## STUDY ON THE USE OF ONE-DAY CONCRETE IN PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) CONSTRUCTION

The demand for rapid-curing concrete has risen as the vehicle volume continues to increase over time. Currently, road re-blocking, especially on major thoroughfares, causes heavier traffic on the roads affecting millions of passengers and commuters in Metro Manila and its neighboring provinces. The rehabilitation of PCCP normally takes around three (3) to seven (7) days before vehicles can pass thru it. Furthermore, the amount of vehicles passing through the major roads takes a toll on the pavement strength causing overloading as the pavement design is not adequate against the vehicle loading. In addition to the effect of road delay on the economy, commuters' dissatisfaction continues to grow.

The Department has a mandate to conduct pavement reconstruction in an efficient and timely manner. The problem lies in how it will be conducted faster with minimal effect on traffic flow. There is an existing technology which utilizes 3-day concrete but it is still considered to be long.

To address this problem, one-day concrete is introduced in this study to replace the conventional 14-days strength concrete. Promptis, a rapid – hardening, fast – formwork removal concrete technology which is able to achieve early compressive strength in as fast as four hours, compared with an average of 18 hours in conventional concrete, is added to the concrete mix to promote rapid hardening and strength development of concrete. Likewise, SF-Crete is an improved and tailor-made concrete solution with the use of advanced mineral additives to enhance early strength without using additional OPC. The introduced one-day concrete is being studied, evaluated and monitored by the Bureau of Research and Standards together.

Promptis, a rapid – hardening, fast – formwork removal concrete technology which is able to achieve early compressive strength in as fast as four hours, compared with an average of 18 hours in conventional concrete, was introduced by CEMEX. Meanwhile, SF-Crete, a high performance concrete with very high early compressive and flexural strength, was introduced by Holcim Philippines. As the research mentioned, their strength develops in a progressive manner as the concrete age, resulting in a highly durable material that also exhibits a good resistance to shrinkage cracking.

The study aims to establish mix design and specifications on the use of *Promptis* as an admixture for the re-blocking/rehabilitation of distressed Portland Cement Concrete Pavement (PCCP) and determine the best blending/ mix proportions on the use of Promptis as an admixture for the re-blocking/rehabilitation of distressed Portland Cement Concrete Pavement (PCCP)

A series of laboratory tests for materials was conducted to determine the exact grading, the potential alkali-silica reactivity of aggregates (chemical) and other physical properties of limestone aggregates to be used in the actual mixing of PCCP. Laboratory evaluation was also performed to ensure that the product introduced will address the Department's needs. Laboratory testing was done in Bureau of Research and Standards witnessed by the proponent's personnel.

With its different test cement factors, results showed that the design mix of One-Day Concrete as its admixture passed the required flexural strength at the age of curing for 24-

hours. It was then recommended for the second stage of Product Evaluation which is the construction of pilot trials.

For Promptis, two small-scale pilot trials were constructed along EDSA in Pasay City and the third small-scale pilot trial along Roman Expressway in Bataan. On the other hand, SF-Crete was used on three (3) pilot trials which were constructed along South Bound of EDSA corner Taft Avenue, Manila, ACSIE Road (West Service Road), Bicutan, Parañaque, and along A2 (in front of SEC-South Bound), A1 (Flyover South Bound), and A7 (2-lane North Bound in front of EDSA Shrine), EDSA corner Ortigas Avenue, Manila.

To monitor the performance of the new technology, non-destructive tests were conducted on a regular basis such as Skid Resistance Test, Sand Patch Test and Crack Mapping. As per Department Order 189, series of 2002, the pilot trials are monitored once per month for a period of six (6) months and then once per quarter for a period of another six (6) months.

Results showed that the calculated average values of skid resistance at the trial section and conventional section of constructed two (2) pilot projects met the suggested value as United Kingdom's Department for International Development Overseas Road Note 18, suggests a minimum skid resistance value of 55 for motorways, trunk and class 1 roads and heavily trafficked road carrying more than 2000 vehicles/day. Skid resistance is dependent on the type of cement, quality of materials used (cement, aggregates and additives added), vehicle axle loading and action of passing vehicles at the site. Likewise, results showed that the calculated average values of texture depth (by sand patch method) at the trial section and conventional section of constructed two (2) pilot projects are higher than the suggested value as United Kingdom's Department for International Development Overseas Road Note 18 recommends that, for a bituminous pavement, a texture depth of less than 0.50 mm indicates that the pavement is already on a warning level of concern. The friction between the vehicle tires and the pavement surface has increased, thus, become skid resistant and safe to motorists. For crack mapping results, several distresses developed on the pilot trials such as temperature cracks, transverse cracks and plastic shrinkage cracks. Exposed aggregates or scaling developed throughout the duration of monitoring period.

Due to One-Day Concrete's ability to attain early setting and strength, it requires different proportion of construction materials and admixtures. Higher cement factor is used in the design which means higher costs in materials and construction. However, in exchange of cost in the reduction in delay in road traffic. According to study made on the effect of traffic in the economy, millions of pesos are lost for every hour of delay in roads. When using oneday concrete, the curing time is lessened drastically, so minimal interruption is experienced on the road which could return some economic benefits in investment and work hours.

While the average results of the Skid Resistance Test and Sand Patch Test return a favorable number, some individual blocks exhibited lower than recommended SRV. Several surface defects were noted such as scaling, transverse cracks, plastic shrinkage cracks and multiple cracks. It is therefore recommended to continue monitoring projects.

Promptis by Cemex and SF-Crete by Holcim Philippines were approved to be used in DPWH projects through the virtue of Department Order No. 61, series of 2016 and Department Order No. 235, series of 2016, respectively.