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1. General Planning

The Japanese National Railways opened the Shinkansen between Tokyo and Shin-Osaka (Tokaido Shinkansen, 516 km) in October, 1964, between Shin-Osaka and Okayama (1st phase of Sanyo Shinkansen, 165 km) in March, 1972 and between Okayama and Hakata (2nd phase of Sanyo Shinkansen) in March, 1975. The line between Tokyo and Morioka (1st phase of Tohoku line, about 500 km) and the line between Omiya and Niigata (Joetsu Line, about 270 km) are under construction.

In Fig. 1 the lines to be constructed and the lines proposed as the Shinkansen Network are also shown. Although the maximum speed is scheduled as 210 km per hour at present, it is possible to increase it up to 260 km per hour in the lines except the Tokaido Line. Since the Shinkansen was first opened 14 years ago, the trains have carried over 1.3 billion passengers, running 482 million km (nearly 627 round trips between the earth and the moon). Particularly it is notable that this has been accomplished without a single casualty and it demonstrates the high rate of safety performance of the Shinkansen as a means of medium- and long-distance high-speed mass transport.

Table 1 shows the ratio of total length of various structures in the Shinkansen Lines in operation It should be noticed that the major structures are embankments (45 %) in the Tokaido Line, concrete viaducts (49 %) in the 1st phase of Sanyo Line and tunnels (52 %) in the 2nd phase of Sanyo Line. The difference is attributed not only to topographical and geographical difference, but also to technological development and engineering concept.

The recent Shinkansen structures have been designed, taking the following items more into account than before; snow-free structures, noise- and vibration-free structures, aseismic design of structures on weak ground and structures suited to slab track without ballast. Because the Tohoku Line and the Joetsu Line pass through heavy now districts, they require snow shelters or snow melters with hot water.

Since the Tokaido Line was opened, complaints of the residents along the line about the noise and ground vibration due to the train passage have prevailed. The rolling stocks, structures and tracks for the recent Shinkansen, therefore, are constructed with greater consideration for abatement of noise and vibration.

In some districts the structures could not avoid being built on weak ground, and it must be remembered that seismic acceleration and displacement are, for the Shinkansen, far more serious than in the conventional lines because of the high-speed operation of the Shinkansen trains. Various special considerations have been paid to the design and construction of these structures.

From a view-point of saving labour for the maintenance of the tracks and securing higher stability of tracks subject to frequent high-speed operation, concrete slab type tracks without ballast are now usually adopted for the Shinkansen lines. This type of track, however, requires more rigid and stable structures to support it.

All the above-mentioned conditions require a considerable increase in construction cost. Serious consideration is now being given to structures which, with no sacrifice in performance, should prove more economical.

The under-sea tunnel between Honshu and Hokkaido, 54 km in length, which will be used for the Shinkansen operation in the future is also under construction. On completion it will mark the longest tunnel record in the world.

Photo 1 Shinkansen Line in Urban Area (Oyama)

Table 1 Composition of Structures in Shinkansen Lines

Structural Types	Tokaido Line (Tokyo to Shin-osaka)		Sanyo Line 1 (Shin-osaka to Okayama)		Sanyo Line 2 (Okayama to Hakata)	
	L	%	L	%	L	%
Cut	44	9	4	2	28	7
Bank	230	45	8	5	42	10
Viaduct	116	22	80	49	88	22
Bridge	57	11	15	9	22	6
Tunnel	69	13	58	35	218	55
Total	516	100	165	100	398	100

L; The total length of each kind of structure in km

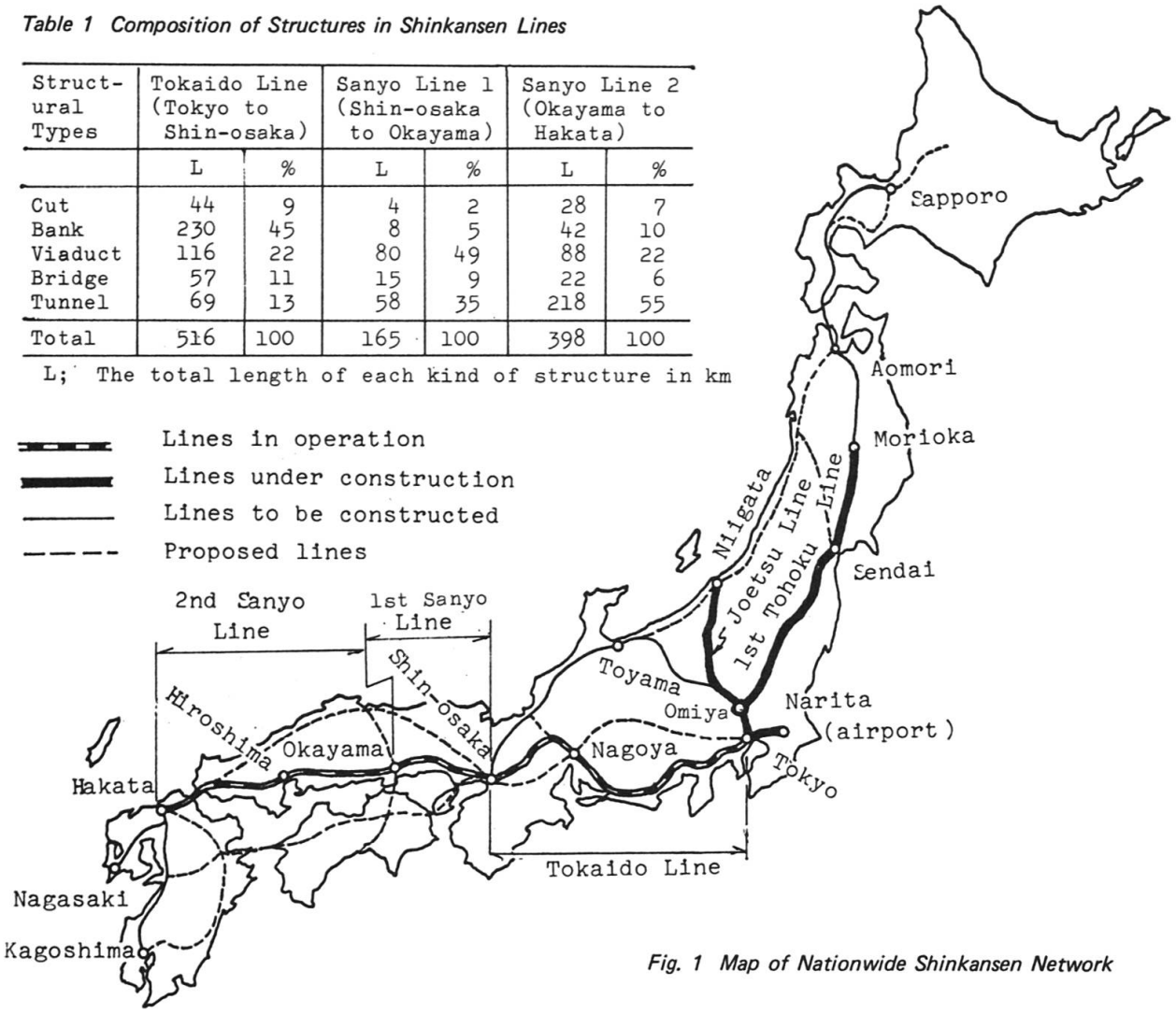

Fig. 1 Map of Nationwide Shinkansen Network

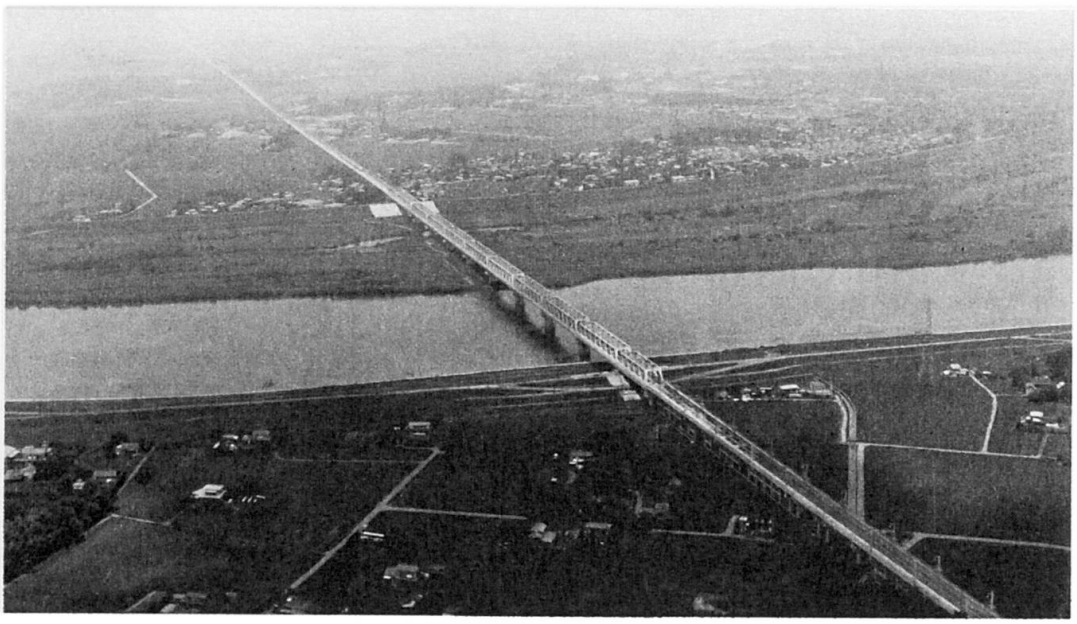

Photo 2 Shinkansen Line across a River (Tonegawa)