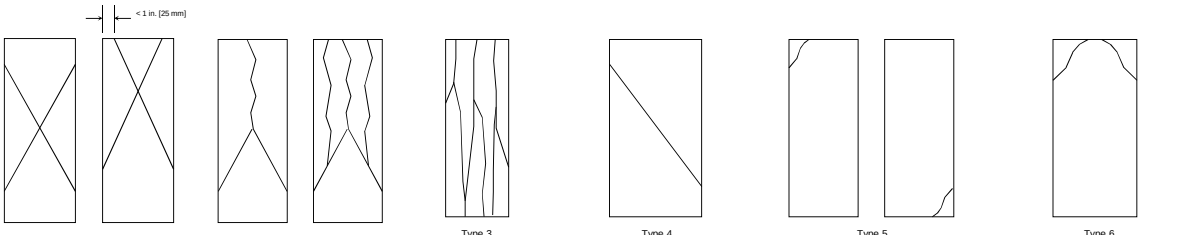
Schematic of Typical Fracture Patterns



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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 T1L	Toll SRA -F2 T1L	Toll SRA -F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:33	10/17/12 10:33	10/17/12 10:33
Test Date / Time	10/24/12 13:40	10/24/12 13:44	10/24/12 13:47
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.02
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.89	7.89	7.85
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.96	1.97	1.95
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	78,176	75,785	73,032
Compressive Strength, psi	6,130	6,000	5,760
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,963

Report Notes

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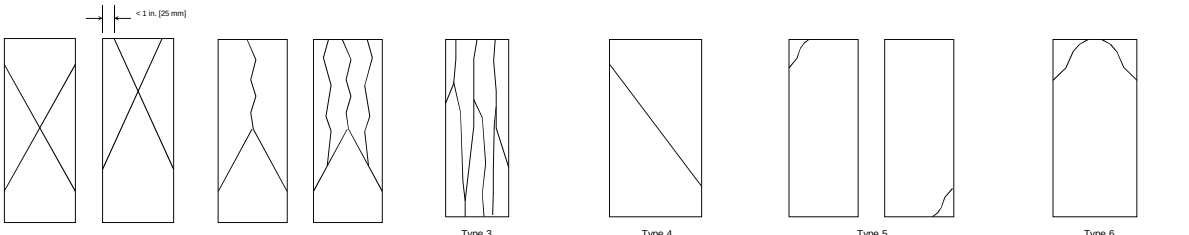
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 T1L	Toll SRA -F2 T1L	Toll SRA -F2 T1L
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 10:33	10/17/12 10:33	10/17/12 10:33
Test Date / Time	11/14/12 15:24	11/14/12 15:28	11/14/12 15:32
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.00	4.00	4.01
Length(without caps), in.	7.87	7.85	7.80
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.01	4.02
Length / Diameter (L/D)	1.96	1.96	1.94
Cross-Sectional Area, in^2	12.63	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	98,200	97,400	97,600
Compressive Strength, psi	7,780	7,710	7,690
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,727

Report Notes

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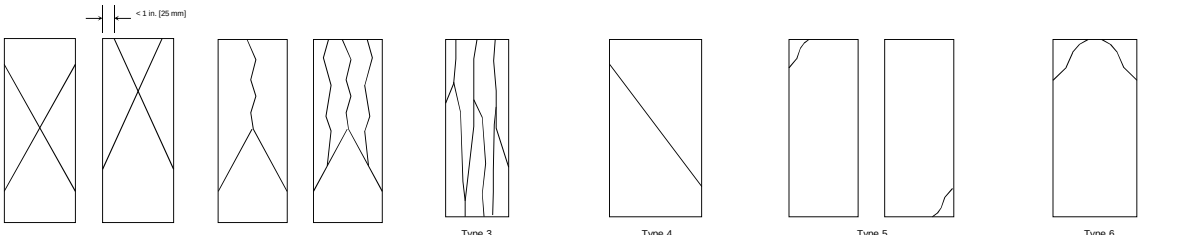
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date:

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA T1L Lab	SRA T1L Lab	SRA T1L Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 13:33	12/19/12 13:33	12/19/12 13:33
Test Date / Time	12/20/12 13:30	12/20/12 13:35	12/20/12 13:39
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.01
Diameter 2, in.	4.00	4.01	3.99
Length(without caps), in.	7.99	8.04	8.01
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.00
Length / Diameter (L/D)	6.00	6.02	6.00
Cross-Sectional Area, in^2	12.63	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	24,200	24,400	24,000
Compressive Strength, psi	1,920	1,920	1,910
Fracture Pattern	Type 5	Type 6	Type 5

Average Compressive Strength, psi	1,917

Report Notes

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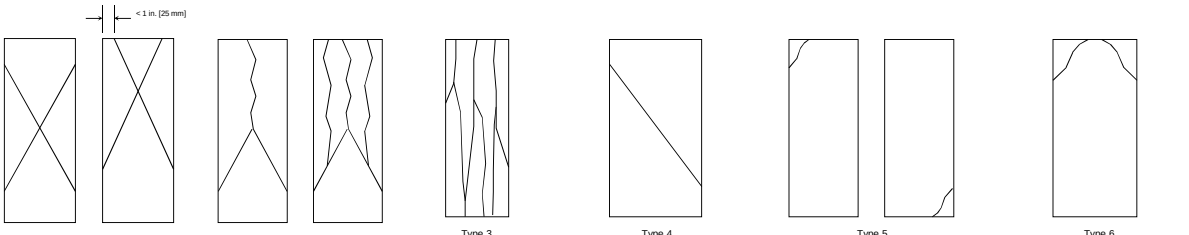
Schematic of Typical Fracture Patterns



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Type 4
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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA T1L Lab	SRA T1L Lab	SRA T1L Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 13:33	12/19/12 13:33	12/19/12 13:33
Test Date / Time	12/22/12 11:15	12/22/12 11:20	12/22/12 11:25
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.00	4.01
Diameter 2, in.	4.02	3.99	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.18	8.17
Average Diameter, in.	4.02	3.99	4.00
Length / Diameter (L/D)	2.04	2.05	2.04
Cross-Sectional Area, in^2	12.69	12.50	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	56,500	56,000	57,000
Compressive Strength, psi	4,450	4,480	4,530
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,487

Report Notes

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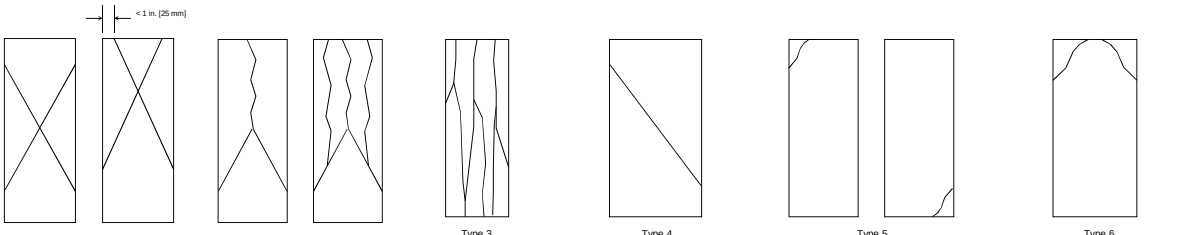
Schematic of Typical Fracture Patterns



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Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA T1L Lab	SRA T1L Lab	SRA T1L Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 13:33	12/19/12 13:33	12/19/12 13:33
Test Date / Time	12/26/12 17:50	12/26/12 16:54	12/26/12 18:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.02	4.03
Diameter 2, in.	4.00	4.00	4.01
Length(without caps), in.	7.92	7.87	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.01	4.02
Length / Diameter (L/D)	1.97	1.96	1.96
Cross-Sectional Area, in^2	12.63	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	72,000	70,500	74,500
Compressive Strength, psi	5,700	5,580	5,870
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,717

Report Notes

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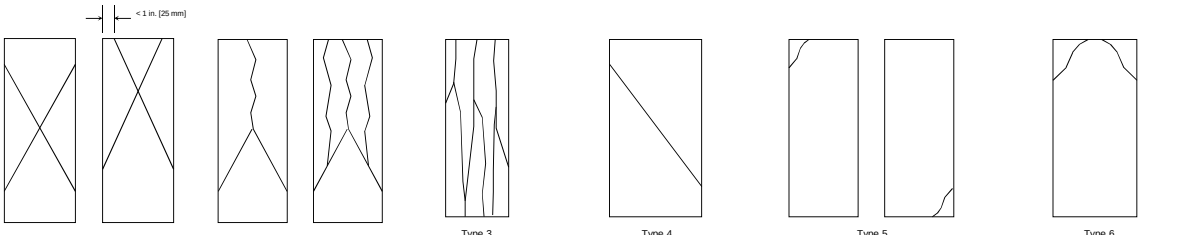
Schematic of Typical Fracture Patterns



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Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 3, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA T1L Lab	SRA T1L Lab	SRA T1L Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 13:33	12/19/12 13:33	12/19/12 13:33
Test Date / Time	1/2/13 16:56	1/2/13 17:00	1/2/13 17:07
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	4.00	4.01	4.00
Length(without caps), in.	7.88	7.86	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.01	4.01
Length / Diameter (L/D)	1.96	1.96	1.97
Cross-Sectional Area, in^2	12.63	12.63	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	81,000	83,200	82,200
Compressive Strength, psi	6,410	6,590	6,510
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,503

Report Notes

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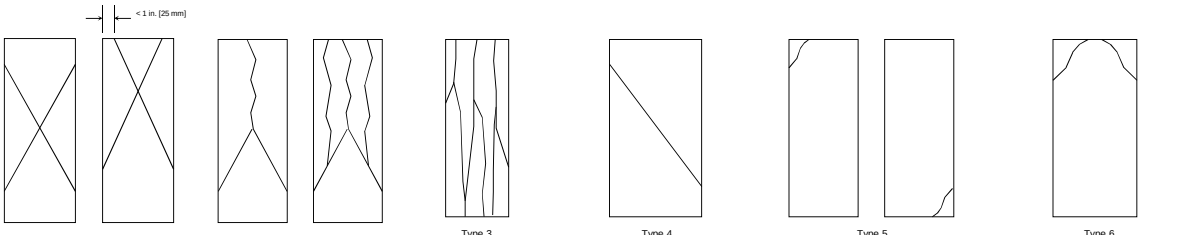
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 17, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA T1L Lab	SRA T1L Lab	SRA T1L Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 13:33	12/19/12 13:33	12/19/12 13:33
Test Date / Time	1/16/13 16:20	1/16/13 16:25	1/16/13 16:30
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.01	4.02
Diameter 2, in.	4.02	4.00	4.01
Length(without caps), in.	7.92	7.88	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.00	4.02
Length / Diameter (L/D)	1.97	1.97	1.96
Cross-Sectional Area, in^2	12.69	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	93,600	92,400	95,000
Compressive Strength, psi	7,380	7,350	7,490
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,407

Report Notes

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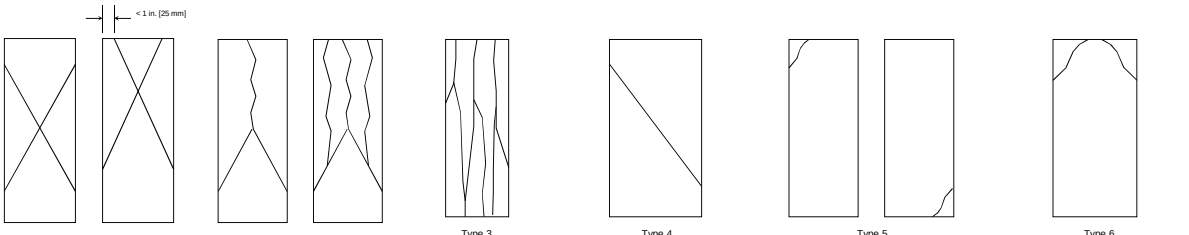
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 18, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 OPC	Toll SRA -F2 OPC	Toll SRA -F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 14:18	10/17/12 14:18	10/17/12 14:18
Test Date / Time	10/18/12 14:15	10/18/12 14:19	10/18/12 14:24
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.02	4.00	4.01
Length(without caps), in.	8.03	8.06	8.06
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.01	4.02
Length / Diameter (L/D)	2.00	2.01	2.00
Cross-Sectional Area, in^2	12.69	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	20,200	20,800	20,800
Compressive Strength, psi	1,590	1,650	1,640
Fracture Pattern	Type 5	Type 5	Type 5

Average Compressive Strength, psi	1,627

Report Notes

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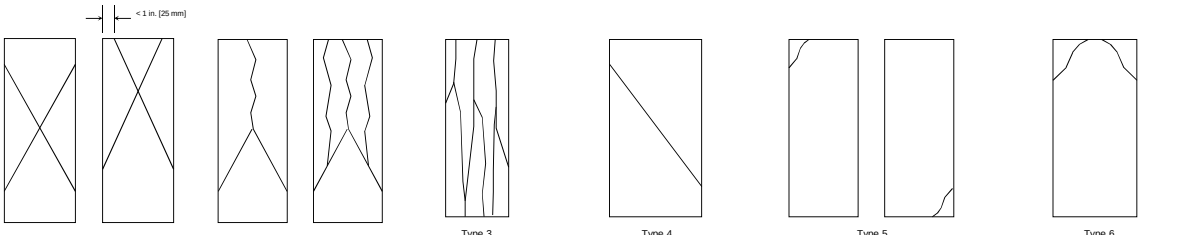
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 22, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 OPC	Toll SRA -F2 OPC	Toll SRA -F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 14:18	10/17/12 14:18	10/17/12 14:18
Test Date / Time	10/20/12 11:02	10/20/12 11:08	10/20/12 11:12
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.02	4.00
Diameter 2, in.	4.03	4.02	4.02
Length(without caps), in.	7.84	7.87	7.74
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.02	4.01
Length / Diameter (L/D)	1.95	1.96	1.93
Cross-Sectional Area, in^2	12.69	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	57,732	53,459	57,502
Compressive Strength, psi	4,550	4,210	4,550
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,437

Report Notes

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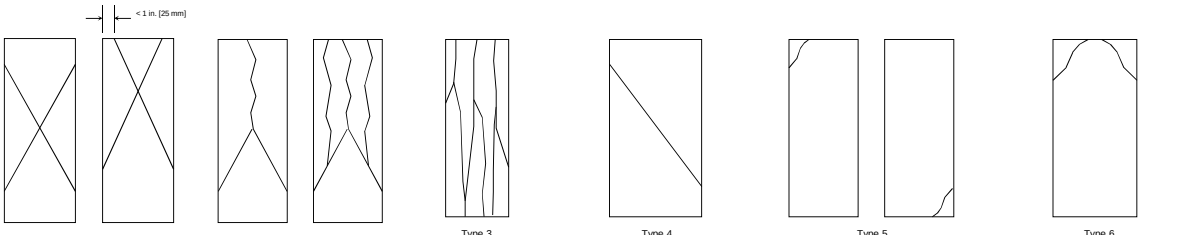
Schematic of Typical Fracture Patterns



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Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: October 24, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 OPC	Toll SRA -F2 OPC	Toll SRA -F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 14:18	10/17/12 14:18	10/17/12 14:18
Test Date / Time	10/24/12 14:00	10/24/12 14:04	10/24/12 14:07
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.00	4.02
Diameter 2, in.	4.00	3.99	4.03
Length(without caps), in.	7.90	7.88	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.00	4.02
Length / Diameter (L/D)	1.97	1.97	1.96
Cross-Sectional Area, in^2	12.57	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	54,852	57,494	42,941
Compressive Strength, psi	4,360	4,570	3,380
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,103

Report Notes

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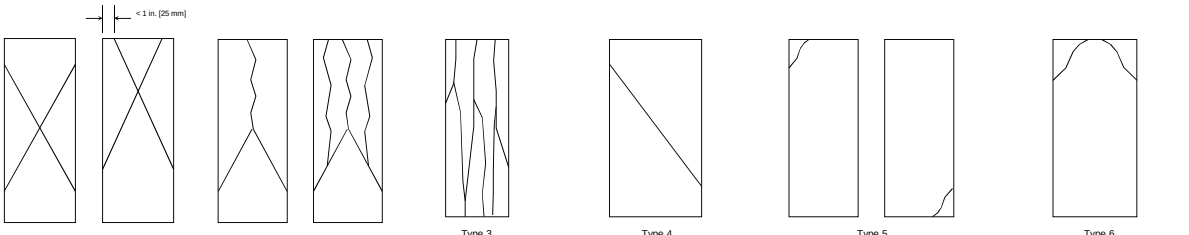
Schematic of Typical Fracture Patterns



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Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	Toll SRA -F2 OPC	Toll SRA -F2 OPC	Toll SRA -F2 OPC
Client Identification	N/A	N/A	N/A
Casting Date	10/17/12 14:18	10/17/12 14:18	10/17/12 14:18
Test Date / Time	11/14/12 15:48	11/14/12 15:52	11/14/12 15:56
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.02
Diameter 2, in.	4.01	4.02	4.02
Length(without caps), in.	7.85	7.87	7.81
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.03	4.02
Length / Diameter (L/D)	1.96	1.95	1.94
Cross-Sectional Area, in^2	12.63	12.76	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	89,100	88,000	91,800
Compressive Strength, psi	7,050	6,900	7,230
Fracture Pattern	Type 2	Type 1	Type 2

Average Compressive Strength, psi	7,060

Report Notes

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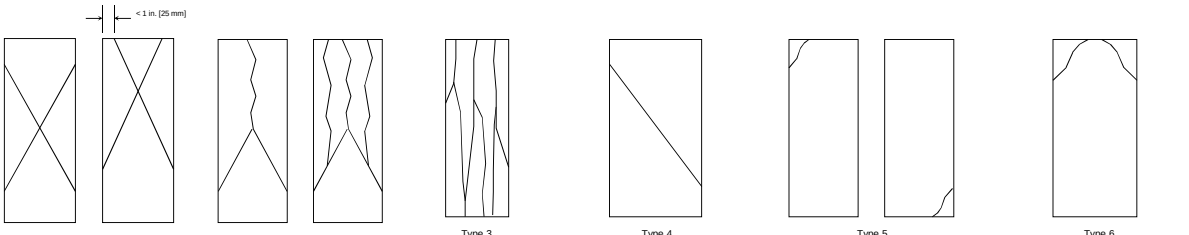
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 20, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA OPC Lab	SRA OPC Lab	SRA OPC Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 10:57	12/19/12 10:57	12/19/12 10:57
Test Date / Time	12/20/12 10:40	12/20/12 10:44	12/20/12 10:49
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.04	4.03	4.02
Diameter 2, in.	4.02	4.01	4.01
Length(without caps), in.	8.06	8.02	8.03
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.02	4.02
Length / Diameter (L/D)	2.00	1.99	2.00
Cross-Sectional Area, in^2	12.76	12.69	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	30,800	29,200	29,800
Compressive Strength, psi	2,410	2,300	2,350
Fracture Pattern	Type 5	Type 6	Type 6

Average Compressive Strength, psi	2,353

Report Notes

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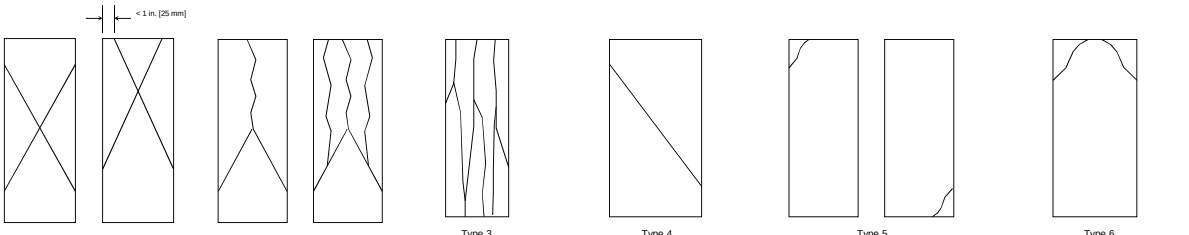
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA OPC Lab	SRA OPC Lab	SRA OPC Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 10:57	12/19/12 10:57	12/19/12 10:57
Test Date / Time	12/22/12 11:00	12/22/12 11:05	12/22/12 11:10
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	3.98	4.02	4.01
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.18	8.18	8.17
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	2.05	2.03	2.04
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	69,000	67,000	67,500
Compressive Strength, psi	5,490	5,280	5,340
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,370

Report Notes

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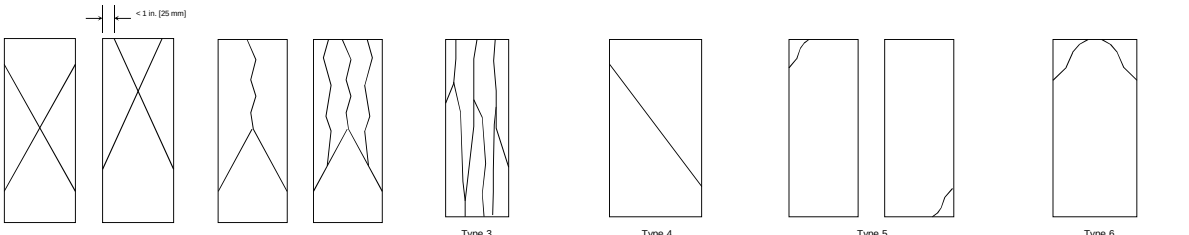
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA OPC Lab	SRA OPC Lab	SRA OPC Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 10:57	12/19/12 10:57	12/19/12 10:57
Test Date / Time	12/26/12 16:11	12/26/12 16:15	12/26/12 16:20
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.02
Diameter 2, in.	4.01	4.00	4.01
Length(without caps), in.	7.89	7.85	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.01	4.02
Length / Diameter (L/D)	1.96	1.96	1.96
Cross-Sectional Area, in^2	12.69	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	82,500	83,000	82,000
Compressive Strength, psi	6,500	6,570	6,460
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,510

Report Notes

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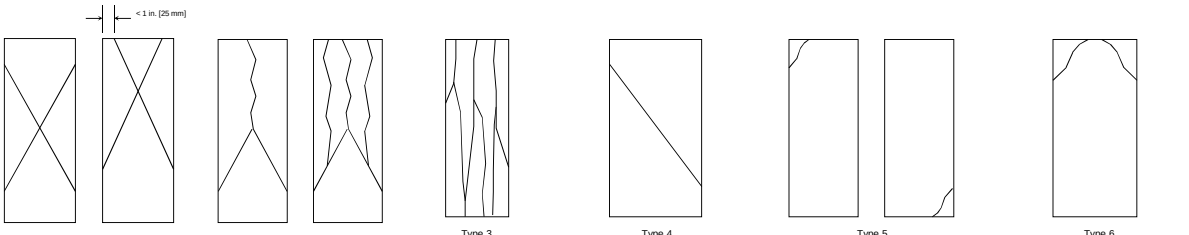
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 3, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA OPC Lab	SRA OPC Lab	SRA OPC Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 10:57	12/19/12 10:57	12/19/12 10:57
Test Date / Time	1/2/13 16:40	1/2/13 16:44	1/2/13 16:50
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	3.99	4.01	4.03
Diameter 2, in.	4.00	4.00	4.02
Length(without caps), in.	7.87	7.87	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	3.99	4.01	4.03
Length / Diameter (L/D)	1.97	1.96	1.96
Cross-Sectional Area, in^2	12.50	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	92,600	95,800	96,000
Compressive Strength, psi	7,410	7,590	7,520
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,507

Report Notes

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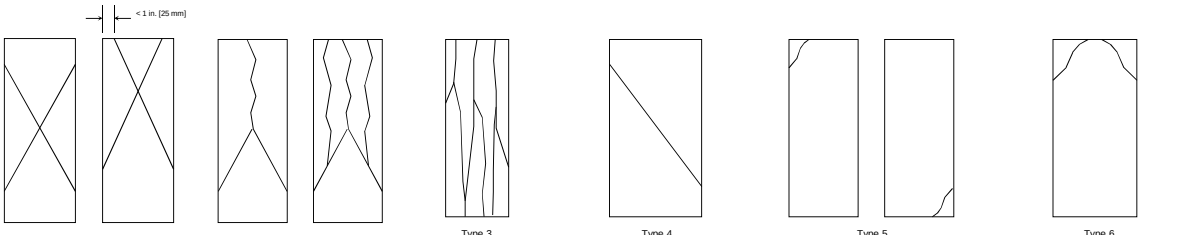
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 17, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SRA OPC Lab	SRA OPC Lab	SRA OPC Lab
Client Identification	N/A	N/A	N/A
Casting Date	12/19/12 10:57	12/19/12 10:57	12/19/12 10:57
Test Date / Time	1/16/13 16:36	1/16/13 16:40	1/16/13 16:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.00	4.01
Diameter 2, in.	4.01	3.99	4.00
Length(without caps), in.	7.89	7.91	7.86
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	3.99	4.01
Length / Diameter (L/D)	1.96	1.98	1.96
Cross-Sectional Area, in^2	12.69	12.50	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	99,000	98,600	100,200
Compressive Strength, psi	7,800	7,890	7,930
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,873

Report Notes

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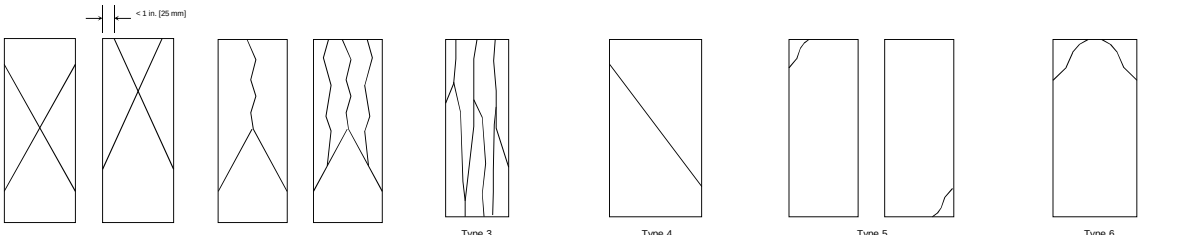
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 15, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	P-SLA	P-SLA	P-SLA
Client Identification	N/A	N/A	N/A
Casting Date	11/14/12 12:06	11/14/12 12:06	11/14/12 12:06
Test Date / Time	11/15/12 11:30	11/15/12 11:33	11/15/12 11:36
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.02	3.99	4.02
Length(without caps), in.	8.04	8.10	8.07
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.00	4.02
Length / Diameter (L/D)	2.00	2.02	2.01
Cross-Sectional Area, in^2	12.76	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	26,000	27,400	27,800
Compressive Strength, psi	2,040	2,180	2,190
Fracture Pattern	Type 5	Type 5	Type 5

Average Compressive Strength, psi	2,137

Report Notes

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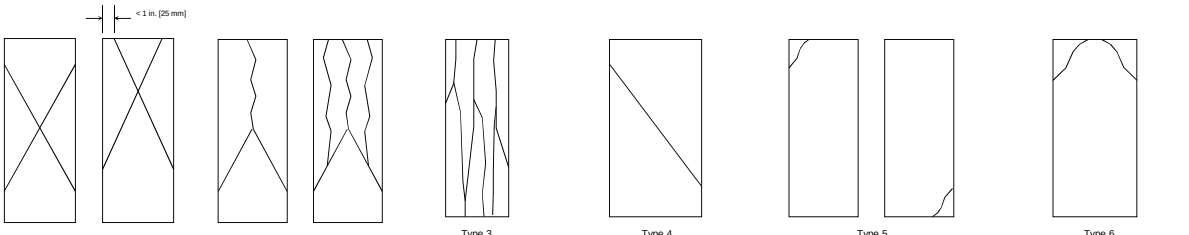
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client:	S.T.A.T.E Testing / Illinois Tollway	**CTLGroup Project No.:**	057122
Project:	HPC for Bridge Decks	**CTLGroup Project Mgr.:**	M. D'Ambrosia
Contact:	Mr. Steve Gillen	**Technician:**	G. Neiweem
Report Date:	November 19, 2012	**Analyst:**	J. Slater
		Approved by:	T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	P-SLA	P-SLA	P-SLA
Client Identification	N/A	N/A	N/A
Casting Date	11/14/12 12:06	11/14/12 12:06	11/14/12 12:06
Test Date / Time	11/17/12 10:30	11/17/12 10:33	11/17/12 10:36
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	3.98	4.01	4.07
Diameter 2, in.	4.02	4.03	3.98
Length(without caps), in.	7.74	7.80	7.84
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.03
Length / Diameter (L/D)	1.93	1.94	1.95
Cross-Sectional Area, in^2	12.57	12.69	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	52,800	57,400	56,000
Compressive Strength, psi	4,200	4,520	4,390
Fracture Pattern	Type 2	Type 1	Type 1

Average Compressive Strength, psi	4,370

Report Notes

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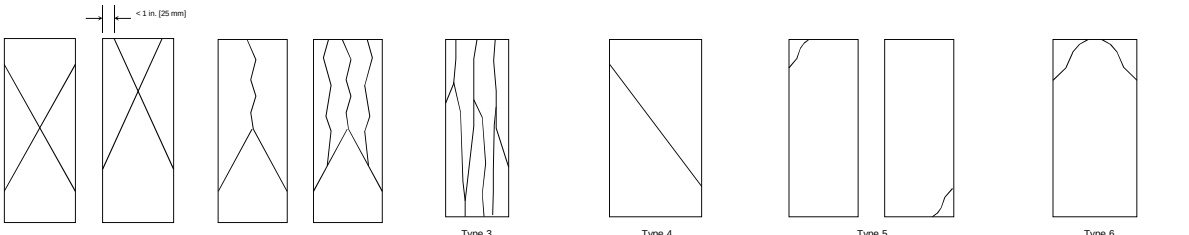
Schematic of Typical Fracture Patterns



Type 1
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client:	S.T.A.T.E Testing / Illinois Tollway	**CTLGroup Project No.:**	057122
Project:	HPC for Bridge Decks	**CTLGroup Project Mgr.:**	M. D'Ambrosia
Contact:	Mr. Steve Gillen	**Technician:**	W. Demharter / B. Szczerowski
Report Date:	November 26, 2012	**Analyst:**	J. Slater
		Approved by:	T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	P-SLA	P-SLA	P-SLA
Client Identification	N/A	N/A	N/A
Casting Date	11/14/12 12:06	11/14/12 12:06	11/14/12 12:06
Test Date / Time	11/21/12 14:50	11/21/12 14:55	11/21/12 15:01
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.04	4.02	4.02
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.90	7.89	7.83
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.96	1.97	1.95
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	74,400	75,200	74,200
Compressive Strength, psi	5,830	5,950	5,850
Fracture Pattern	Type 3	Type 3	Type 3

Average Compressive Strength, psi	5,877

Report Notes

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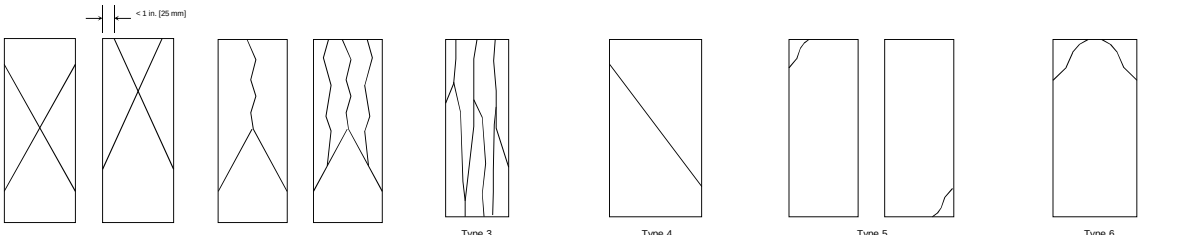
Schematic of Typical Fracture Patterns



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Type 2
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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 29, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	P-SLA	P-SLA	P-SLA
Client Identification	N/A	N/A	N/A
Casting Date	11/14/12 12:06	11/14/12 12:06	11/14/12 12:06
Test Date / Time	11/28/12 17:12	11/28/12 17:16	11/28/12 17:20
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.03
Diameter 2, in.	4.03	4.01	4.02
Length(without caps), in.	7.90	7.87	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	1.96	1.96	1.96
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

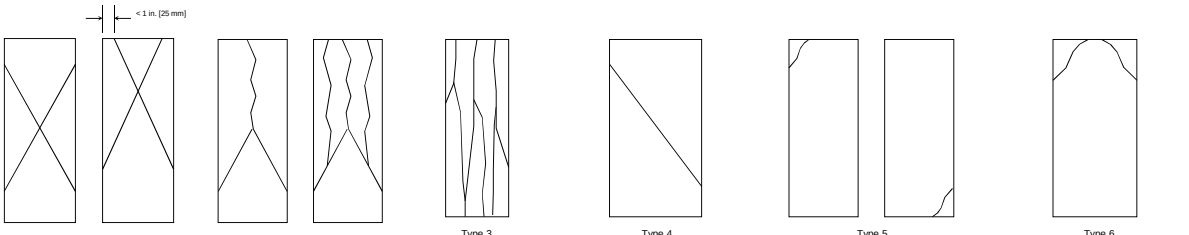
Maximum Load, lb	88,000	89,000	86,500
Compressive Strength, psi	6,900	7,050	6,820
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	6,923

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 13, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	P-SLA	P-SLA	P-SLA
Client Identification	N/A	N/A	N/A
Casting Date	11/14/12 12:06	11/14/12 12:06	11/14/12 12:06
Test Date / Time	12/12/12 16:05	12/12/12 16:10	12/12/12 16:15
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.04	4.01
Diameter 2, in.	4.01	4.02	4.00
Length(without caps), in.	7.86	7.89	7.91
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.03	4.00
Length / Diameter (L/D)	1.95	1.96	1.98
Cross-Sectional Area, in^2	12.69	12.76	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

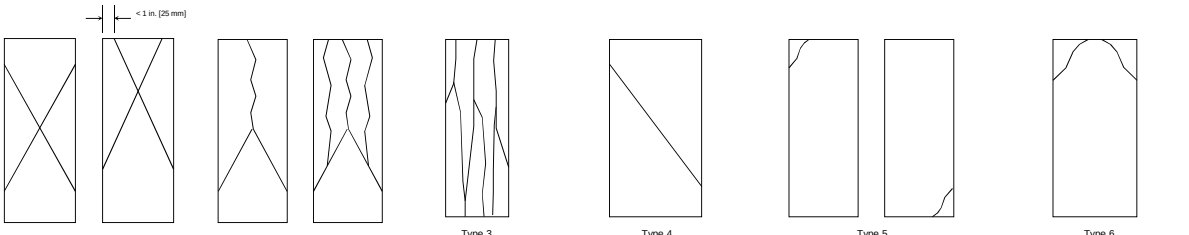
Maximum Load, lb	88,600	84,800	90,000
Compressive Strength, psi	6,980	6,650	7,160
Fracture Pattern	Type 1	Type 2	Type 1

Average Compressive Strength, psi	6,930

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: November 30, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA Lab	SLA Lab	SLA Lab
Client Identification	N/A	N/A	N/A
Casting Date	11/28/12 8:47	11/28/12 8:47	11/28/12 8:47
Test Date / Time	11/29/12 8:46	11/29/12 8:50	11/29/12 8:55
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.04	4.02	4.02
Diameter 2, in.	4.03	4.01	4.02
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.16	8.20	8.20
Average Diameter, in.	4.03	4.01	4.02
Length / Diameter (L/D)	2.03	2.04	2.04
Cross-Sectional Area, in^2	12.76	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

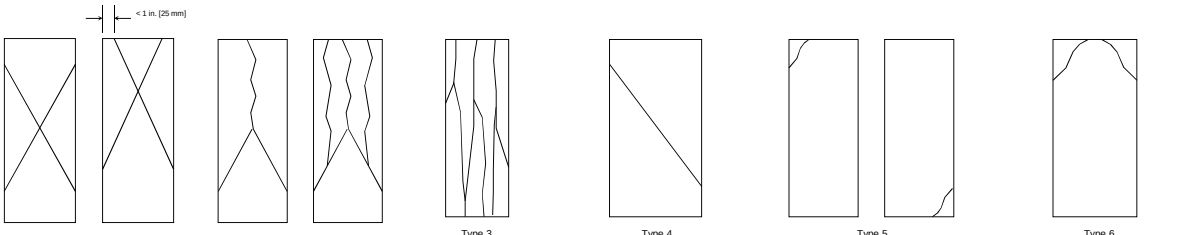
Maximum Load, lb	42,200	42,800	41,800
Compressive Strength, psi	3,310	3,390	3,290
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	3,330

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 3, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: G. Neiweem
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA Lab	SLA Lab	SLA Lab
Client Identification	N/A	N/A	N/A
Casting Date	11/28/12 8:47	11/28/12 8:47	11/28/12 8:47
Test Date / Time	12/1/12 10:30	12/1/12 10:40	12/1/12 10:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.02	3.99
Diameter 2, in.	4.02	4.01	4.04
Length(without caps), in.	7.83	7.88	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.02	4.01
Length / Diameter (L/D)	1.95	1.96	1.97
Cross-Sectional Area, in^2	12.69	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

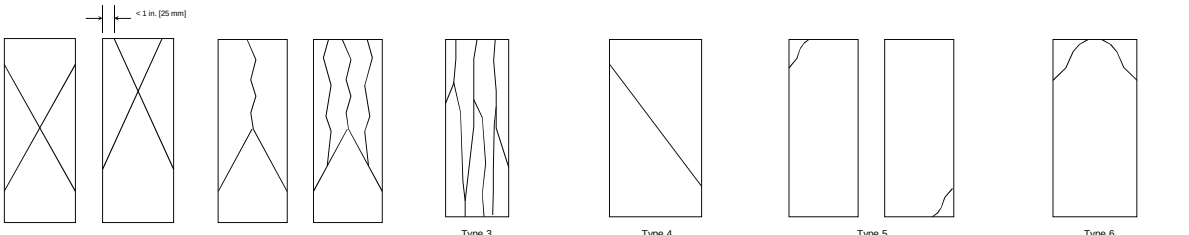
Maximum Load, lb	72,600	74,600	75,800
Compressive Strength, psi	5,720	5,880	6,000
Fracture Pattern	Type 4	Type 1	Type 2

Average Compressive Strength, psi	5,867

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 5, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA Lab	SLA Lab	SLA Lab
Client Identification	N/A	N/A	N/A
Casting Date	11/28/12 8:47	11/28/12 8:47	11/28/12 8:47
Test Date / Time	12/5/12 11:30	12/5/12 11:35	12/5/12 11:39
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.00	4.03	4.01
Diameter 2, in.	3.99	4.02	4.00
Length(without caps), in.	7.87	7.86	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.00
Length / Diameter (L/D)	1.97	1.95	1.97
Cross-Sectional Area, in^2	12.57	12.69	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	97,000	96,500	96,000
Compressive Strength, psi	7,720	7,600	7,640
Fracture Pattern	Type 1	Type 1	Type 2

Average Compressive Strength, psi	7,653

Report Notes

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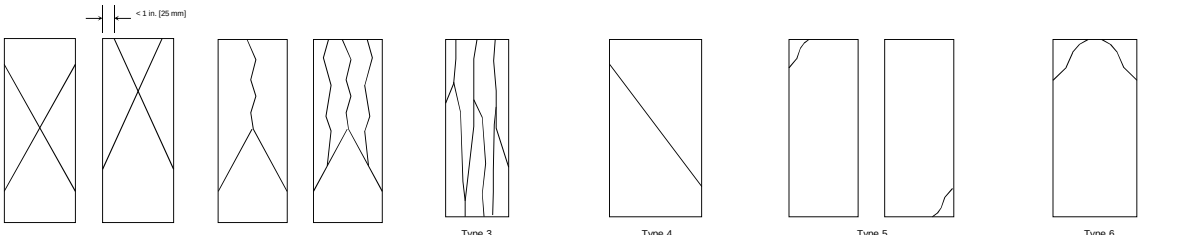
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: December 13, 2012

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA Lab	SLA Lab	SLA Lab
Client Identification	N/A	N/A	N/A
Casting Date	11/28/12 8:47	11/28/12 8:47	11/28/12 8:47
Test Date / Time	12/12/12 15:45	12/12/12 15:50	12/12/12 15:55
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.00	4.00	4.02
Diameter 2, in.	4.01	3.99	4.01
Length(without caps), in.	7.92	7.87	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.00	4.02
Length / Diameter (L/D)	1.97	1.97	1.96
Cross-Sectional Area, in^2	12.63	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	101,200	102,000	103,600
Compressive Strength, psi	8,010	8,110	8,160
Fracture Pattern	Type 1	Type 1	Type 2

Average Compressive Strength, psi	8,093

Report Notes

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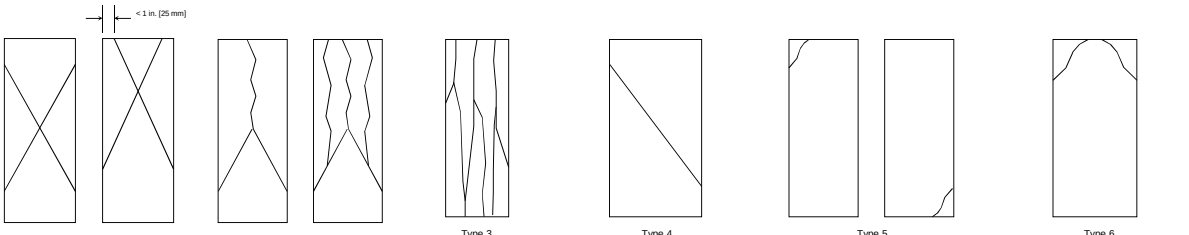
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	SLA Lab	SLA Lab	SLA Lab
Client Identification	N/A	N/A	N/A
Casting Date	11/28/12 8:47	11/28/12 8:47	11/28/12 8:47
Test Date / Time	12/26/12 17:35	12/26/12 16:40	12/26/12 16:44
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.00	4.03	4.04
Diameter 2, in.	4.02	4.00	4.02
Length(without caps), in.	7.88	7.92	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.01	4.03
Length / Diameter (L/D)	1.96	1.97	1.96
Cross-Sectional Area, in^2	12.63	12.63	12.76
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	94,500	100,000	97,500
Compressive Strength, psi	7,480	7,920	7,640
Fracture Pattern	Type 2	Type 2	Type 2

Average Compressive Strength, psi	7,680

Report Notes

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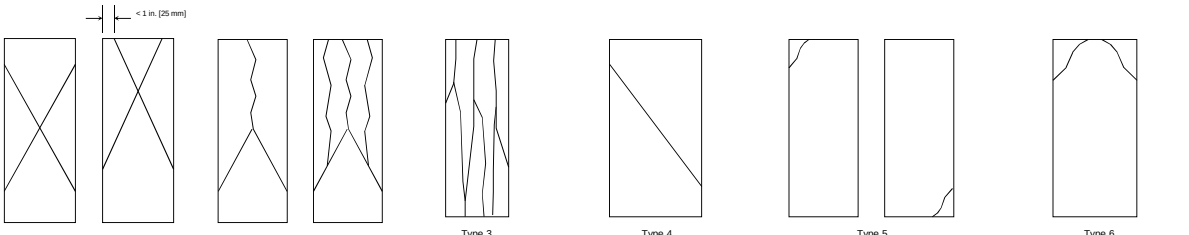
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-OZ-L	OPT-OZ-L	OPT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	12/28/12 13:53	12/28/12 13:57	12/28/12 14:01
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.01
Diameter 2, in.	3.99	4.02	4.01
Length(without caps), in.	8.04	8.00	8.06
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.03	4.01
Length / Diameter (L/D)	2.01	1.98	2.01
Cross-Sectional Area, in^2	12.57	12.76	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	7,200	7,000	7,000
Compressive Strength, psi	570	550	550
Fracture Pattern	Type 6	Type 6	Type 6

Average Compressive Strength, psi	557

Report Notes

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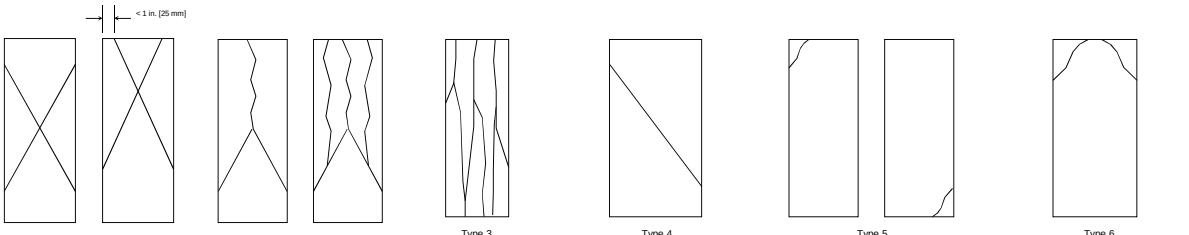
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-OZ-L	OPT-OZ-L	OPT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	12/31/12 8:50	12/31/12 8:56	12/31/12 9:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	4	4	4
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.01	4.04	4.02
Diameter 2, in.	3.99	4.02	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.21	8.20	8.22
Average Diameter, in.	4.00	4.03	4.01
Length / Diameter (L/D)	2.05	2.03	2.05
Cross-Sectional Area, in^2	12.57	12.76	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	43,800	46,800	46,000
Compressive Strength, psi	3,480	3,670	3,640
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	3,597

Report Notes

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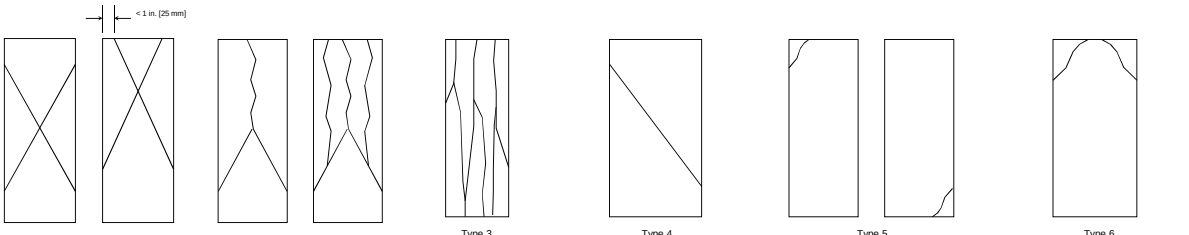
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 4, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-OZ-L	OPT-OZ-L	OPT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	1/3/13 17:00	1/3/13 17:04	1/3/13 17:08
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.04	4.01
Diameter 2, in.	4.01	4.03	4.01
Length(without caps), in.	7.90	7.87	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.03	4.01
Length / Diameter (L/D)	1.97	1.95	1.96
Cross-Sectional Area, in^2	12.69	12.76	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	61,400	61,000	59,000
Compressive Strength, psi	4,840	4,780	4,670
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,763

Report Notes

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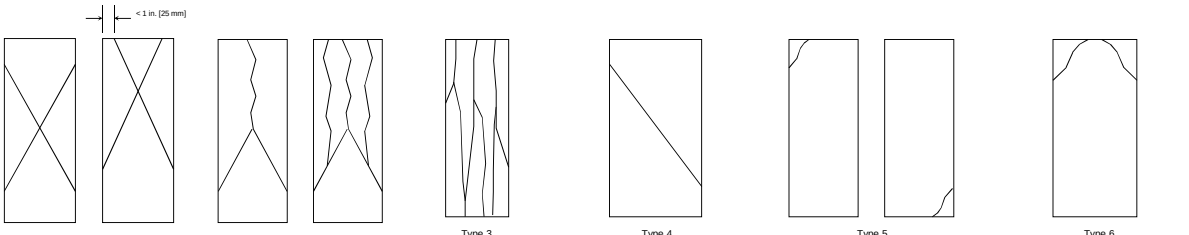
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 10, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-OZ-L	OPT-OZ-L	OPT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	1/10/13 10:46	1/10/13 10:50	1/10/13 10:55
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.03	4.02	4.03
Diameter 2, in.	4.01	4.01	4.02
Length(without caps), in.	7.88	7.86	7.90
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.01	4.02
Length / Diameter (L/D)	1.96	1.96	1.97
Cross-Sectional Area, in^2	12.69	12.63	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	75,200	73,600	74,200
Compressive Strength, psi	5,930	5,830	5,850
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,870

Report Notes

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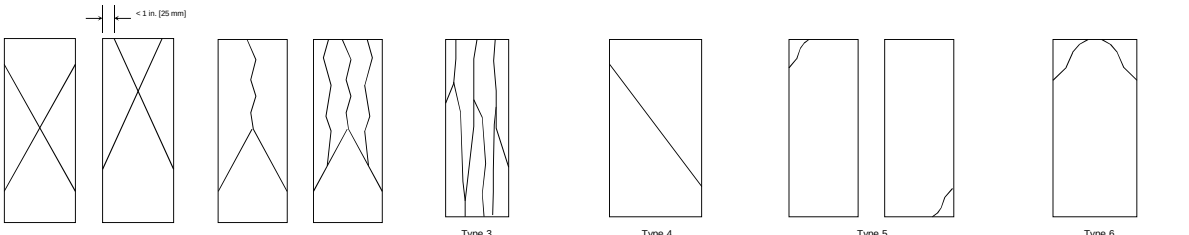
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 24, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT-OZ-L	OPT-OZ-L	OPT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	1/24/13 14:34	1/24/13 14:40	1/24/13 14:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.00	4.03	4.01
Diameter 2, in.	3.98	4.02	4.00
Length(without caps), in.	7.90	7.87	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	3.99	4.02	4.01
Length / Diameter (L/D)	1.98	1.96	1.97
Cross-Sectional Area, in^2	12.50	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	90,200	91,000	90,600
Compressive Strength, psi	7,220	7,170	7,170
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,187

Report Notes

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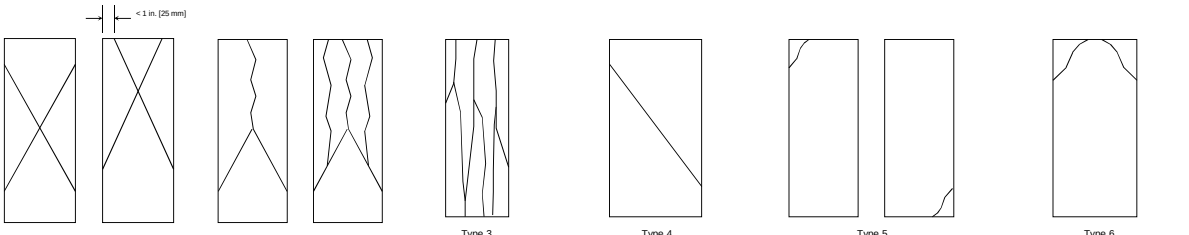
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 8, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT Lab	OPT Lab	OPT Lab
Client Identification	N/A	N/A	N/A
Casting Date	1/7/13 10:08	1/7/13 10:08	1/7/13 10:08
Test Date / Time	1/8/13 10:04	1/8/13 10:08	1/8/13 10:11
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	3.99	4.03	4.01
Diameter 2, in.	4.00	4.01	4.01
Length(without caps), in.	8.01	8.02	8.00
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	3.99	4.02	4.01
Length / Diameter (L/D)	2.01	1.99	2.00
Cross-Sectional Area, in^2	12.50	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	18,400	19,000	18,200
Compressive Strength, psi	1,470	1,500	1,440
Fracture Pattern	Type 5	Type 5	Type 5

Average Compressive Strength, psi	1,470

Report Notes

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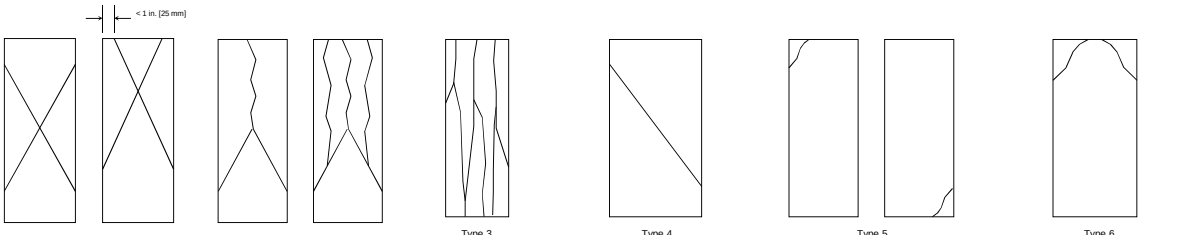
Schematic of Typical Fracture Patterns



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Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 10, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT Lab	OPT Lab	OPT Lab
Client Identification	N/A	N/A	N/A
Casting Date	1/7/13 10:08	1/7/13 10:08	1/7/13 10:08
Test Date / Time	1/10/13 11:00	1/10/13 11:05	1/10/13 11:13
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	3	3	3
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.02
Diameter 2, in.	4.01	4.02	4.01
Length(without caps), in.	7.83	7.90	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.02	4.01
Length / Diameter (L/D)	1.95	1.96	1.96
Cross-Sectional Area, in^2	12.63	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	55,000	56,200	56,000
Compressive Strength, psi	4,350	4,430	4,430
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	4,403

Report Notes

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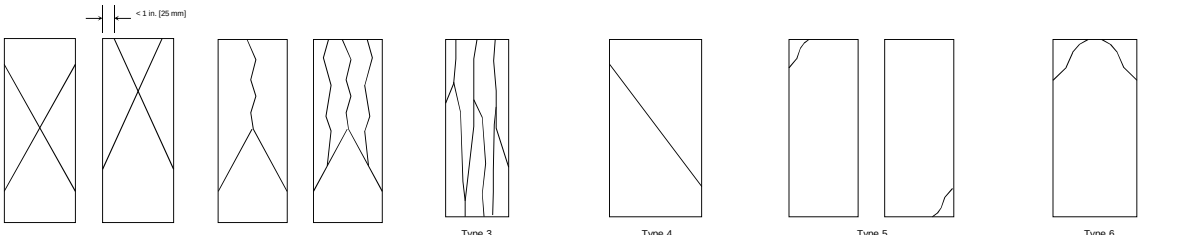
Schematic of Typical Fracture Patterns



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Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 15, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT Lab	OPT Lab	OPT Lab
Client Identification	N/A	N/A	N/A
Casting Date	1/7/13 10:08	1/7/13 10:08	1/7/13 10:08
Test Date / Time	1/14/13 15:50	1/14/13 15:55	1/14/13 16:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.01
Diameter 2, in.	3.99	4.01	4.00
Length(without caps), in.	7.93	7.89	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	1.98	1.96	1.96
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	75,200	73,800	74,000
Compressive Strength, psi	5,980	5,820	5,860
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	5,887

Report Notes

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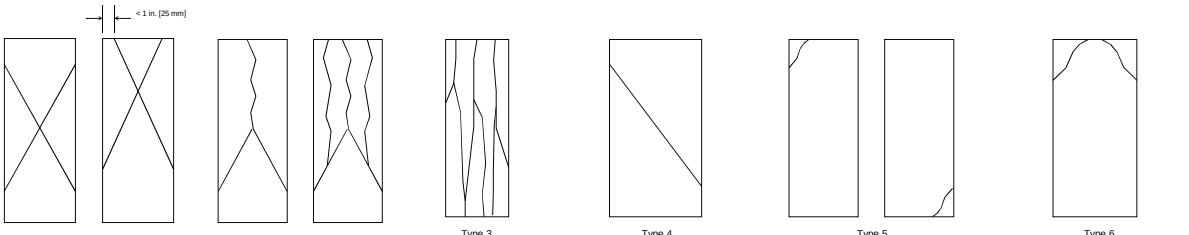
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 22, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT Lab	OPT Lab	OPT Lab
Client Identification	N/A	N/A	N/A
Casting Date	1/7/13 10:08	1/7/13 10:08	1/7/13 10:08
Test Date / Time	1/21/13 17:35	1/21/13 17:40	1/21/13 17:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.01	4.03
Diameter 2, in.	4.00	3.99	4.02
Length(without caps), in.	7.90	7.87	7.91
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.00	4.02
Length / Diameter (L/D)	1.97	1.97	1.97
Cross-Sectional Area, in^2	12.63	12.57	12.69
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	90,200	89,600	90,000
Compressive Strength, psi	7,140	7,130	7,090
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,120

Report Notes

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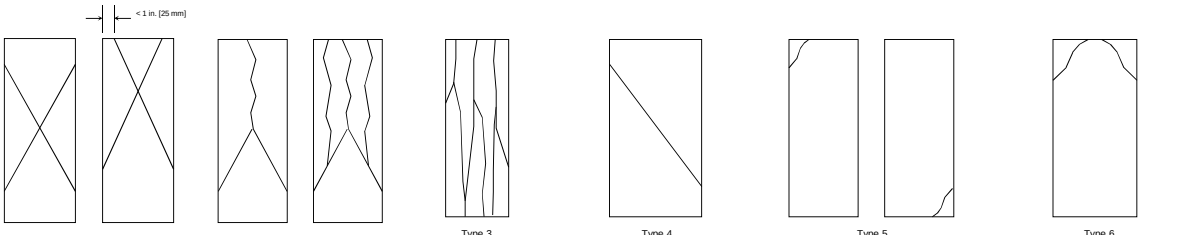
Schematic of Typical Fracture Patterns



Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: February 5, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	OPT Lab	OPT Lab	OPT Lab
Client Identification	N/A	N/A	N/A
Casting Date	1/7/13 10:08	1/7/13 10:08	1/7/13 10:08
Test Date / Time	2/4/13 17:50	2/4/13 17:55	2/4/13 18:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	28	28	28
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.02	4.03	4.00
Diameter 2, in.	4.01	4.02	3.99
Length(without caps), in.	7.87	7.90	7.89
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.03	4.00
Length / Diameter (L/D)	1.96	1.96	1.97
Cross-Sectional Area, in^2	12.69	12.76	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	101,600	100,200	100,800
Compressive Strength, psi	8,010	7,850	8,020
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	7,960

Report Notes

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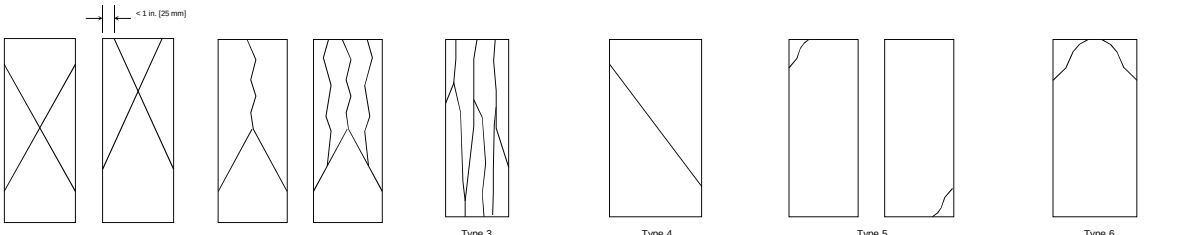
Schematic of Typical Fracture Patterns



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Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-OZ-L	ULT-OZ-L	ULT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	12/28/12 0:00	12/28/12 0:00	12/28/12 0:00
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	1	1	1
Moisture Condition at Test	In Molds	In Molds	In Molds
Curing Conditions (Temp/RH)	Moist	Moist	Moist
Capping Method	Neoprene	Neoprene	Neoprene

Concrete Dimensions

Diameter 1, in.	4.01	4.03	4.01
Diameter 2, in.	4.00	4.02	4.00
Length(without caps), in.	8.02	8.00	7.88
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.00	4.02	4.01
Length / Diameter (L/D)	2.00	1.99	1.96
Cross-Sectional Area, in^2	12.57	12.69	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	2,400	2,600	2,400
Compressive Strength, psi	190	200	190
Fracture Pattern	Type 6	Type 6	Type 6

Average Compressive Strength, psi	193

Report Notes

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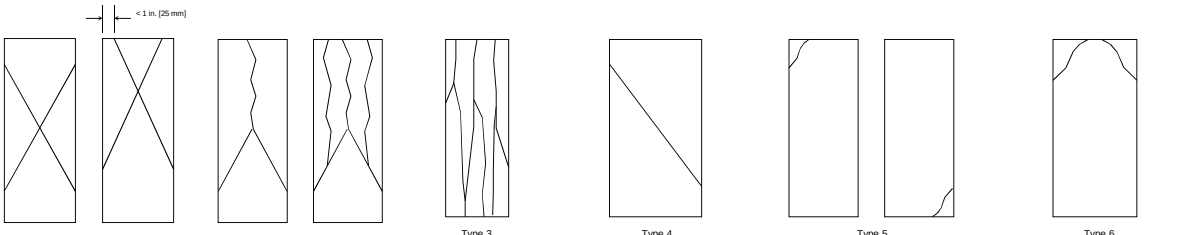
Schematic of Typical Fracture Patterns



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Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 2, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-OZ-L	ULT-OZ-L	ULT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	12/31/12 8:35	12/31/12 8:40	12/31/12 8:45
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	4	4	4
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Sulfur	Sulfur	Sulfur

Concrete Dimensions

Diameter 1, in.	4.03	4.01	4.02
Diameter 2, in.	4.02	3.99	4.00
Length(without caps), in.	N/A	N/A	N/A
Length(with caps), in.	8.20	8.22	8.22
Average Diameter, in.	4.03	4.00	4.01
Length / Diameter (L/D)	2.03	2.05	2.05
Cross-Sectional Area, in^2	12.76	12.57	12.63
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	24,800	25,000	25,200
Compressive Strength, psi	1,940	1,990	2,000
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	1,977

Report Notes

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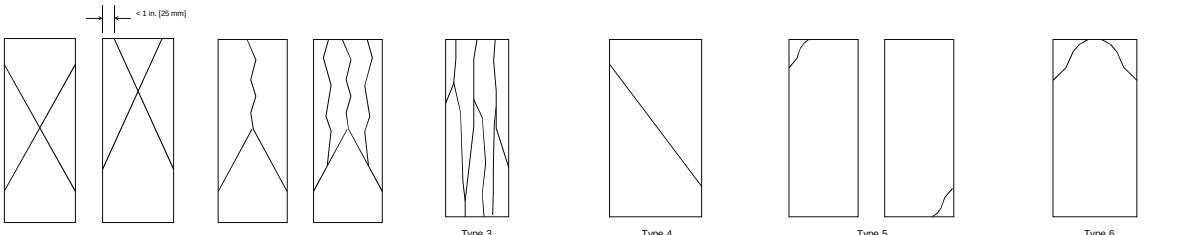
Schematic of Typical Fracture Patterns



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Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: January 4, 2013

CTLGroup Project No.: 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Analyst: J. Slater
Approved by: T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-OZ-L	ULT-OZ-L	ULT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	1/3/13 16:45	1/3/13 16:49	1/3/13 16:54
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	7	7	7
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.02	4.00
Diameter 2, in.	4.04	4.00	3.99
Length(without caps), in.	7.89	7.90	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.02	4.01	3.99
Length / Diameter (L/D)	1.96	1.97	1.97
Cross-Sectional Area, in^2	12.69	12.63	12.50
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

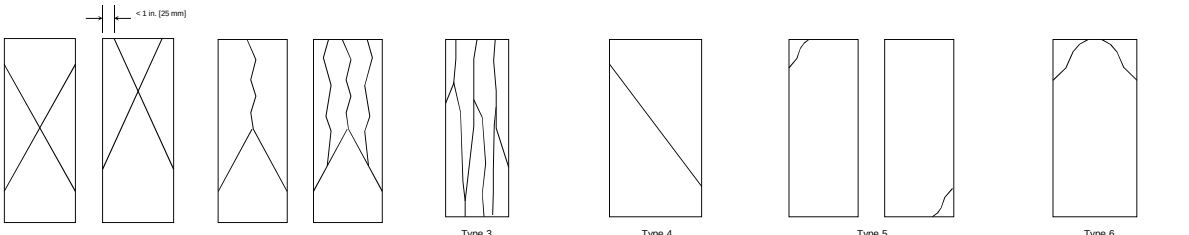
Maximum Load, lb	30,200	32,800	31,800
Compressive Strength, psi	2,380	2,600	2,540
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	2,507

Report Notes

1. This report may not be reproduced except in its entirety.

Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Client:	S.T.A.T.E Testing / Illinois Tollway	**CTLGroup Project No.:**	057122
Project:	HPC for Bridge Decks	**CTLGroup Project Mgr.:**	M. D'Ambrosia
Contact:	Mr. Steve Gillen	**Technician:**	W. Demharter
Report Date:	January 10, 2013	**Analyst:**	J. Slater
		Approved by:	T. Van Dam

ASTM C39 and AASHTO T 22

Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

Specimen Identification

CTLGroup Identification	ULT-OZ-L	ULT-OZ-L	ULT-OZ-L
Client Identification	N/A	N/A	N/A
Casting Date	12/27/2012	12/27/2012	12/27/2012
Test Date / Time	1/10/13 11:18	1/10/13 11:22	1/10/13 11:27
Loading Rate, psi/sec	35	35	35

Concrete Description

Concrete Age at Test, days	14	14	14
Moisture Condition at Test	Moist	Moist	Moist
Curing Conditions (Temp/RH)	73° F / 100%	73° F / 100%	73° F / 100%
Capping Method	Ground	Ground	Ground

Concrete Dimensions

Diameter 1, in.	4.01	4.01	4.01
Diameter 2, in.	4.01	4.00	4.00
Length(without caps), in.	7.84	7.86	7.87
Length(with caps), in.	N/A	N/A	N/A
Average Diameter, in.	4.01	4.01	4.00
Length / Diameter (L/D)	1.95	1.96	1.97
Cross-Sectional Area, in^2	12.63	12.63	12.57
Weight, lb. (in air)	N/A	N/A	N/A
Weight, lb. (in water)	N/A	N/A	N/A
Density	not requested	not requested	not requested

Compressive Strength and Fracture Pattern

Maximum Load, lb	48,200	47,600	47,800
Compressive Strength, psi	3,820	3,770	3,800
Fracture Pattern	Type 1	Type 1	Type 1

Average Compressive Strength, psi	3,797

Report Notes

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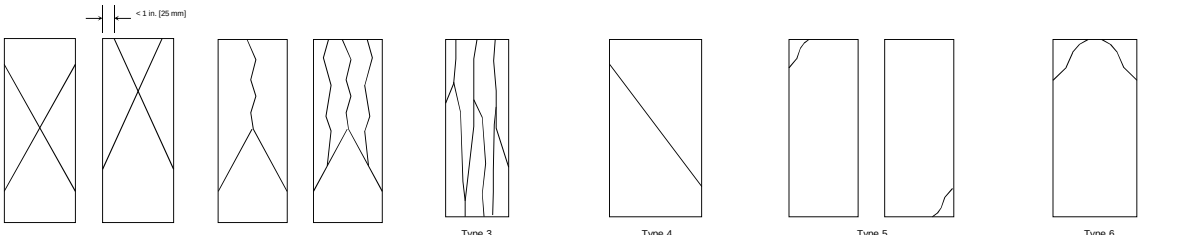
Schematic of Typical Fracture Patterns



Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

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Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbounded caps)

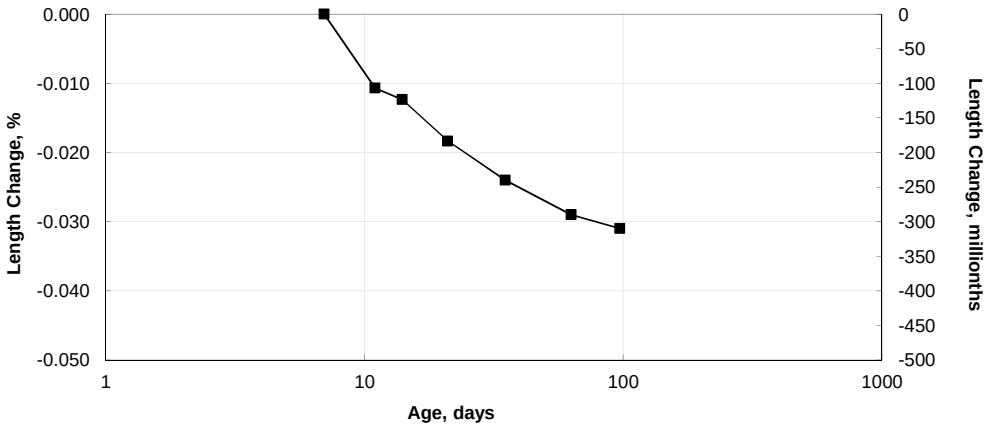
Type 6
Similar to Type 5 but end of cylinder is pointed

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

ULT-Ozinga



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
10/18/2012	1	--	Initial	0.0240	0.0525	-0.0238								
10/24/2012	7	0	Start dry	0.0242	0.0527	-0.0236	0.000	0.000	0.000	**0.000**	0	0	0	**0**
10/28/2012	11	4	dry	0.0232	0.0516	-0.0247	-0.010	-0.011	-0.011	**-0.011**	-100	-110	-110	**-107**
10/31/2012	14	7	dry	0.0230	0.0514	-0.0248	-0.012	-0.013	-0.012	**-0.012**	-120	-130	-120	**-123**
11/7/2012	21	14	dry	0.0224	0.0508	-0.0254	-0.018	-0.019	-0.018	**-0.018**	-180	-190	-180	**-183**
11/21/2012	35	28	dry	0.0219	0.0502	-0.0260	-0.023	-0.025	-0.024	**-0.024**	-230	-250	-240	**-240**
12/19/2012	63	56	dry	0.0214	0.0497	-0.0265	-0.028	-0.030	-0.029	**-0.029**	-280	-300	-290	**-290**
1/22/2013	97	90	dry	0.0212	0.0494	-0.0266	-0.030	-0.033	-0.030	**-0.031**	-300	-330	-300	**-310**

Notes:

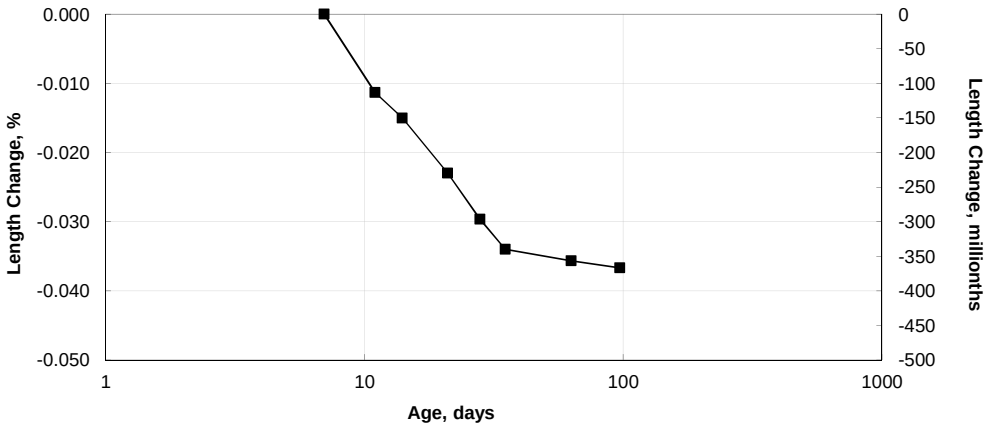
1. Specimens fabricated at CTLGroup on October 17, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

BS T1L



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
11/8/2012	1	--	Initial	-0.0089	-0.0383	-0.0403								
11/14/2012	7	0	Start dry	-0.0088	-0.0382	-0.0402	0.000	0.000	0.000	**0.000**	0	0	0	**0**
11/18/2012	11	4	dry	-0.0100	-0.0393	-0.0413	-0.012	-0.011	-0.011	**-0.011**	-120	-110	-110	**-113**
11/21/2012	14	7	dry	-0.0104	-0.0396	-0.0417	-0.016	-0.014	-0.015	**-0.015**	-160	-140	-150	**-150**
11/28/2012	21	14	dry	-0.0112	-0.0404	-0.0425	-0.024	-0.022	-0.023	**-0.023**	-240	-220	-230	**-230**
12/5/2012	28	21	dry	-0.0119	-0.0412	-0.0430	-0.031	-0.030	-0.028	**-0.030**	-310	-300	-280	**-297**
12/12/2012	35	28	dry	-0.0123	-0.0416	-0.0435	-0.035	-0.034	-0.033	**-0.034**	-350	-340	-330	**-340**
1/9/2013	63	56	dry	-0.0125	-0.0417	-0.0437	-0.037	-0.035	-0.035	**-0.036**	-370	-350	-350	**-357**
2/12/2013	97	90	dry	-0.0126	-0.0418	-0.0438	-0.038	-0.036	-0.036	**-0.037**	-380	-360	-360	**-367**

Notes:

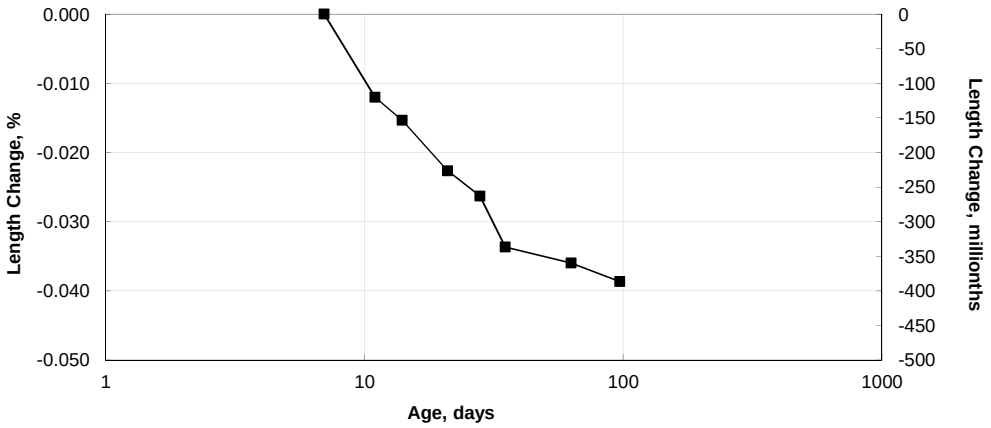
1. Specimens fabricated at CTLGroup on November 7, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

BS OPC



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
11/8/2012	1	--	Initial	-0.0246	-0.0297	-0.0305								
11/14/2012	7	0	Start dry	-0.0244	-0.0296	-0.0303	0.000	0.000	0.000	**0.000**	0	0	0	**0**
11/18/2012	11	4	dry	-0.0257	-0.0306	-0.0316	-0.013	-0.010	-0.013	**-0.012**	-130	-100	-130	**-120**
11/21/2012	14	7	dry	-0.0260	-0.0310	-0.0319	-0.016	-0.014	-0.016	**-0.015**	-160	-140	-160	**-153**
11/28/2012	21	14	dry	-0.0267	-0.0316	-0.0328	-0.023	-0.020	-0.025	**-0.023**	-230	-200	-250	**-227**
12/5/2012	28	21	dry	-0.0271	-0.0320	-0.0331	-0.027	-0.024	-0.028	**-0.026**	-270	-240	-280	**-263**
12/12/2012	35	28	dry	-0.0278	-0.0328	-0.0338	-0.034	-0.032	-0.035	**-0.034**	-340	-320	-350	**-337**
1/9/2013	63	56	dry	-0.0280	-0.0331	-0.0340	-0.036	-0.035	-0.037	**-0.036**	-360	-350	-370	**-360**
2/12/2013	97	90	dry	-0.0283	-0.0333	-0.0343	-0.039	-0.037	-0.040	**-0.039**	-390	-370	-400	**-387**

Notes:

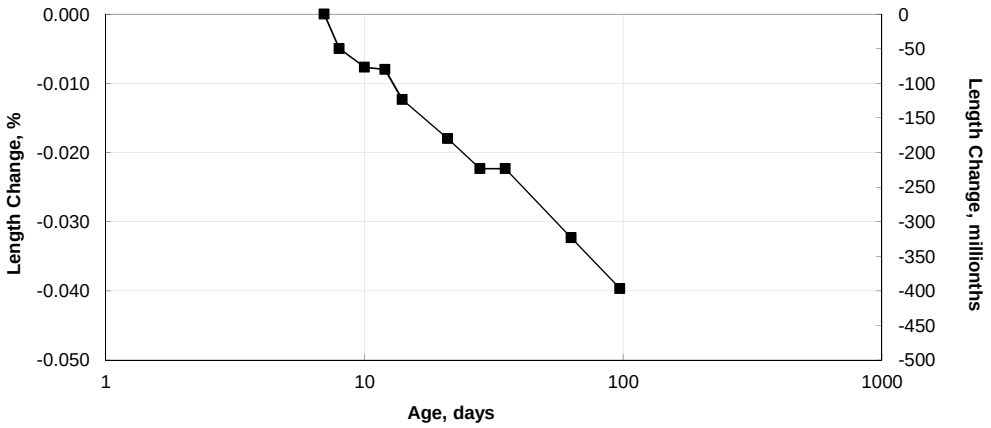
1. Specimens fabricated at CTLGroup on November 7, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

SLA



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
11/29/2012	1	--	Initial	-0.0244	0.0101	-0.0335								
12/5/2012	7	0	Start dry	-0.0242	0.0102	-0.0333	0.000	0.000	0.000	**0.000**	0	0	0	**0**
12/6/2012	8	1	dry	-0.0247	0.0097	-0.0338	-0.005	-0.005	-0.005	**-0.005**	-50	-50	-50	**-50**
12/8/2012	10	3	dry	-0.0250	0.0094	-0.0340	-0.008	-0.008	-0.007	**-0.008**	-80	-80	-70	**-77**
12/10/2012	12	5	dry	-0.0250	0.0094	-0.0341	-0.008	-0.008	-0.008	**-0.008**	-80	-80	-80	**-80**
12/12/2012	14	7	dry	-0.0254	0.0089	-0.0345	-0.012	-0.013	-0.012	**-0.012**	-120	-130	-120	**-123**
12/19/2012	21	14	dry	-0.0260	0.0084	-0.0351	-0.018	-0.018	-0.018	**-0.018**	-180	-180	-180	**-180**
12/26/2012	28	21	dry	-0.0265	0.0080	-0.0355	-0.023	-0.022	-0.022	**-0.022**	-230	-220	-220	**-223**
1/2/2013	35	28	dry	-0.0265	0.0080	-0.0355	-0.023	-0.022	-0.022	**-0.022**	-230	-220	-220	**-223**
1/30/2013	63	56	dry	-0.0275	0.0070	-0.0365	-0.033	-0.032	-0.032	**-0.032**	-330	-320	-320	**-323**
3/5/2013	97	90	dry	-0.0282	0.0062	-0.0372	-0.040	-0.040	-0.039	**-0.040**	-400	-400	-390	**-397**

Notes:

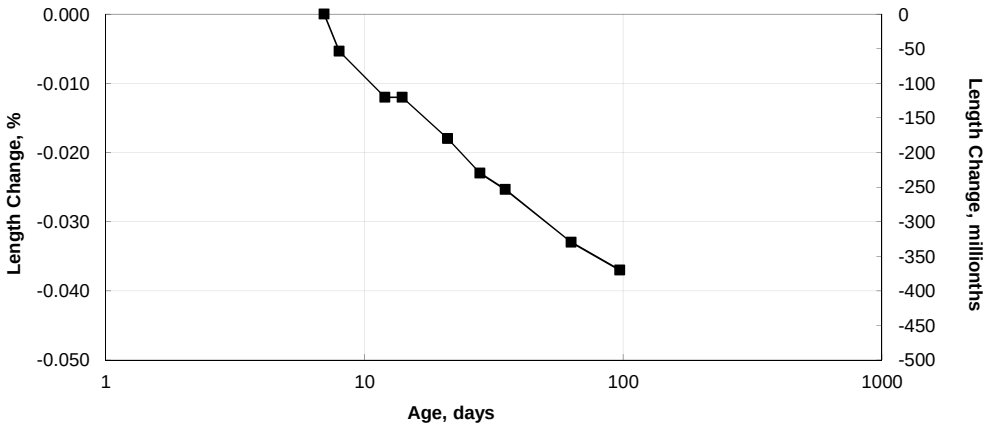
1. Specimens fabricated at CTLGroup on November 28, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

SRA OPC



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
12/20/2012	1	--	Initial	-0.0321	-0.0221	-0.0393								
12/26/2012	7	0	Start dry	-0.0320	-0.0220	-0.0392	0.000	0.000	0.000	**0.000**	0	0	0	**0**
12/27/2012	8	1	dry	-0.0324	-0.0226	-0.0398	-0.004	-0.006	-0.006	**-0.005**	-40	-60	-60	**-53**
12/31/2012	12	5	dry	-0.0331	-0.0232	-0.0405	-0.011	-0.012	-0.013	**-0.012**	-110	-120	-130	**-120**
1/2/2013	14	7	dry	-0.0331	-0.0232	-0.0405	-0.011	-0.012	-0.013	**-0.012**	-110	-120	-130	**-120**
1/9/2013	21	14	dry	-0.0337	-0.0239	-0.0410	-0.017	-0.019	-0.018	**-0.018**	-170	-190	-180	**-180**
1/16/2013	28	21	dry	-0.0341	-0.0244	-0.0416	-0.021	-0.024	-0.024	**-0.023**	-210	-240	-240	**-230**
1/23/2013	35	28	dry	-0.0344	-0.0246	-0.0418	-0.024	-0.026	-0.026	**-0.025**	-240	-260	-260	**-253**
2/20/2013	63	56	dry	-0.0352	-0.0253	-0.0426	-0.032	-0.033	-0.034	**-0.033**	-320	-330	-340	**-330**
3/26/2013	97	90	dry	-0.0356	-0.0256	-0.0431	-0.036	-0.036	-0.039	**-0.037**	-360	-360	-390	**-370**

Notes:

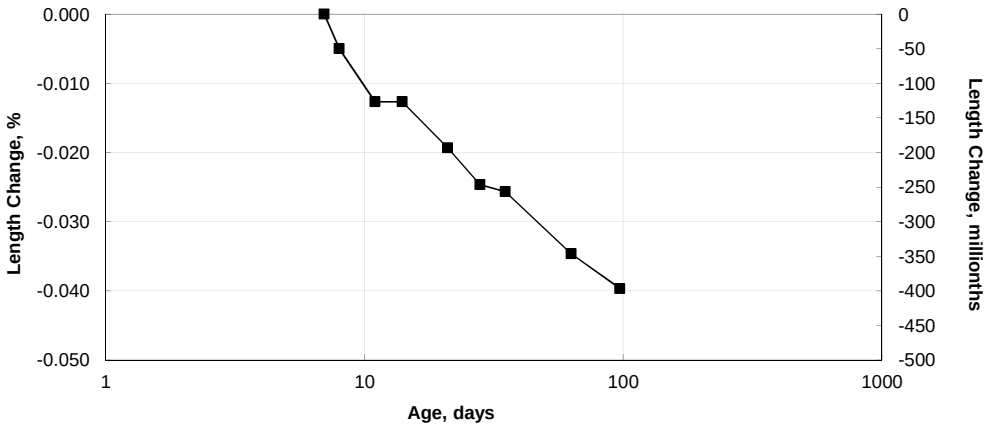
1. Specimens fabricated at CTLGroup on December 19, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

SRA T1L



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
12/20/2012	1	--	Initial	0.0384	-0.0341	0.0092								
12/26/2012	7	0	Start dry	0.0385	-0.0341	0.0092	0.000	0.000	0.000	**0.000**	0	0	0	**0**
12/27/2012	8	1	dry	0.0381	-0.0346	0.0086	-0.004	-0.005	-0.006	**-0.005**	-40	-50	-60	**-50**
12/30/2012	11	4	dry	0.0374	-0.0354	0.0078	-0.011	-0.013	-0.014	**-0.013**	-110	-130	-140	**-127**
1/2/2013	14	7	dry	0.0374	-0.0354	0.0078	-0.011	-0.013	-0.014	**-0.013**	-110	-130	-140	**-127**
1/9/2013	21	14	dry	0.0367	-0.0360	0.0071	-0.018	-0.019	-0.021	**-0.019**	-180	-190	-210	**-193**
1/16/2013	28	21	dry	0.0361	-0.0365	0.0066	-0.024	-0.024	-0.026	**-0.025**	-240	-240	-260	**-247**
1/23/2013	35	28	dry	0.0359	-0.0364	0.0064	-0.026	-0.023	-0.028	**-0.026**	-260	-230	-280	**-257**
2/20/2013	63	56	dry	0.0351	-0.0374	0.0055	-0.034	-0.033	-0.037	**-0.035**	-340	-330	-370	**-347**
3/26/2013	97	90	dry	0.0345	-0.0379	0.0051	-0.040	-0.038	-0.041	**-0.040**	-400	-380	-410	**-397**

Notes:

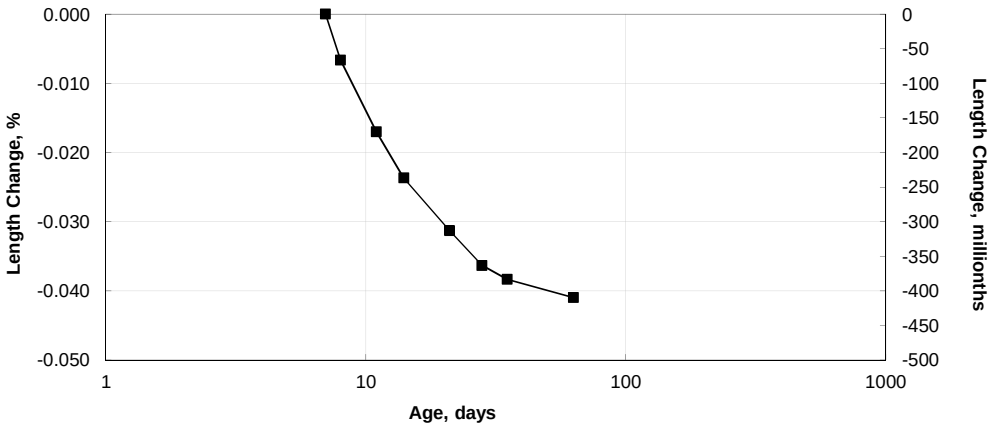
1. Specimens fabricated at CTLGroup on December 19, 2012.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client: S.T.A.T.E Testing / Illinois Tollway
Project: HPC for Bridge Decks
Contact: Mr. Steve Gillen
Report Date: March 26, 2013

CTLGroup Project No. 057122
CTLGroup Project Mgr.: M. D'Ambrosia
Technician: W. Demharter
Approved by: T. Van Dam

AASHTO T160-09 / ASTM C157/C157M-08
Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

OPT



				Specimen Length, in.			*Length Change, %*			**Average, %**	*Length Change, millionths*			**Average, millionths**
Date	Age, days	Days of Drying	Condition	A	B	C	A	B	C		A	B	C	
1/8/2013	1	--	Initial	-0.0355	-0.0415	-0.0364								
1/14/2013	7	0	Start dry	-0.0355	-0.0415	-0.0364	0.000	0.000	0.000	**0.000**	0	0	0	**0**
1/15/2013	8	1	dry	-0.0360	-0.0422	-0.0372	-0.005	-0.007	-0.008	**-0.007**	-50	-70	-80	**-67**
1/18/2013	11	4	dry	-0.0370	-0.0432	-0.0383	-0.015	-0.017	-0.019	**-0.017**	-150	-170	-190	**-170**
1/21/2013	14	7	dry	-0.0379	-0.0438	-0.0388	-0.024	-0.023	-0.024	**-0.024**	-240	-230	-240	**-237**
1/28/2013	21	14	dry	-0.0387	-0.0445	-0.0396	-0.032	-0.030	-0.032	**-0.031**	-320	-300	-320	**-313**
2/4/2013	28	21	dry	-0.0392	-0.0451	-0.0400	-0.037	-0.036	-0.036	**-0.036**	-370	-360	-360	**-363**
2/11/2013	35	28	dry	-0.0394	-0.0453	-0.0402	-0.039	-0.038	-0.038	**-0.038**	-390	-380	-380	**-383**
3/11/2013	63	56	dry	-0.0396	-0.0456	-0.0405	-0.041	-0.041	-0.041	**-0.041**	-410	-410	-410	**-410**

Notes:

1. Specimens fabricated at CTLGroup on January 7, 2013.
2. Test specimens are 3x3x11.25-in. prisms.
3. Specimens stored at 73.4±3°F in saturated lime water for 7 days, then stored in a controlled environment kept nominally at 73.4±3°F and 50±4% RH for the remainder of testing.

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	October 22, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
ULT Field A	9/21/2012	10/19/2012	28	685	Very Low
ULT Field B	9/21/2012	10/19/2012	28	695	Very Low
ULT Field C	9/21/2012	10/19/2012	28	730	Very Low
Average				**703**	Very Low

Notes:

1. Cylinders cast by Ozinga on September 21, 2012 and returned to CTLGroup the same day.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
4. This report may not be reproduced except in its entirety.
5. ASTM C1202 Precision Statement: "The single operator coefficient of variation of a single test result has been found to be 12.3%. Therefore the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not vary by more than 42%."

Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	November 19, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
ULT Lab A	10/17/2012	11/15/2012	29	553	Very Low
ULT Lab B	10/17/2012	11/15/2012	29	569	Very Low
ULT Lab C	10/17/2012	11/15/2012	29	556	Very Low
Average				**559**	Very Low

Notes:

1. Cylinders cast by CTLGroup on October 17, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	November 19, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
BS T1L Field A	10/17/2012	11/14/2012	28	1239	Low
BS T1L Field B	10/17/2012	11/14/2012	28	1390	Low
BS T1L Field C	10/17/2012	11/14/2012	28	1347	Low
Average				**1325**	Low

Notes:

1. Cylinders cast by Meyer on October 17, 2012 and returned to CTLGroup the same day.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	December 6, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
BS T1L Lab A	11/7/2012	12/4/2012	27	1280	Low
BS T1L Lab B	11/7/2012	12/4/2012	27	1192	Low
BS T1L Lab C	11/7/2012	12/4/2012	27	1156	Low
Average				**1209**	Low

Notes:

1. Cylinders cast by CTLGroup on November 7, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	November 19, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
BS OPC Field A	10/17/2012	11/14/2012	28	1450	Low
BS OPC Field B	10/17/2012	11/14/2012	28	1571	Low
BS OPC Field C	10/17/2012	11/14/2012	28	1456	Low
Average				**1492**	Low

Notes:

1. Cylinders cast by Meyer on October 17, 2012 and returned to CTLGroup the same day.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	December 6, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
BS OPC Lab A	11/7/2012	12/4/2012	27	1129	Low
BS OPC Lab B	11/7/2012	12/4/2012	27	1192	Low
BS OPC Lab C	11/7/2012	12/4/2012	27	1361	Low
Average				**1227**	Low

Notes:

1. Cylinders cast by CTLGroup on November 7, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	November 19, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SRA T1L Field A	10/17/2012	11/14/2012	28	1045	Low
SRA T1L Field B	10/17/2012	11/14/2012	28	1031	Low
SRA T1L Field C	10/17/2012	11/14/2012	28	1051	Low
Average				**1042**	Low

Notes:

1. Cylinders cast by Meyer on October 17, 2012 and returned to CTLGroup the same day.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	January 18, 2013	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SRA T1L A	12/19/2012	1/16/2013	28	1030	Low
SRA T1L B	12/19/2012	1/16/2013	28	1083	Low
SRA T1L C	12/19/2012	1/16/2013	28	1023	Low
Average				**1045**	Low

Notes:

1. Cylinders cast by CTLGroup on December 19, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	November 19, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SRA OPC Field A	10/17/2012	11/14/2012	28	1426	Low
SRA OPC Field B	10/17/2012	11/14/2012	28	1491	Low
SRA OPC Field C	10/17/2012	11/14/2012	28	1435	Low
Average				**1451**	Low

Notes:

1. Cylinders cast by Meyer on October 17, 2012 and returned to CTLGroup the same day.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	January 18, 2013	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SRA OPC A	12/19/2012	1/16/2013	28	949	Very Low
SRA OPC B	12/19/2012	1/16/2013	28	946	Very Low
SRA OPC C	12/19/2012	1/16/2013	28	1162	Low
Average				**1019**	Low

Notes:

1. Cylinders cast by CTLGroup on December 19, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	December 7, 2012	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
P-SLA A	11/14/2012	12/5/2012	21	973	Very Low
P-SLA B	11/14/2012	12/5/2012	21	936	Very Low
P-SLA C	11/14/2012	12/5/2012	21	986	Very Low
Average				**965**	Very Low

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
P-SLA A	11/14/2012	12/12/2012	28	1169	Low
P-SLA B	11/14/2012	12/12/2012	28	1137	Low
P-SLA C	11/14/2012	12/12/2012	28	1024	Low
Average				**1110**	Low

Notes:

1. Cylinders cast by Prairie on Novemeber 14, 2012 and returned to CTLGroup the next day.
2. Three 4x2-inch nominal disks were saw-cut from the bottom of three submitted 4"x8" cylinders for the 21 day test and from the top for the 28 day test.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	January 2, 2013	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
SLA Lab A	11/28/2012	12/26/2012	28	792	Very Low
SLA Lab B	11/28/2012	12/26/2012	28	795	Very Low
SLA Lab C	11/28/2012	12/26/2012	28	802	Very Low
Average				**796**	Very Low

Notes:

1. Cylinders cast by CTLGroup on November 28, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	January 28, 2013	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
OPT-OZL A	12/27/2012	1/24/2013	28	1777	Low
OPT-OZL B	12/27/2012	1/24/2013	28	1963	Low
OPT-OZL C	12/27/2012	1/24/2013	28	1950	Low
Average				**1897**	Low

Notes:

1. Cylinders cast by Ozinga on December 27, 2012 and returned to CTLGroup the following
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
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Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible

Client:	S.T.A.T.E.Testing / Illinois Tollway	CTLGroup Proj. No:	057122
Project:	HPC for Bridge Decks	CTLGroup Proj. Mgr:	M. D'Ambrosia
Contact:	Mr. Steve Gillen	Technician:	P. Brindise
Report Date:	February 6, 2013	Analyst:	J. Slater
		Approved:	T. Van Dam

ASTM C1202 - 10 / AASHTO T277-07
Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Sample ID	Reported Cast Date	Start Test Date	Age on Test Date	Charge Passed (coulombs)	Chloride Ion Penetrability
OPT A	1/7/2013	2/4/2013	28	1438	Low
OPT B	1/7/2013	2/4/2013	28	1292	Low
OPT C	1/7/2013	2/4/2013	28	1339	Low
Average				**1356**	Low

Notes:

1. Cylinders cast by CTLGroup on January 7, 2012.
2. Three 4x2-inch nominal disks were saw-cut from the top of three submitted 4"x8" cylinders.
3. Samples were cured at 73°F in limewater from the time they were stripped from molds until they reached an age of 7 days. After the 7th day they were transferred to a 100°F lime water tank for 21 days until testing.
4. This report may not be reproduced except in its entirety.
5. ASTM C1202 Precision Statement: "The single operator coefficient of variation of a single test result has been found to be 12.3%. Therefore the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not vary by more than 42%."

Interpretation of results:

ASTM C 1202 - 10 / AASHTO T277-07, Table 1: Chloride Ion Penetrability Based on Charge Passed

Charge Passed (coulombs)	Chloride Ion Penetrability
>4000	High
2000 - 4000	Moderate
1000 - 2000	Low
100 - 1000	Very Low
< 100	Negligible