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The Development of Taiwan's Expressway Network

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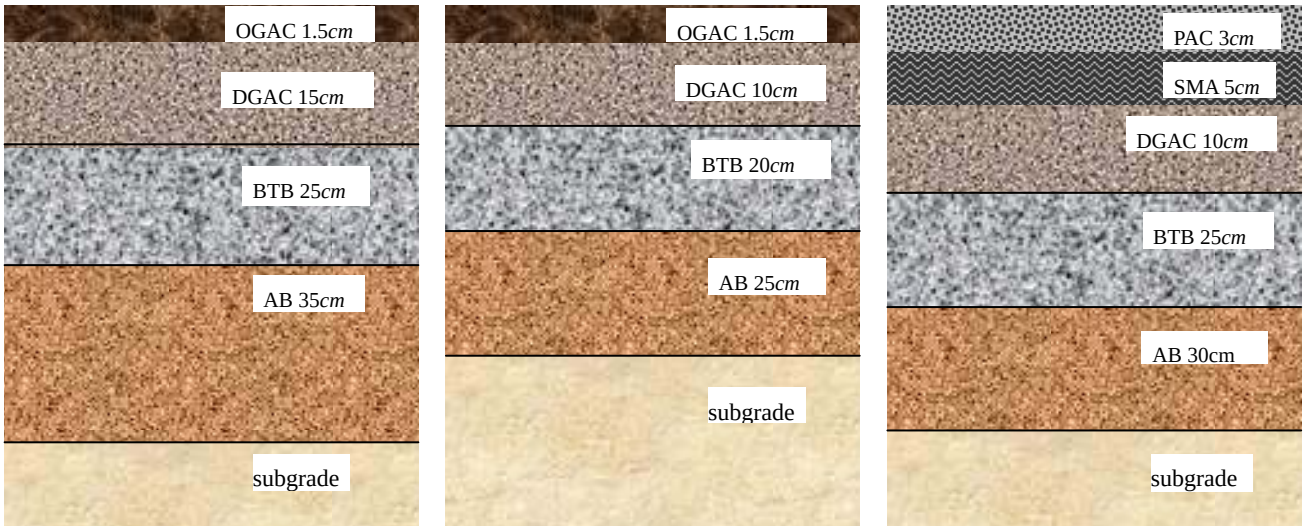
The advent of modern expressways in Taiwan, as one of the "10 national infrastructure development projects", started in early 1970's. The first trans-island expressway, stretching for about 400*km* along Taiwan's western plains, was completed in 1978. In this stage, roadway sections were predominantly earth embankment. Typical pavement structure of Freeway No. 1, as depicted in Fig. 1(a), comprised of 15*mm* open-graded asphalt concrete (OGAC) as a friction course, 150*mm* dense-graded asphalt concrete (DGAC), 250*mm* bituminous-treated base (BTB), and 350*mm* aggregate base (AB).

Due to the rapid-growing economy in Taiwan and increased demand in freight and passenger transport, some sections of Freeway No. 1 soon reached a high traffic volume of as many as 200,000 vehicles per day in late 1980's. In addition, truck traffic at various sections of the expressway ranged between 10-20%, with a weighted average truck factor of 2.2-3.0. To find solutions for the congestion in this freeway, the Expressway Engineering Bureau, mandated specifically with the planning, design, and construction of the national expressway network, was established in 1990. The bureau embarked on an extensive expressway network construction program to enhance the transport capacity in Taiwan. Some 600*km* of new expressways were built in 15 years, including: 1) the second trans-island expressway (Freeway No. 3) routed mostly along the mountains in western Taiwan; 2) several branch lines and beltways (Freeway No. 2, 4, 8, and 10) improving the mobility in population centers; and 3) the first expressway extending to the eastern part of Taiwan (Freeway No. 5). These were the "golden years" for expressway network development in Taiwan. Many state-of-the-art construction techniques and new materials were brought to Taiwan's engineering arena. An example was the first-time use of tunnel boring machine in 1991 for the construction of Hsuehshan Tunnel, which is 12.9*km* long, longest in Southeast Asia. In this stage, pavement structures were designed using both the AASHTO and Asphalt Institute methods with minor modifications based on local experiences. Typical pavement section of Freeway No. 3 shows significant reduction in the thickness of AC and BTB, as illustrated in Fig. 1(b).

In recent years, the continued expansion of the expressway network has run its ways through rural and mountain areas. The use of elevated roadways and tunnels became routine. For instance, of the 55*km* of Freeway No. 5, 20.1*km* are tunnels and 29.1*km* are bridges. Also, Freeway No. 6 has a total length of 38*km*, including 27*km* of bridges and 4*km* of tunnels. In the mean time, the design and management of expressway pavements have shifted from structure-concern-only rationale to multi-function valued design concepts. The use of innovative materials and environment-friendly projects are encouraged explicitly. This is manifested by the pavement structure shown in Fig. 1(c) for Freeway No. 6, which was just opened to traffic early in 2009. The combination of porous asphalt concrete (PAC) and stone-mastic asphalt (SMA) has ushered in a new era of pavements in Taiwan.



(a) Freeway No. 1 (b) Freeway No. 3 (c) Freeway No. 6

Fig. 1. Typical Pavement Structure of Expressways in Taiwan (not to scale).