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## 11. Countermeasures against Snow

The Tokaido Shinkansen has been occasionally troubled by snow, but fortunately the section of the line subjected to snow is limited to a very short one. The trouble has been coped with by sprinkling water and thus melting the snow.

Snow lying on the track is blown-up by high speed operation of trains and sticks to the machines installed under the floor of rolling stock and occasionally gives rise to machine trouble. Also, lumps of snow frozen to the rolling stock drop in a warmer district by vibration, sometimes flying over and causing trouble to houses along the line.

Both the Tohoku Line and the Joetsu Line pass through heavy snow districts, so that counter-measures against snow are indispensable in order to maintain a normal operation of trains. The rolling stocks used for both the lines are provided with a greater driving power than those of the conventional Shinkansens and snow ploughs are attached to the fronts of the trains.

Among the counter-measures intensively investigated in the design of rolling stocks, electric facilities and track structures from various view-points, those taken in the track structures will be briefly explained here.

### The Tohoku Line

As seen in table 1, the snow depth is 50 cm in the northern part and 20 cm in other parts. The methods of coping with snow are principally a modification of the slab-type track structure and snow melting device by hot water.

As shown in Fig. 1, the formation width of the slab-type track is increased by 1.5 m compared with the normal one and the track slab is raised as much as 30 cm by placing concrete under it, so that the snow driven off the surface of the track slab may be able to be sufficiently piled.

In the section of ballast track which is adopted near and in station yards and in weak ground regions, hot water is sprinkled to thaw the snow.

### The Joetsu Line

As seen in table 1, a maximum snow fall in mountainous regions reaches 3 meters in depth and even in plain districts, 1 to 2 m. Also, the intensity of snow fall is 50 to 100 cm per day. Under these conditions, such positive measures as covering the track by shelters or melting snow by hot water have to be taken.

The line was located intentionally along the regions which require more tunnels, as the tunnels themselves ensure

snow-free track. But in such mountainous districts the track must be protected not only from snow fall itself but also snow-slides (see Fig. 2). For this purpose, the tunnel shells were extended beyond their ends and special concrete bridges (with a box-type section) were constructed in a few locations, so that trains may run through the inside, protected from snow, as shown in Fig. 3, 4 and 5 (refer to chapter 3). The force due to snow-slide was analyzed and estimated at 1.7 to 5.3 t/m<sup>2</sup>.

Also snow shelters made of steel or concrete are adopted in the regions free from snow slide. However, this kind of shelter is subject to a great intensity of pressure changing from plus to minus due to a high-speed passage of a train, in addition to the external force of wind.

### Snow Melting Devices

From the view-point of melting snow fast, it is preferable to use water as hot and as much as possible. There exists, however, an optimum temperature and amount of water to be used from a view-point of efficiency and economy.

In the districts near long tunnels the water springing in the tunnels is utilized (see Photo 1 and 2).

In ordinary districts water from wells and rivers are used. But in order to limit the water consumption and to raise the water temperature, a circulation and heating system has been developed. In this system a control center is placed every 2 to 3 km along necessary sections of the line, using the supervisory remote control system.

The system works automatically, controlling the amount and temperature of water, according to the intensity of snowfall. Fig. 6 shows schematically the remote control system of the snow melter.

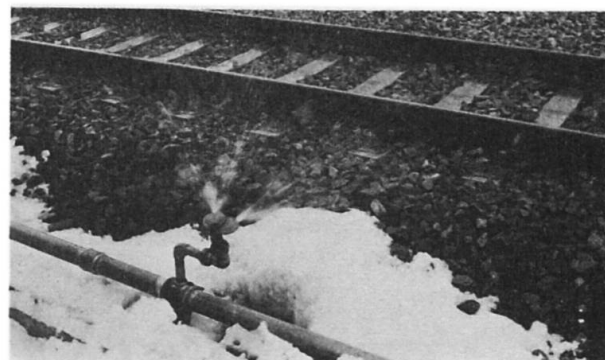


Photo 1 Sprinkler for snow-melt



Photo 2 Snow melter for turnout

Table 1 Data of snow along the lines

Districts		Max. snow depth (cm)	Max. snow fall (cm/day)	Snow-fall days
Tohoku Line	Koriyama	20	18	11
	Fukushima	26	26	12
	Sendai	16	16	66
	Ichinoseki	20	19	12
	Kitakami	51	34	31
	Morioka	33	25	20
Joetsu Line	Jomokogen	32	24	13
	Yuzawa	294	91	55
	Utsunomiya	270	81	57
	Nagaoka	157	63	42
	Niigata	40	28	18

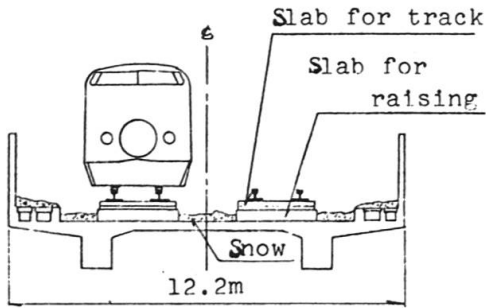


Fig. 1 Raised track structure

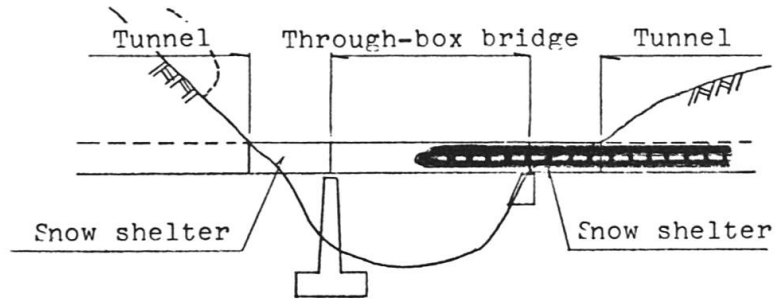


Fig. 2 Anti-snow structures for a short open section

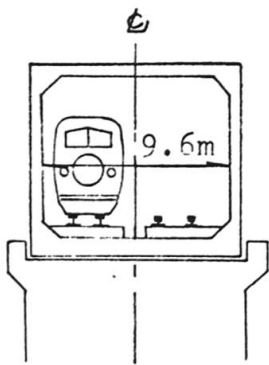


Fig. 3 Through-box bridge

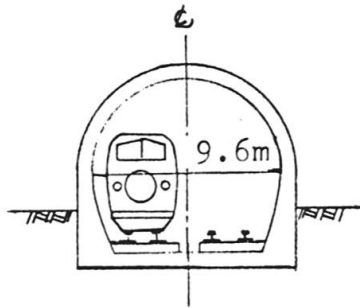


Fig. 4 Snow-shelter

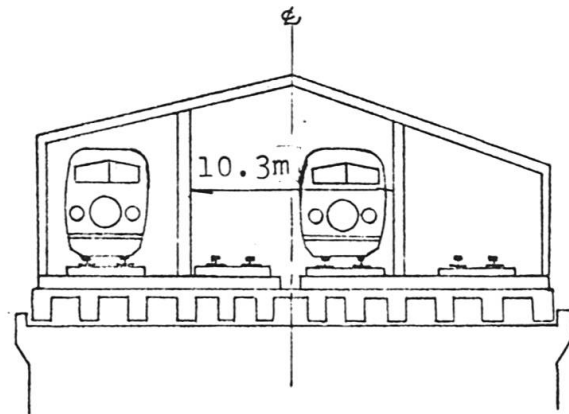


Fig. 5 Snow-shed near a station

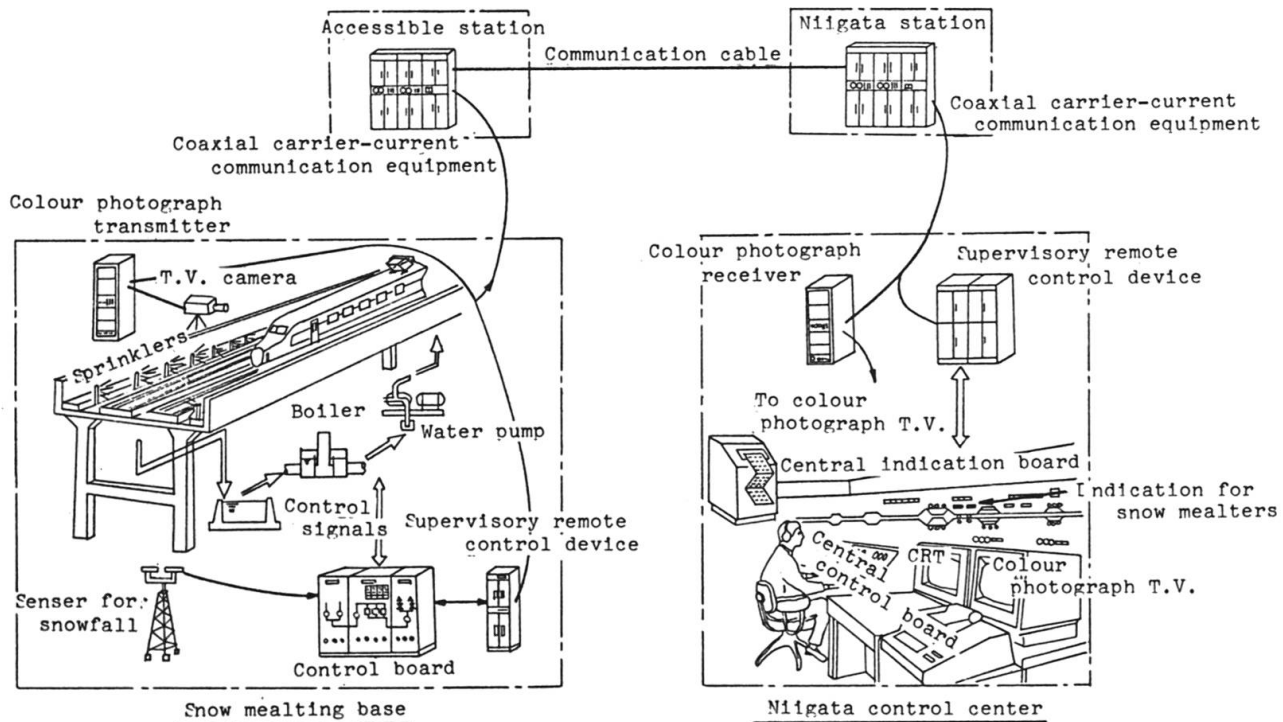


Fig. 6 Supervisory remote control system