ISSN 1997-1400 Int. J. Pavement Res. and Technol. 1(4)

The Quest for Long-Life Concrete Pavements: from Theory to Practice

Shiraz Tayabji
Associate Editor, IJPRT
Senior consultant, Fugro Consultants, Inc., Columbia, Maryland, USA (stayabji@aol.com)

The achieving of long-life pavements is a topic of international discussion and focus. This is true in developing countries and in developed countries that have had the benefit of over a hundred years of technological advancements in the quest for long-life concrete pavements. We have evolved from pavements lasting one year in the early days of highway transportation to 20 to 25 years during the second half of the 20th century to having an expectation that pavements should provide a low maintenance service life of 40 plus years. Our current expectations are driven by three primary factors as listed below:

- Traffic growth in metropolitan areas allow minimal access for pavement repair and rehabilitation
- Economic conditions in most countries dictate fiscal discipline
- Sustainability concerns dictate that we pay attention to conservation of resources and minimizing environmental damage resulting from construction activities.

With respect to concrete pavements, the definition of long-life used in the United States is as follows:

- Original concrete surface service life is 40+ years.
- Pavement will not exhibit premature construction and materials-related distress.
- Pavement will have reduced potential for cracking, faulting, and spalling for jointed pavements and reduced potential for punchout distress for continuously reinforced pavements.
- Pavement will maintain desirable ride and surface texture characteristics with only minimal intervention activities, if warranted, for ride and texture, joint resealing, and minor repairs.

Long-life concrete pavements have been attainable for a long time as evidenced by the fact that a number of very old pavements remain in service; however, recent advances in design, construction, and concrete materials technology give us the knowledge and technology needed to achieve consistently what we already know to be attainable. That is the challenge we face as pavement engineers - to attain the long-term pavement performance consistently. We ask ourselves where the gaps in technology are. Are the gaps in the design of the pavement systems or are the gaps in specifying what the end product should be or are the gaps in delivering a constructed project that meets the design expectations?

Over the last 20 years or so, we have made significant advances in understanding the behavior of concrete pavements subjected to traffic and environmental loadings. We continue to perfect this understanding using sophisticated finite-element analysis procedures. Gaps do remain. For example, we cannot yet realistically model the effect of drainage layers and the moisture state in the pavement system. As a result we develop either conservative (more costly) designs or risky designs (early failures/more costly). But, a more serious gap exists in how we specify the desired end product. We test for concrete as delivered. But, we do not have good procedures to test the concrete as placed. In fact, although we strive hard to obtain durable concrete, we have no process for testing the durability of as-placed concrete. As we continue to improve our understanding of the behavior of concrete pavements using sophisticated analytical tools, we must balance that with equal emphasis on delivering the end product with the desired characteristics that can be measured nondestructively, rapidly, and hopefully cost-effectively. We can hope to obtain long-life consistently only when we are able to balance our understanding of the pavement behavior with developing process to specify, test, and deliver the desired end product – the long-life concrete pavement.