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Autor: Hauser-Gubser, A.E.
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Descending mixed freight enters Filisur in September 1978.

RhB Freight Traffic Part 3

Drawbar Loading

by A.E.Hauser-Gubser

Continued from page 16 September 1993 Swiss Express. All photographs by the author

It is now time to discuss drawbar loads, since the application of the load factor to indicate the correct number of wagons that can be hauled by a particular locomotive has various advantages. For the modeller, the low permissible loadings means that trains will be comparatively short, but since you will probably be using a variety of classes, the length of train should vary according to the power available at the front end. As an example, the permissible drawbar load for a Ge4/4^I on the 45‰ Landquart - Davos ramps is 135 metric tonnes. This corresponds to six loaded cement cars of 23 tonnes gross apiece. In HOm the length of this train will be about 680 mm. including the locomotive.

I feel however that the intellectual challenge of finding solutions to specific logistic problems has considerable merit and should not be missed, if it is only to prove to your condescending guests that the hobby does have to be taken seriously. To help you derive the correct train lengths, you will find in Table 1 the permissible drawbar loads for most RhB locomotives on various gradients, while in Table 2 the overall permissible loads for the same gradient, and how to calculate the drawbar loads for your layout if your main ramp does not have the same inclination as the RhB lines. Table 3 gives the roster of RhB freight wagons as at 31 August 1992.

When you plan a small industry for your layout, it is important to consider not only the outward flow of manufactured products, but the inward flow of raw materials and/or components. Some industries take in more tonnage than they ship out; a case in point, very relevant to the RhB, is a stone mason. This concern not only receives the various rough stones by rail (granite, sandstone, magnesian

Tiefencastel in September 1978.

Table 1 Drawbar loads of Rhätian Railway locomotives

Loco class	Nos	Power kW	Tractiveeffort kN	at km/h	Weight tonnes	Drawbar loads in tonnes on gradients 25	35	45	60	70 ‰	Comment
G3/4	1-16	200	40	18	33.9	70	55	45	--	--	1
G2/2+2/3	25-32	368	66	20	48.4	120	90	70	--	--	1,2
G4/5	107-129	588	70	30	70	125	95	75	--	--	1
Ge2/4	221-222	450	41	39.3	31.8	100	70	50	--	--	
Ge4/6	353-355	544	62	31.3	59	140	95	65	--	--	
Ge6/6^{I}	411-415	940	116	29.2	66	310	220	160	--	--	3
Ge4/4^{I}	601-610	1180	93	45.7	47	260	185	135	110	--	4
Ge6/6^{II}	701-707	1780	140	45.7	65	390	280	205	--	--	
Ge4/4^{II}	611-633	1700	117	52	50	335	245	185	--	--	
Ge4/4^{III}	641-649	2500	145	62	62	410	290	210	--	--	5
ABe4/4	481-488	680	76	32	44	--	--	--	70	--	6
ABe4/4	41-49	680	87	28	43	--	--	--	--	70	7
ABe4/4	51-56	1016	96	38	47	--	--	--	--	90	8

Comments

1: Steam locomotives
2: Mallet articulated
3: Nos 411-415 are higher powered than 401-410
4: 110 tonnes once Chur - Arosa is operated on 11 kV ac
5: Latest locomotive with converter technology, introduced 1992/3
6: 70 tonnes as long as Arosa line is operated with dc
7: Bernina line, conventional dc technology
8: Bernina line, converter technology

Table 2 Drawbar Loading

Highest permissible drawbar loads

The highest permissible drawbar loads are:

for 25‰	440 tonnes	for 60‰	175 tonnes
for 35‰	310 tonnes	for 70‰	140 tonnes
for 45‰	230 tonnes		

How to determine locomotive drawbar loads

Drawbar loads depend on tractive force, speed, gradient, curve radii, rolling resistance, type of wagon (2- or 4-axle) and breaking strength of the couplers. The RhB has established exact data for each of these criteria for each locomotive class. It would be going too far to use the same method here, but it is possible to determine the appropriate loading with tolerable accuracy by the formula:

DL=((kNx101.936)/rr)-LW

where:

DL = Drawbar load in tones	LW=Locomotive weight
rr = Rolling resistance	101.936=Factor to obtain tractive effort in kg

To overcome a gradient we substitute one kg per tonne of train weight per promille gradient (ie 35‰ = 35 kg per tonne). To this we have to add the resistance to rolling proper:

5.0 - 5.5 kg for 15-25‰	7.0 - 8.0 kg for 45 - 55‰
5.5 - 6.0 kg for 25-35‰	8.0 - 9.0 kg for 55 - 65‰
6.0 - 7.0 kg for 35-45‰	9.0 - 10.0 kg for 65 - 70‰

Let us assume you have a model of a Ge6/6[I] locomotive and that your steepest gradient is 40‰. The permissible drawbar load is:

(116 kN x 101.936/46)-66 = 91 tonnes.

These values remain true so long as you use the speeds set out in Table 1. as soon as you increase your speed the available kN and therefore the available drawbar loads are reduced. We then have to find the tractive effort in kN by the formula:

Power x 3.6 / speed

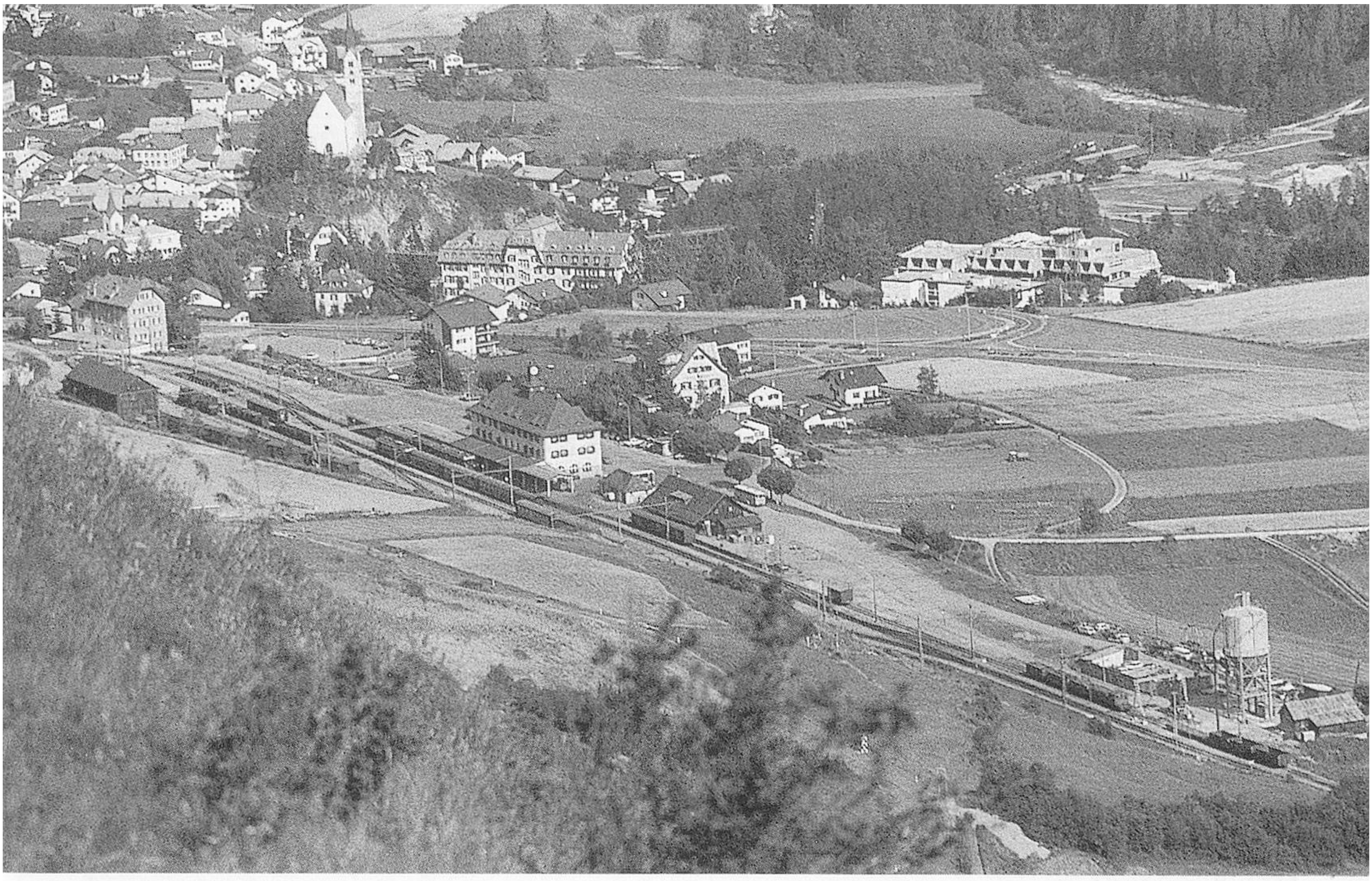
As an example, a Ge4/4[II] climbs the 35‰ Albula ramp at 60 km/h, hence the available kN are:

1700 x 3.6 / 60 = 102 kn

which allows a drawbar load according to the first formula of only 200 tonnes instead of the 245 tonnes available at 52 km/h. Do not use speeds in excess of 60 km/h for ramps up to 45‰ and not over 45 km/h for ramps of 50-70‰. Although lower speeds than those given in Table 1 would allow for higher drawbar loads, this in not done on the RhB, because the already tight timetable schedules have to be kept and the management is keen to deliver the goods as fast as possible.

It may be useful to check with Table 1 to know how precise my formulae are. Take a Ge6/6[II] on the 45‰ ramp from Landquart to Davos Platz. 140 kN x 101.936 divided by 52 less 65 = 209 tonnes, a difference of 4 tonnes against the official timetable, which is certainly within acceptable tolerances.

limestone, granular dolomite, marble, etc.), but also the tools to work them, diamond cutting wheels up to 1.2 m diameter, carborundum and silicon carbide in many grit sizes and quantities of up to 40 tonnes, steel ropes and much auxiliary equipment and machinery spares. The products, depending on their size and shape, leave the factory by flat car, covered van and in containers. The latter are frequently loaded straight from the production line with the 7 mm thick granite cladding sheets used on so many modern buildings. A stoneworks is not very demanding of space, since most products are made to the customers requirements. Only if you add concrete articles to the production line will you need to provide an open storage area for standard products held to meet purchaser's demands.



Top: Scuol-Tarasp in September 1980.

Bottom: Zernez in June 1991, west side of station with wagons loaded with granite ready for despatch, loaded wagons with timber and a train for spent ballast.

Table 3: Roster of RhB Goods Wagons as at 31 August 1992

Class	Numbers	Axles	In service (rebuilt)	Nos. in use	Tare tonnes	Load capacity	Total cars	Total capacity
1: Vans								
Gbk-v	5502..5614	2	1911-13	102	7	12.5		
Gbk	5616..5790	2	1889-91 (1950-52)	38	7.2	12.5		
Gb	5801-5813	2	1911-14 (1961-67)	13	7.2	15		
Gb	5815-5817	2	1967	3	7.2	15		
Gb	5901-5912	2	1925-31	12	7.5	15		
Gb	5913-5920	2	1960-62	8	7.4	15		
Gb	5001-5100	2	1962-63	100	7.8	15		
Gak-v	5401-5420	4	1979	20	15	26		
Haik-v	5101-5119	4	1970	19	13.2	26		
Haik-vy	5120	4	1973	1	15	26		
Haik-v	5121-5135	4	1980	15	15	26		
Haikq-y	5161-5170	4	1980-81	10	15	26		
Haik-y	5171-5190	4	1992	20	18	35		
Iak	5421*	4	1983	1	15	26	362	6206
2: High sided open wagons								
Ek	6023..6226	2	1903-31	38	5	10		
E	6601..6635	2	1911-13	33	6.4	15		
Fb	8501..8523	2	1913 (1977-83)#	22	8	20	93	1315
3: Low sided open wagons								
Kkl	7027..7090	2	1900-06	21	5	10		
Kk-w	7301..7385	2	1911-14	63	5.1	12.5		
K-w	7501-7509	2	1913-14	9	5.8	15	93	1132.5
4: Flat wagons								
Rkp-w	8202-8218@	4	1911	17	12.3	25		
Rp-w	8231..8240	4	1956	9	11.4	35		
Rp	8221-8226	4	1931	6	14	30		
Rp-w	8271-8290	4	1979	20	15	35		
R-w	8241..8270	4	1966-79	25	15	35		
Rp-w	? @	4	1992-93	27	18	42		
Sk-l	8401-8412	4	1911-1935	12	15	35	116	4049
5: Tank wagons								
Uh	8101,8103	2	1926-28	2	8	15		
Uhk-v	8104-8106	2	1953	3	9	15		
Uhk	8113-8116	2	1900	4	5	5		
Uahk-v	8121-8126	4	1930-36	6	13	22		
Uah	8131-8140	4	1973	10	12	35		
Uahk-v	8141-8162	4	1954-64	22	13	30		
Uahr	8163-8172	4	1965	10	12	30		
Uah	8173-8192	4	1967-69	20	12	35	77	2237

Table 3 (continued): Roster of RhB Goods Wagons as at 31 August 1992

Class	Numbers	Axles	In service (rebuilt)	Nos. in use	Tare tonnes	Load capacity	Total cars	Total capacity
6: Cement silo wagons								
Uce	8001-8100	2	1956-64	100	8	15		
Uace	7991-8000	4	1992	10	16	40	110	1900
7: Gravel/ballast container wagons								
Lbk	7346..8645	2	1903-13	22	5	13		
Fad	8701-8712	4	1968-74	12	14	34		
Fad	8721-8725	4	1983	5	18	35		
Fad	8751-8756	4	1978	6	18	30		
Fa-u	8761-8770	4	1992	10	18	42		
Fd	8651..8665	2	1954-65	15	7	15	70	1837
8: Refrigerator vans								
Ick	4511-4512	2	1911-13	2	7	12	2	24
9: Runner wagons								
Lck	7802-7826	2	1896-1913	19	5	10		
Lklp	7827-7828	2	1914	2	5	10	21	210
10: Low loading wagons								
Ua-z		6	1958	1	23	42		
Uaik	8252	4	1928	1	12	15		
Uaik	8301	4	1928	1	13	27	3	84

Total wagons 947 Total capacity 18970.5 tonnes.

* Refrigerated

Rebuilt with steel sides

@ For containers

There are about 40 wagons in private ownership, but built to RhB standards. Among them is a low loading wagon for combined road/rail transport with a load capacity of 93 tonnes.

I very much hope that the information in these three articles has helped members appreciate the complexity of RhB freight traffic patterns and has helped the modellers to improve the operating pattern of their lines. Whilst we have been concerned with the RhB, the mainstay of Swiss HOm modelling, other narrow gauge lines, the FO, BVZ, MOB, RBS, AB etc, follow a similar pattern, the variations being accounted for by different industries, topography and passenger requirements. You will even find some of the elements described on the SBB, for instance the Cargo Domizil service and freight centres, but on a much larger scale.

Finally, remember that in the freight business, methods are frequently changing. Let us therefore take a look into the future, when the 19 km Vereina tunnel will be completed. This will boost freight traffic to and from the Engadin enormously because of the reduction in running time by at least an hour. This will mean that the lorry will lose much of its competitive advantage, since unless it is sent on low loaders through the tunnel, it will have to travel over one of the tortuous passes. Then of course there will be the car carrying trains through the tunnel, hauled by one of the new Ge4/4[III] class locomotives, a model of which is almost certain to be on the market before long.