BULK FIREROK Thermal Resistant Cement

Case Study

FireRok™ Partial Depth Slab Repair, Naval Air Station (NAS) Patuxent River December 2008

Overview

On 15 and 16 Dec. 2009, CERATECH Field Engineering travelled to NAS Patuxent River to provide technical assistance and instruction in the placement of **Firerok**® in the jet engine testing facility, known as the Hush House. This was a partial depth application where the existing material under the test stand had deteriorated from exposure to the high temperatures associated with jet engine testing. The test stand mounts the engine horizontally and the thrust is vectored into a series of baffles. While the surface to be repaired doesn't directly receive the heat and thrust of high-power testing, it does receive the high temperatures radiated from the engine and heat transferred from the stand into the anchor points cast into the slab. CERATECH's thermal resistant cement, **Firerok**®was specified as the repair material for its ability to withstand the high temperatures without degradation and achieve a 650 psi flexural strength @ 28 days.

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Materials and Weather

Material used for this project was **Firerok**® and was delivered in four (3) cu.yd. supersacks.

In order to provide the necessary thermal resistance and specific heat characteristics, Basalt/Diabase coarse aggregate was sourced through Guldelsky Materials in Brandywine, MD. The mix design used for the project is attached at the end of this report. Final W/C ratio was 0.204 and produced an 8" slump.

Weather during placement was clear and sunny, with temperatures averaging 43.3°F and humidity at 33.3%. While the placement was considered indoors (inside a large hangar-type building), the site itself was not completely protected from breeze, nor was it climate controlled. The exhaust baffles/thrust deflectors and air inlets vented directly outside and could not be closed off. Thus, drafts of 1-2 mph could be felt blowing across the surface of the material.

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Prepared Site

The placement site is where jet engines are anchored for high-power testing and measured 24' x 17.5'. The existing concrete had been jackhammered out to an average depth of 6", with areas around drains, anchors and other embedded devices deeper. Actual calculated material requirement was 7.4 cuyds. A rebar mat of #6 bars, 10" on-centers was present and generally clean and free of scale and corrosion. The vertical rebar members were embedded in the host and appeared to be tied in to another embedded mat. Asphalt impregnated fiberboard was used to isolate the slab as a contraction joint. This would be capped and sealed with high temperature sealant at a later date. At the time of inspection, the bond interface was dry, and appeared to be free of cracks and unsound material. We advised the contractors that the surface would need to be saturated with water, with no standing water, prior to placing **Firerok**® in order to facilitate a proper bond.

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Batching and Activation

Carruth and Son (ready mix supplier) operate a portable plant in the Lexington Park area, which provides service to NAS Patuxent River. 12 cuyds of **Firerok**® had been delivered to Carruth to support the Hush House project and stored under a pole barn at their plant. Given the actual job requirement and packaging configuration of the **Firerok**®, we decided to go with a 9 cuyd load, leaving 3 cuyds in reserve for contingencies. Truck #14 was dispatched to deliver the material. #14 is a rear discharging McNeilus mixer with total capacity of 10.5 cuyds. Inspection of the drum prior to charging revealed a dry drum with clean, well maintained fins. Retarder, sand, stone and 30% of the batch water was added and mixed under the plant. 3 supersacks of material were then loaded into the drum followed by 49% of the batch water. This would ensure slump control at the site and uniform mix. Moisture contents of the sand and stone taken prior to mixing were 3.7% and .2% respectively. Carruth also used 130°F water for batching. A breakdown of batching is in the table below (lbs/cuyd):

Component	1 cuyd (design, SSD aggs)	1 cuyd (actual)	9 cuyd (actual load)
Coarse Aggregate	1710	1710	15390
Fine Aggregate	1720	1784	16056
Total Water	165	165	1485
Water from Agg's.	0	64	576
Batch Water	165	101	909

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Batching and Activation (continued)

Prior to leaving the plant, I had the driver back the material up to the throat of the drum for inspection. The material was visibly plastic, estimated to be in the 1-2" slump range and had an equilibrium temperature of 58°F. Transit time to the site was approximately 20 minutes.

Activation occurred at the site by adding CERATECHs liquid activator admixture. The material was mixed for 2-3 minutes and the load was brought back up again and the last 4 buckets were added with 5 gal of water and mixed for 7 minutes. Slump was measured at 3" and 5 gal of water was added. We discharged some of the material to let the crew begin working and placing. Total water for the load was 12.7 gal less than design and yielded the final W/C ratio previously indicated above. Material temperature at discharge was 56°F.

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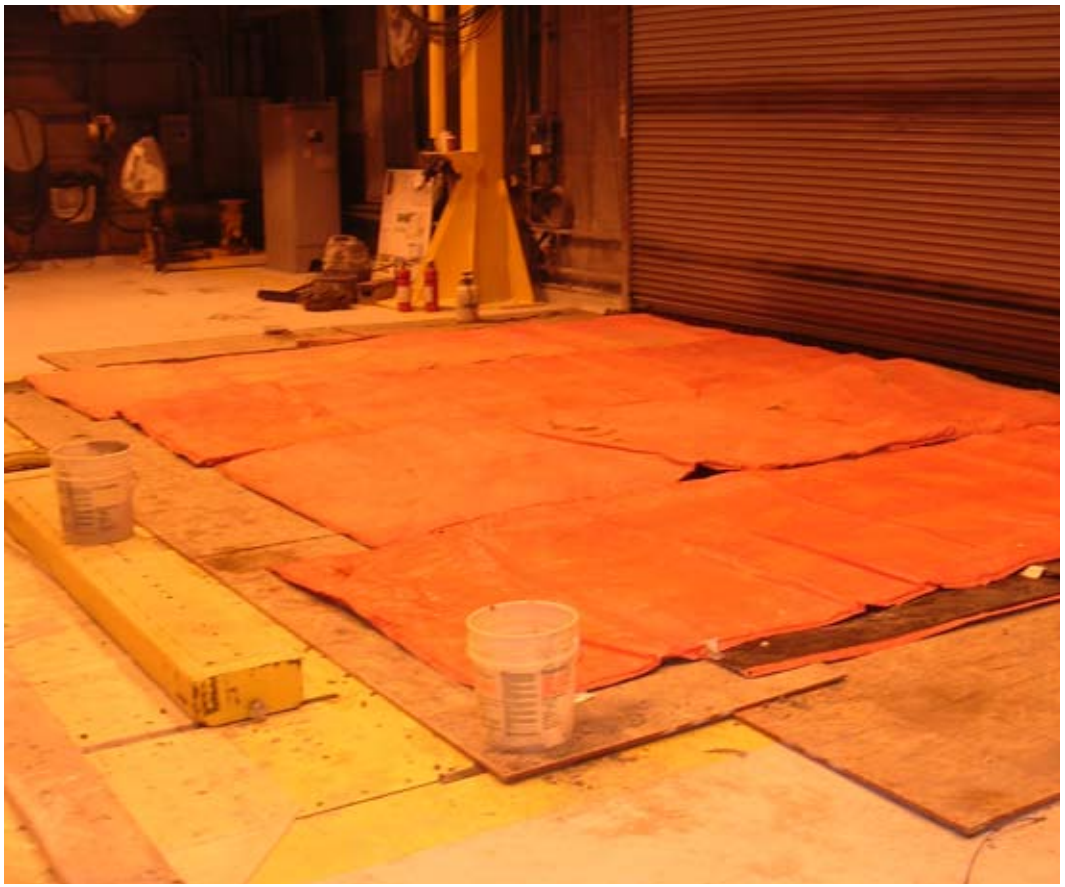
Placing and Finishing

The placement crew decided to place half of the slab, then reposition the truck to pour the other half. During the transition, the lab tech would take material for samples. The mixer was able to adequately discharge material directly into the site and the crew placed, floated and screeded **FireRok**™, all by hand. Consolidation was accomplished through the use of two pencil vibrators. At 9:13 AM, the truck began discharging after all slump adjustments had been made and by 9:50 AM had finished pouring. The slab required 7.5 cuyds of material and the remaining 1.5 cuyds was taken back to the ready mix yard.

Once discharge was completed, we took a few minutes to discuss finishing with the crew, now that they had a good feel for the material. Since they had no finishing aid available, we instructed them to use a very light mist of water on the surface to help close it and achieve a good, hard trowelled finish. After two and a half hours, the material hadn't set and we left for lunch. Once we came back, the material had achieved final set, estimated to be at 3 to 3.5 hours after activation. The finishers did a good job of closing and trowelling the surface. Ambient temperature was 51.1°F; material temperature, as measured by contact thermometer, varied from 51-57°F. Host material temperature generally reflected ambient condi-



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Placing and Finishing (Continued)

tions. Humidity was 26.1%. By previous arrangement, curing blankets were on hand to protect and insulate the material from the cold weather and were placed in two layers.

Conclusions

Overall this was a very successful application. The placement crew had no experience with high performance materials but did a good job adjusting to the nuances of **Firerok**® and produced superior results. In all aspects of the project, no problems of significance occurred and the material performed as expected.

Vibrators for Consolidation: The pencil vibrators used by the crew were clearly underpowered in terms of amplitude. Adequate consolidation was achieved with great effort, only though at slumps of 6" and more. Spud type vibrators would have been a better choice, as they have the amplitude to more effectively and efficiently consolidate the denser **Firerok**® material.