

FACTS & ANALYSIS

The Maximum Speed and the Technology Development of the Shinkansen

Table 1 below shows the changes of the maximum train speeds of the Tokaido, Sanyo, Tohoku and Kyushu Shinkansen lines. The technologies of the major technical elements of railway systems such as rolling-stocks, tracks, electric facilities and test equipment which contribute to realize 270km/h operation of the whole Tokaido Shinkansen trains are also shown in the table 1.

Table 1 The maximum speed and the technology development of the Shinkansen

Maximum speed & technical elements		Fiscal year																								
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
※1 Speed	Shinkansen	Tokaido	← 210km/h (Series 0)		220 · 230km/h (Series 0 · 100 · 100N)										270km/h (Series 300 · 700 · N700)											
		Sanyo	← 210km/h (Series 0)		220 · 230 · 270 · 285km/h (Series 0 · 100 · 100N · 300 · 700)										300km/h (Series 500 · N700)											
		Tohoku	240km/h (Series 200)																							
		Kyushu	260km/h (Series 400 · 800)																							
			275km/h (Series E2 · E3)																							
※2 Technical elements	rolling stock	axle weight	axle weight 16 ton : steel												axle weight 11 ton : AC induction motor · aluminum alloy											
		brake	dynamic brake												regenerative brake											
		passing at curve	tilting system																							
		electric motor	DC motor												AC induction motor											
		main circuit controller	phase control												VVVF converter control (GTO · IGBT)											
	track	linear maintenance · grinding of top surface of rail · prolongation of rail length with welding																								
	electric facility	overhead catenary	high speed catenary												high speed catenary											
		power feeding	BT feeding system												AT feeding system											
	noise	pantograph	6~8 pantographs												2 pantographs											
		rolling stock	complete car-body hood · bogie skirt →																							
	test equipment		high speed rolling-stock test equipment (500km/h)												high speed brake test equipment											
			large-scale low-noise wind tunnel (400km/h)																							

※ 1 Speed : Maximum speed of each Shinkansen EMU

※ 2 Technical elements : Technologies introduced to achieve 270km/h operation of all Tokaido Shinkansen EMUs

The AC motor driving system of light axle weight and the high performance which was put into practical use by applying modern electronics technology to the power distributed traction systems which are unique characteristics of Japanese Shinkansen EMUs, would be one of the most superior system in the world.

Meanwhile, the newly introduced large scale test equipment is very useful to promote efficiency and practicality of research development and application tests, since it enables safe and easy setting of various test conditions and repeated implementation of reappearance tests.

Besides various new technologies shown in the above table, comparing the weight of main circuit equipment of driving system and traction force of each Shinkansen EMU, the former of the Series 0 train which used DC motor amounted to 140 tons. On the other hand, the Series 300 and N700 decreased weight and increased traction capacity by adopting AC induction motor. Hence comparing the Series 0 with N700, the weight of main circuit equipment was decreased to less than half and the traction power/weight ratio was improved by about 2.9 times.

As for energy saving, comparing initial the Series 0 with N700, energy consumption is expected to be decreased by 23%, despite increased maximum speed by 50 km/h from 220km/h to 270km/h.

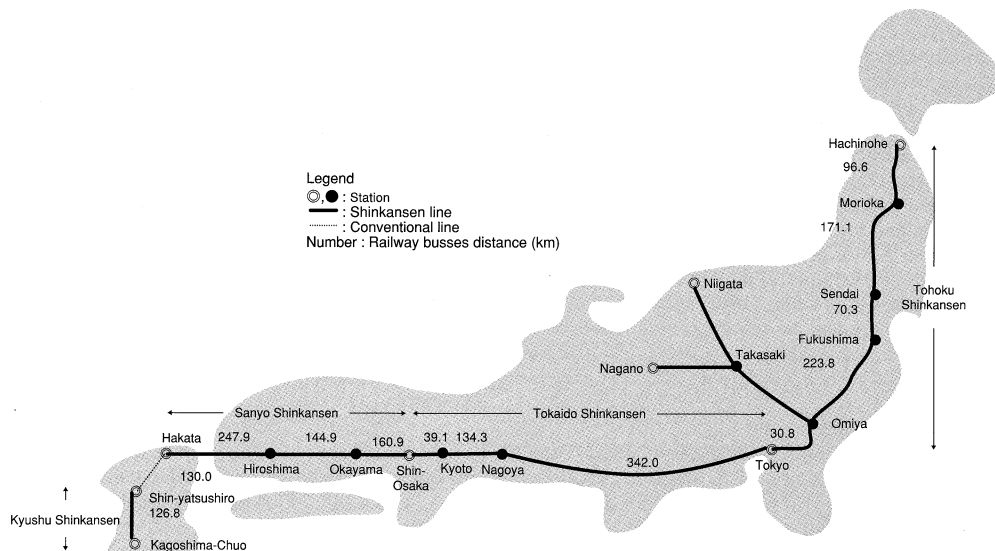


Fig. 1 Location of the Shinkansen lines