

Strength-on-Demand Concrete

I-93 Rapid Bridge Replacement (93Fast I4)



A total of 14 bridges on Interstate 93, where the traffic volume is 200,000 cars per day, needed replacement due to deterioration of the concrete. Using normal construction procedures, this project would have taken at least five years to complete.

In order to accelerate the project and minimize the impact on commuters, the MassDOT chose to use the Patrick-Murray Administrations' Accelerated Bridge Program, which includes the use of accelerated project development and construction techniques.

Project:

I-93 Rapid Bridge Replacement
(93Fast I4)

Location:

Medford, MA

Owner/s:

Massachusetts Department of
Transportation (MassDOT)

Concrete Producer:

Boston Sand & Gravel

Construction Contractor:

JF White

Requirements:

Compressive Strength: 2,000 psi
(14 MPa) in 4 hours after final set

Target air content: 7%

Target slump 10 in. (250 mm)

Products Used:

MasterAir[®] AE 200
air-entraining admixture

MasterGlenium[®] 7500
high-range water-reducing admixture

MasterSure[®] Z 60
workability-retaining admixture

MasterSet[®] DELVO ESC
extended set control admixture

MasterSet AC 534
accelerating admixture

MasterLife[®] SRA 20
shrinkage-reducing admixture

Market Sector:

Paving



The Challenge

Under this program, it was determined that the project could be completed over 10 weekends in the summer of 2011 using precast bridge units fabricated off-site and hauled into place.

After placement, these 252 precast modular units, which form the superstructure of the bridge, were to be connected using a special rapid-setting concrete that would achieve a compressive strength of 2,000 psi (14 MPa) in 4 hours after final set. The total quantity of concrete required was approximately 1,600 yd³ (1,230 m³).

The Solution

The MassDOT approved the use of Master Builders Solutions' 4x4 Concrete System, a unique method of achieving 400 psi (2.75 MPa) flexural strength in 4 hours, or as needed. Concrete producer Boston Sand & Gravel and their admixture partner, Master Builders Solutions, developed a modified 4x4 Concrete mixture utilizing Type III cement, Class F fly ash and Master Builders Solutions admixtures that was able to achieve the compressive strength of 2,000 psi (14 MPa) in 4 hours after final set. The admixture products included MasterSure Z 60 workability-retaining admixture and MasterLife SRA 20 shrinkage-reducing admixture. The concrete met all the requirements of the MassDOT, including low shrinkage, allowing the bridge to be reopened to traffic on schedule.

Rapid-Setting Concrete Mixture Proportions

Type III Cement	720 lb/yd ³ (428 kg/m ³)
Class F Fly ash	180 lb/yd ³ (107 kg/m ³)
Water	277 lb/yd ³ (165 kg/m ³)
w/cm	0.31

Facts and Benefits

- A total of 252 precast modular units were connected with 4x4 Concrete
- The entire bridge replacement project was completed on time over a period of 10 weekends
- The bridge was closed each Friday after rush hour and reopened to traffic at 5:00 AM each Monday.
- 1,600 yd³ (1,230 m³) of 4x4 Concrete were used
- Additional information can be obtained from a dedicated web page developed for the project: www.mass.gov/massdot/93fast14

About Master Builders Solutions

Master Builders Solutions is a leading global manufacturer of concrete admixtures, as well as other sustainable solutions for the construction industry, focussed on delivering its vision: **Inspiring people to build better**. Master Builders Solutions provides value-added technology and market-leading R&D capabilities to improve the performance

of construction materials and to enable the reduction of CO₂ emissions in the production of concrete. Founded in 1909, Master Builders Solutions has ca. 1600 employees operating 35 production sites globally, supporting their customers in mastering their building challenges of today – for a decarbonised future.

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