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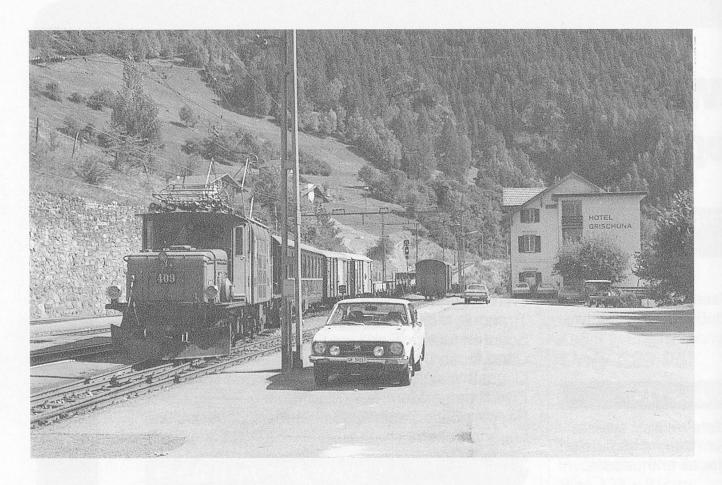
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Descending mixed freight enters Filisur in September 1978.

RhB Freight Traffic Part 3

Drawbar Loading

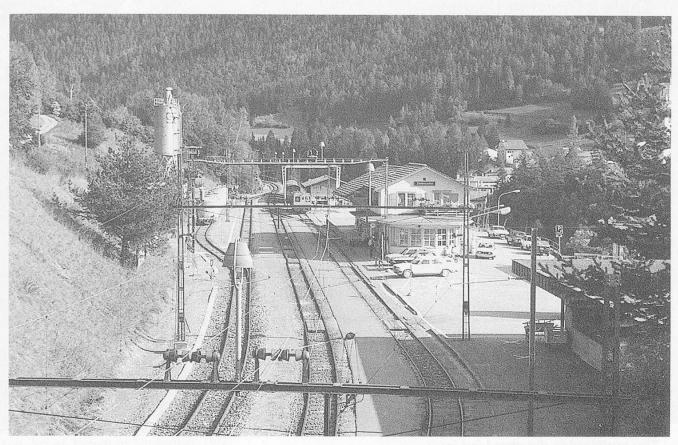
by A.E.Hauser-Gubser

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 Ge4/41 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	Nos	Power	Tract	iveeffort	Weight	Draw	bar loa	ads in t	onnes	on gr	adients	Comment
class		kW	kN a	t km/h	tonnes	25	35	45	60	70	%	
G3/4	1-16	200	40	18	33.9	70	55	45				·
G2/2+2/3	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				
Ge6/61	411-415	940	116	29.2	66	310	220	160				3
Ge4/41	601-610	1180	93	45.7	47	260	185	135	110			4
Ge6/611	701-707	1780	140	45.7	65	390	280	205				
Ge4/411	611-633	1700	117	52	50	335	245	185				
Ge4/4III	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

rr = Rolling resistance

LW=Locomotive weight

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% 9.0 - 10.0 kg for 65 - 70%

Let us assume you have a model of a Ge6/6¹ locomotive and that your steepest gradient is 40%. The permissible drawbar load is:

 $(116 \text{ kN} \times 101.936/46)-66 = 91 \text{ tonnes}.$

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: $1700 \times 3.6 / 60 = 102 \text{ kn}$

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.



Swiss Express Vol.4/1 March 1994

			ds Wagons			2		
Class	Numbers	Axles	In service	Nos. in	Tare	Load	Total	Total
			(rebuilt)	use	tonnes	capacit	y cars	capacity
1: Vans								
	55025614	2	1911-13	102	7	12.5		
	56165790	2	1889-91	38	7.2	12.5		
			(1950-52)					
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		
	5121-5135	4	1980	15	15	26		
Haikq-y	5161-5170	4	1980-81	10	15	26		
	5171-5190	4	1992	20	18	35		
	5421*	4	1983	1	15	26	362	6206
2: High side	ed open wago	ons						
	60236226	2	1903-31	38	5	10		
	66016635	2	1911-13	33	6.4	15		
	85018523	2	1913	22	8	20	93	1315
	0001110000		(1977-83)#					
3: Low side	ed open wago	ns						
	70277090	2	1900-06	21	5	10		
	73017385	2	1911-14	63	5.1	12.5		
	7501-7509	2	1913-14	9	5.8	15	93	1132.5
4: Flat wag	ions							
	8202-8218@	4	1911	17	12.3	25		
	82318240	4	1956	9	11.4	35		
	8221-8226	4	1931	6	14	30		
	8271-8290	4	1979	20	15	35		
	82418270	4	1966-79	25	15	35		
	?@	4	1992-93	27	18	42		
	8401-8412	4	1911-1935	12	15	35	116	4049
5: Tank wa	naons							
	8101,8103	2	1926-28	2	8	15		
	8104-8106	2	1953	3	9	15		
	8113-8116	2	1900	4	5	5		
	8121-8126	4	1930-36	6	13	22		
	8131-8140	4	1973	10	12	35		
	8141-8162	4	1954-64	22	13	30		
	8163-8172	4	1965	10	12	30		
	8173-8192	4	1967-69	20	12	35	77	2237
Jan	0170-0132	Т	1307-03	40	14	00	11	££01

6: Cement sil Uce 80 Uace 79 7: Gravel/bal Lbk 73 Fad 87 Fad 87 Fad 87 Fad 87	ilo wagons 001-8100 991-8000		In service (rebuilt) 1956-64	Nos. in use	Tare tonnes	Load capacity		Total capacity
Uce 80 Uace 79 7: Gravel/bal Lbk 73 Fad 87 Fad 87 Fad 87 Fad 87	001-8100 991-8000	2	1956-64		tonnes	capacity	y cars	capacity
Uce 80 Uace 79 7: Gravel/bal Lbk 73 Fad 87 Fad 87 Fad 87 Fad 87	001-8100 991-8000			100				Capacity
Uace 79 7: Gravel/bal Lbk 73 Fad 87 Fad 87 Fad 87 Fad 87 Fad 87	991-8000			100				
7: Gravel/bal Lbk 73 Fad 87 Fad 87 Fad 87 Fa-u 87		4		100	8	15		
Lbk 73 Fad 87 Fad 87 Fad 87 Fa-u 87	llast containe		1992	10	16	40	110	1900
Lbk 73 Fad 87 Fad 87 Fad 87 Fa-u 87		r wagon:	S					
Fad 87 Fad 87 Fa-u 87			1903-13	22	5	13		
Fad 87 Fa-u 87	701-8712	4	1968-74	12	14	34		
Fa-u 87	721-8725	4	1983	5	18	35		
	751-8756	4	1978	6	18	30		
Fd 86	761-8770	4	1992	10	18	42		
	6518665	2	1954-65	15	7	15	70	1837
8: Refrigerato	or vans							
		2	1911-13	2	7	12	2	24
9: Runner wa	agons							
		2	1896-1913	19	5	10		
Lklp 78	827-7828	2	1914	2	5	10	21	210
10: Low load	ling wagons							
Ua-z		6	1958	1	23	42		
Uaik 82	252	4	1928	1	12	15		
Uaik 83		4	1928	4	13	27	3	84

Total wagons 947 Total capacity 18970.5 tonnes.

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.

^{*} Refrigerated

[#] Rebuilt with steel sides

[@] For containers