Innovation Research of Management of Highways Construction

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Abstract—Construction management is a construction enterprise according to the business development strategy and the enterprise internal and external conditions, in accordance with the modern enterprise operation law, through the optimized allocation of production factors and dynamic management.

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Vehicles could soon be bouncing along on highways made from scrap tyres. Almost one billion tyres are scrapped every around the world: thrown into landfills or piled up in junkyards. And they take up a lot of space. If you lined up the 7 million tyres that Ford Motor Co. promised to replace on its Explorer sport-utility vehicles earlier this year in the United states, they would stretch from Hong Kong to London —about 9,700 kilometers. But Lee Kin-Man has a solution.

About 10 years ago, the civil engineer dragged some old tyres into his lab at the Hong Kong University of Science and technology, determined to find uses for this junkyard problem. He struck upon an idea: Why not turn tyres into building bricks? The technology came along quickly; it just took time to commercialize it .

Lee turns tyres into a lightweight, porous and bouncy substance that can replace gravel in the construction of roads. He calls it Rubber Soil. First the steel reinforcements are wrenched out of the tyres ,then the remaining rubber is diced up into "crumbs" that are then congealed together with a cementing mixture.

"Think of it as construction congee[rice soup]with secret ingredients," says Edwin Leung, one of Lee's partners in his start-up, Earth -Link Technology Enterprises, which they set up to commercialize Rubber Soil .The mixture is being patented in Hong Kong, China, the U.S. and Europe.

Before asphalt or concrete is poured to pave roads, layers of soil or gravel are laid down as foundation material. The process is often dusty, dirty and noisy as the soil and gravel are pounded into the ground. Replacing it with a Rubber Soil mixture could reduce this noise and pollution—the new substance could be poured directly into the ground or pieced together as prefabricated blocks.

Only 18% of all tyres are recycled, so this looks like a very useful idea ."Rubber soil proves that waste can be a rich resource if used properly," says Eric Liu, a researcher at the environmental group, Friends of the earth, in Hong Kong. "It is an environmentally friendly solution to our growing scrap-tyre problem." Currently, virtually all tyres are simply tossed out in countries like China, where about 100 million tyres are scrapped every year.

DON'T BURN THAT

And it isn't simply a matter of space. Rubber is a stubbornly resistant material that refuses to disintegrate. "It takes a hundred years, maybe more, for rubber to fully decompose ,"Lee says. "In the meantime,it's just underground, releasing toxic fumes." That's if the tyres are ever buried. Most are piled up in scrapyards where they become breeding grounds for disease and vermin and are fire hazards. When a pile of 10 million tyres caught fire during a lightning storm in California, the mess burned for nine months, emitting thick black smoke and toxic fumes .Lee's invention could use up this rubber rubble before it catches fire.

Of course, Rubber soil is much more expensive than simple soil or gravel, which cost about HK$60($7.70) for every cubic meter. Rubber soil would be about five times that much. Lee realizes that could be a stumbling block. "Construction companies aren't going to pay five times as much just because it is cleaner and environmentally friendly," he says. "They're out to make something for as cheap as they can." But Rubber Soil could, in the end, be a cost-cutting tool. Because of its elastic qualities, rubber can absorb more pressure than either soil or gravel. By replacing these materials with cushioning Rubber Soil, road-builders can reduce the asphalt layer, which normally absorbs all the weight of cars on the road. Just reducing the asphalt's thickness by 100-200 millimeters can cut costs by more than 20%,says Lee.

Lee hopes such savings will lure construction companies, especially in China. "Tens of thousands of kilometers of roads are going to be built in western China," Lee says. "If they utilize Rubber Soil ,we could use up all the scrap-tyre piles around the world in no time."

Figure1. A road environment engineering instance

The offsite manufacturing of steel and other components of reinforced concrete for bridges and tunnels is nothing new. But the need for reconstructing or replacing heavily used highway facilities has increased the use of prefabricated components in startling ways. In some cases components are manufactured thousands of miles from the job site; in others, they are manufactured immediately adjacent to the site. Either way, we are rethinking how design and construction can be integrated.

When the Texas Department of Transportation needed to replace 113 bridge spans on an elevated interstate highway in Houston, it found that the existing columns were reusable, but the bent caps (the horizontal connections between columns) had to be replaced. As an alternative to the conventional, time-consuming, cast-in-place approach, researchers at the University of Texas devised new methods of installing precast concrete bents. In this project, the precast bents cut construction time from 18 months to slightly more than 3 months.

As part of a massive project to replace the San Francisco-Oakland Bay Bridge, the California Department of Transportation and the Bay Area Toll Authority had to replace a 350-foot, 10-lane section of a viaduct on Yerba Buena Island. In this case, the contractor, C.C. Myers, prefabricated the section immediately adjacent to the existing viaduct. The entire bridge was then shut down for the 2007 Labor Day weekend, while the existing viaduct was demolished and the new 6,500-ton segment was "rolled" into place. The entire operation was accomplished 11 hours ahead of schedule.

Probably the most extensive and stunning collection of prefabricated applications on a single project was on the Central Artery/Tunnel Project ("Big Dig") in Boston. For the Ted Williams Tunnel, a dozen 325-foot-long steel tunnel sections were constructed in Baltimore, shipped to Boston, floated into place, and then submerged. However, for the section of the tunnel that runs beneath the Four Points Channel, which is part of the I-90 extension, bridge restrictions made this approach infeasible. Instead, a huge casting basin was constructed adjacent to the channel where 30- to 50-ton concrete tunnel sections were manufactured The basin was flooded and the sections winched into position with cables and then submerged.

An even more complicated process was used to build the extension tunnel under existing railroad tracks, which had poor underlying soil conditions. Concrete and steel boxes were built at one end of the tunnel, then gradually pushed into place through soil that had been frozen using a network of brine-filled pipes.

New generations of specialty concretes have improved one or more aspects of performance and allow for greater flexibility in highway design and construction. High-performance concrete typically has compressive strengths of at least 10,000 psi. Today, ultra-high-performance concretes with formulations that include silica fume, quartz flour, water reducers, and steel or organic fibers have even greater durability and compressive strengths up to 30,000 psi. These new concretes can enable construction with thinner sections and longer spans.

Latex-modified concrete overlays have been used for many years to extend the life of existing, deteriorating concrete bridge decks by the Virginia DOT, which pioneered the use of very early strength latex-modified concretes for this application. In high-traffic situations, the added costs of the concrete have been more than offset by savings in traffic-control costs and fewer delays for drivers.

As useful as these and other specialty concretes are, nanotechnology and nanoengineering techniques, which are still in their infancy, have the potential to make even more dramatic improvements in the future.

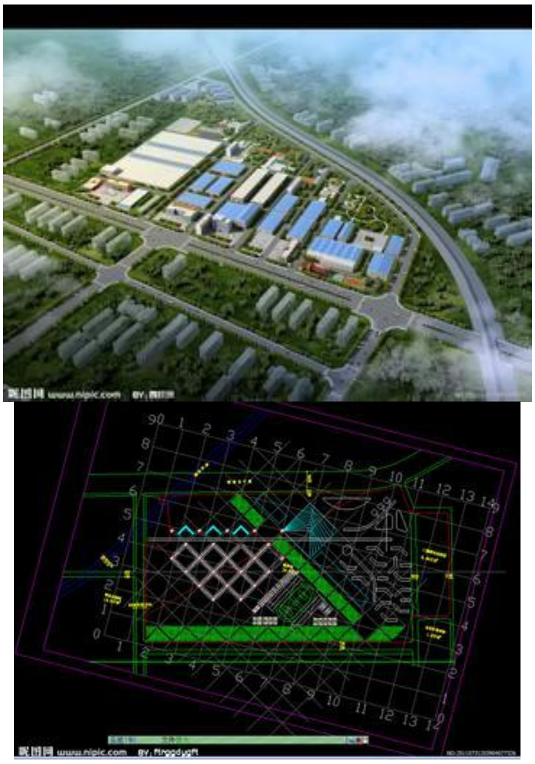

Figure 2. Road environment harmonious

Every year, many prestressed concrete (PC) bridge girders are accidentally damaged by overheight vehicles or construction equipment during site clean-up. When this happens, questions arise about the repair strategy. Considering that a girder may be significantly damaged, the only alternative to repair is its replacement, which, although effective, is typically the most expensive solution. In addition, the replacement option requires the closure of traffic lanes and a lengthy disruption of traffic. There has been relatively limited research on the damage assessment and repair of PC bridge girders subjected to vehicular impact. With reference to traditional repair techniques, laboratory investigations by Zobel, Carrasquillo, and Fowler were conducted to evaluate application methods and performance characteristics of several prepackaged repair materials combined with pressure epoxy injection as well as strand splice assemblies. Under the repetitive nature of highway loading, repair methods such as internal strand splices and external post-tensioning were found to be only partially satisfactory because they could not restore the ultimate strength of the damaged member. Other studies were conducted on prestressed and nonprestressed concrete deep beams predamaged in shear and strengthened with steel clamping units that acted as external stirrups .

Fiber-reinforced polymer (FRP) systems have emerged as alternatives to traditional materials and techniques (externally bonded steel plates, steel or concrete jackets, and external post-tensioning). The strengthening of reinforced concrete (RC) and PC structures using externally bonded steel plates and composite laminates has proven to be an effective method for increasing or restoring their structural capacity. Klaiber et al. and Russo et al. presented the outcomes of experiments conducted both in the field and in the laboratory on undamaged and damaged PC beams strengthened with carbon FRP (CFRP). Strengthening of impact-damaged girders with FRP laminates and, in particular, with CFRP laminates installed by manual layup has already been explored.

To provide an experimental validation for the FRP strengthening techniques of damaged PC girders, laboratory tests were conducted at the University of Missouri-Rolla. The experimental campaign was aimed at proving that the CFRP upgrade technique could restore the original ultimate flexural capacity of the damaged girder.

Tests on three specimens-one undamaged (Specimen 1, named S-1) and two on differently predamaged and CFRP upgraded beams (Specimens 2 and 3, referenced in the following as S-2 and S-3, respectively)-indicate that the CFRP upgrade technique is structurally efficient in providing the damaged beams with stiffness and strength very close to that of the original undamaged beam.

The present paper deals with the full-scale laboratory validation of an FRP strengthening technique that has already been used in the field. The experimental and analytical work allows quantifying the benefits of the use of CFRP composites applied by manual layup to damaged PC girders and provides experimental evidence for the development of practical design criteria.

Since the mid-1950s, the tremendous growth in the number and usage of motor vehicles has meant that the countries of the western world have spent immense sums on developing their road networks. In more recent years, the newly developing third world countries have also invested very considerable amounts in highway infrastructures in order to boost their burgeoning economics. The needs generated by the great increases in vehicle numbers and kilometers of road have given rise to major research programmes in traffic planning and engineering, and in pavement materials and design, which have led to notable improvements in highway construction and traffic operations.

Unfortunately，research into the preservation of the highway network has not paralleled that of planning, design, construction and traffic management. Partly as a result of this, and partly for financial reasons, this aspect of the road engineer's work has tended to be treated as the “poor relation” of highway engineering.

In recent years, however, as major highway construction programmes have come close to completion, the need to preserve the road system as a national asset has become apparent to governments in many countries. Furthermore, many of Transport estimated that some 20 percent of its motorway pavements had a life expectation of 0-5 years,18 percent had 6-10 years, 20 percent had 11-15 years, and 42 percent had 16 plus years. As a result, it is now clear that the “after-care” of highways is going to be-come one of the most rapidly developing areas of highway engineering in the next decade and beyond.

Terminology concerned with highway preservation varies considerably from country to country; it also varies from urban area to rural area. The following definitions should not necessarily be assumed to apply to all locations and highway systems.

A well-established description of highway maintenance is that it is concerned with the task of preserving, repairing and restoring a system of roadways, with its elements, to its designed or accepted configuration. Examples of system elements are as follows : carriageway surfaces, shoulders, roadsides，drainage facilities, bridges, tunnels, signs, markings and lighting fixtures. Included in the task are such traffic services as lighting and signal operation, snow and ice removal, and the operation of roadside rest areas.

Highway maintenance programmes are developed to carry out the above task, and to contain the detrimental effects of weather, organic growth, deterioration, traffic wear, dam-age and vandalism. Deterioration includes the effects of ageing, material failures, and design and construction faults.

The preservation and repair of buildings, stockpiles and equipment essential to performing the highway maintenance task are also part of highway maintenance programmes.

A routine maintenance programme groups those activities that are carried out as frequently as required during each year on all elements of the highway (including its ancillary furniture and equipment),in order to ensure serviceability at all times and in all weathers. The main operations included are:

(1) the cleansing of carriageways, verges, ditches, drains, signs and signals, safety barriers, etc. ，as well as grass cutting and tree pruning.

(2) the repair of minor damage to carriageways, verges, slopes, culverts, signals and signposts, barriers, lighting facilities, and buildings, as well as any urgent interventions

required to restore disrupted traffic movement, e.g. removal of debris from the carriageway.

(3) the replacement of ancillary furniture and equipment that has been damaged, e.g. signing, barriers, road markings, drainage tubes or small channels, planted areas, lighting facilities.

(4)winter maintenance operations intended to retain service-ability in poor weather conditions, e. g. clearance of snow and ice, having regard to prevention and cure.

A periodic maintenance programme covers all longer-term programmable operations required within the service life of the road. These activities, which may be required only at intervals of several years, can be divided into two main groups, as follows:

(1)the renewal or renovation of the wearing surfaces of carriageways that become worn or deformed by use, e. g. the regravelling of unpaved roads and the resealing/surface dressing of paved roads.

(2)the restoration of road markings, culverts and ancillary items, and the repainting of metal bridges, etc.

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REFERENCES

[1] Stackelberg H. *The Theory of the Market Economy*. Oxford: Oxford University Press, 1952.

[2] Miller,T., Friesz,T. & Robin,R., Heuristic algorithms for delivered pric spatially competitive network facility location problem. Ann. Oper. Res., 34,pp.177-202,1992.

[3] Pieume, C.O, Fotso L.P. & P. Siarry. A method for solving bilevel linear progremming problem. *Journal of Information and Optimization Science*, 29(2), pp. 335-358,2008.

[4] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1992, pp.68–73.

[5] I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.

[6] K. Elissa, “Title of paper if known,” unpublished.

[7] R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.

[8] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[9] M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

[10] D. Kornack and P. Rakic, “Cell Proliferation without Neurogenesis in Adult Primate Neocortex,” Science, vol. 294, Dec. 2001, pp. 2127-2130, doi:10.1126/science.1065467.