4C grading

1. Description

SR TIMSORT (call in simulation_4C if flag_wpm=1) generates a list of assortments of the available timber. timsort.f is called per year, generating the list of ‚timber pieces' of the whole stand separated for the remaining and harvested part of the stand. The output of the assortments with information about the diameter, lenght, volume and species is given in an output data file <name>_mansort.out* (harvested part) und <name>_standsort.out* (remaining part).

Following information are used

- a data set for grading per species with data about minimum lenght, minimum diameter (see Table 1)
- data about bark (see Table 2, data field rabz in amod_tisort.f)

Per tree cohort the following variables are used:

N (number), H (height), HBO (bole height), DBH, DCRB (trunk diameter at crown base)

The grading uses 6 categories according to Table 1, called STE, SG1, SG2, IN1, IN2, FUE (see Table 3).

Grading is controlled by flag_sort

Flag_sort = 0 : all assortments

Flag_sort = 1 : no STE, all other

Flag_sort = 2 : only SG2 (3m), IN1,IN2, FUE

Flag_sort = 3 : only SG1 (4m), IN1,IN2, FUE

2. Calculation of required variables

suml - length of the always measured stem segments

Dborg – basis diameter at height stoh (stump height)

Horg – height of the total stem

Dbase – diameter at the stem base

a) Diameter Db at height Hs = STOH (STOH = 10 cm)

if HBO = 0.:

$$Dborg = \frac{(Horg - STOH) * Dbase}{Horg}$$

else

$$Dborg = DCRB + (Dbase - DCRB) * \frac{(HBO - STOH)}{HBO}$$

b) Diameter Dx at height Hx:

Hx ≤ HBO

$$\tan\alpha = \frac{Dborg - DCRB}{HBO} = \frac{Dx - DCRB}{(HBO - suml - Hx)}$$

$$Dx = \frac{(Dborg - DCRB)(HBO - suml - Hx)}{HBO} + DCRB$$

Hx > HBO

$$\tan\beta = \frac{DCRB}{2(Horg - HBO)} = \frac{Dx}{2(Horg - suml - Hx)}$$

$$Dx = \frac{DCRB(Horg - suml - Hx)}{(Horg - HBO)}$$

DCRB=0

$$Dx = Dborg\frac{Horg - suml - Hx}{(Horg - stoh)}$$

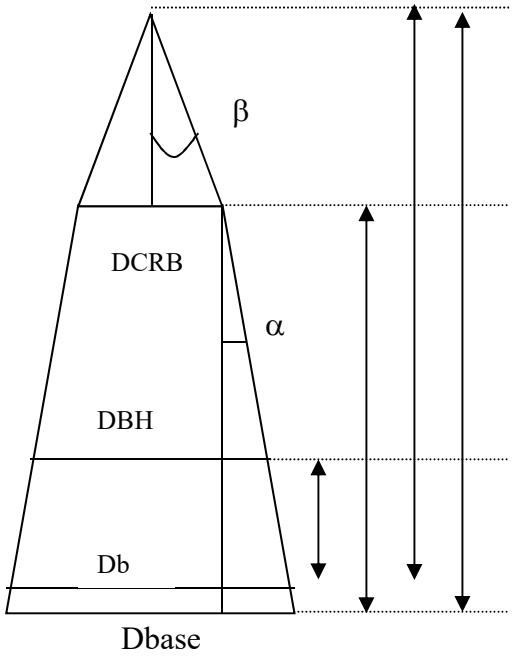

Figure 1 stem variables

c) height Hx at diameter Dx

DCRB <Dx

$$\frac{HBO}{Dborg - DCRB} = \frac{HBO - suml - Hx}{Dx - DCRB}$$

$$Hx = HBO - suml - \frac{HBO(Dx - DCRB)}{Dborg - DCRB}$$

DCRB > Dx

$$\frac{Horg - HBO}{DCRB} = \frac{Horg - Hx - suml}{dx}$$

$$Hx = Horg - suml - \frac{(Horg - HBO)Dx}{DCRB}$$

DCRB = 0

$$Hx = Horg - suml - \frac{(Horg - stoh)Dx}{Dborg}$$

3. Variables for grading

For data and definitions see Table 1:

RABZ – bark extraction (Table 2)

LMIN - minimum diameter at H=0.1 m

LDMIN - minimum diameter at Hlzmin/2

LZMIN

LASFIXL1

LASFIXL2

LASDMIN

LASZMIN

ZUS addition at stem length (5cm, 10 cm,)

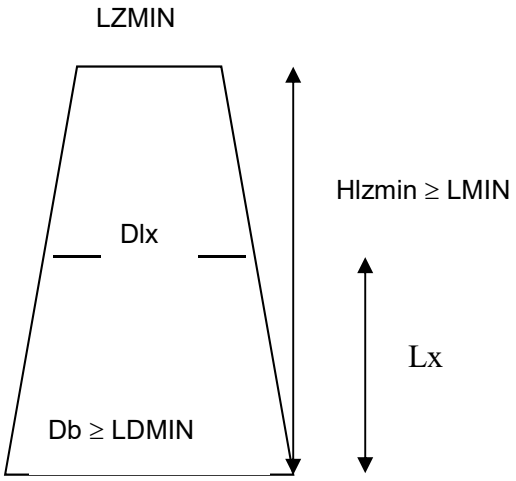

Figure 2 stem section characteristics

Per species

Per diameter class, per cohort

Db ≤ LZMIN yes → fulewood

↓

no

Hlzmin is calculated: stem length Hx with Dx= LZMIN

Hlzmin ≤ LMIN yes ⟶ industrial wood

no ↓

Lx = Hlzmin/2

Dlx is calculated: diameter at height Lx

Dlx ≤ LDMIN yes ⟶ stem sections

no ↓

calculation of the volume of the stem

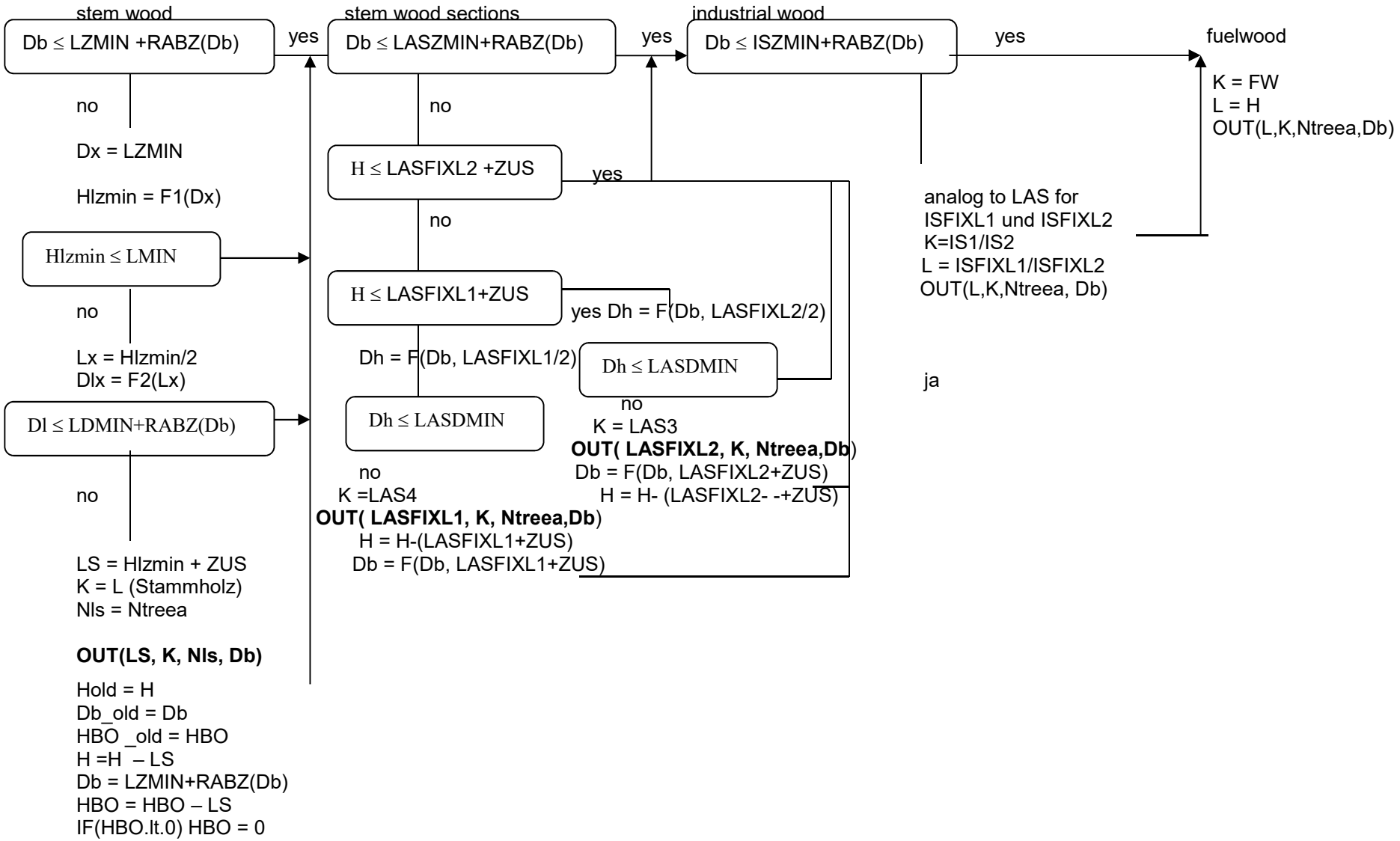

Figure 3 Flow Diagram of grading

Table 1 Parameter for timber grading in 4C (P. Mohr)

Species group	species	Stump height [m]	Stem wood (L) – min. lengtht [m]	L –min. diameter [cm o.R.]	L-min. top diameter [cm o.R.]	Wood section (LAS) - length 1 [m]	LAS -length 2 [m]	LAS-min. diameter [cm o.R.]	LAS –min. top diameter [cm o.R.]	Ind. wood(IS)-length 1 [m]	IS-length 2 [m]	IS-min. diameter [cm o.R.]	IS-min. top diameter [cm m.R.]	Fuel wood (BRH)
BAGRP	BAUM	STOH	LMIN	LDMIN	LZMIN	LASFIXL1	LASFIXL2	LASDMIN	LASZMIN	ISFIXL1	ISFIXL2	ISDMIN	ISZMIN	BRH
Pinelike needle wood Nadelholz	Pine larch	0.1	4	30	14	4	3	15	11	2	1	10	7	
Sprucelike needle wood	Spruce, Douglas fir	0.1	4	30	14	4	3	15	11	2	1	10	7	
Soft broadleaved. wood	birch	0.1	4	35	20	4	3	20	11	2	1	10	7	
Hard broadleaved wood	Beech, oak	0.1	4	30	20	4	3	20	11/ 18 (Bäucker)	2	1	10	7	

o.R. – without bark

Table 2 bark extraction DM- diameter in the middle of the stem (section)

Species	DM [cm]	Bark [cm]
beech	< 35	1
	>35	2
spruce	< 25	1
	25-40	2
	> 40	3
pine	< 20	1
	20-30	2
	> 30	4
oak	< 40	3
	40-60	5
	> 60	6
birch	< 40	2

New assortment for pine LAS1a (Juli 2003): with LAS1DMIN = 11 and LAS1ZMIN = 11; length as for LAS

Table 3 timber assortment abbreviations

Model 4C	**Timber grade**	
ste	L	Stem wood
sg1	LAS 1	wood sections length 1
sg2	LAS2	wood sections length 2
in1	IS1	industrial timber length 1
in2	IS2	industrial timber length 1
fue	BRH	Fuel wood

Example of output in file <name>_standsort.out
diam_wob : diameter without bark
t_d_wob: top diameter without bark
top_d – diameter at top

Sortiment of whole stand (without harvested trees)

year	count	spec	type	cm len	cm diam	cm diam_wob	cm top_d	cm t_d_wob	M³/ha Volume	Kg C/ha DW	number
1	326	4	fue	354.229	4.317	1.317	0	0	0.0022	0.621	14
1	325	4	fue	625.218	5.587	2.587	0	0	0.0058	1.614	24
1	324	4	fue	870.851	8.157	5.157	0	0	0.0146	4.08	35
1	323	4	fue	1146.379	10.065	7.065	0	0	0.0327	9.162	17
1	322	4	fue	1344	11.808	8.808	0	0	0.0581	16.262	5
1	321	4	fue	1367	12.665	9.665	0	0	0.0697	19.52	3
1	320	4	in1	210	13.255	10.255	12.665	9.665	0.0291	8.156	3
1	319	4	fue	826.194	12.667	9.667	0	0	0.0347	9.717	1
1	318	4	in1	210	14.014	11.014	12.667	9.667	0.0311	8.701	1
1	317	4	in1	210	15.436	12.436	14.759	11.759	0.0395	11.06	1
1	316	4	fue	920	12.963	9.963	0	0	0.0405	11.332	2
1	315	4	in1	210	14.356	11.356	12.963	9.963	0.0328	9.179	2
1	314	4	in1	210	15.792	12.792	15.204	12.204	0.0413	11.566	2
1	313	4	in1	210	17.026	14.026	16.439	13.439	0.048	13.44	2
1	312	4	in1	210	18.261	15.261	17.673	14.673	0.0552	15.455	2
1	311	4	in1	210	19.495	16.495	18.907	15.907	0.0629	17.61	2
1	310	4	fue	950	14.679	11.679	0	0	0.0536	15.006	5
1	309	4	in1	210	15.787	12.787	14.679	11.679	0.04	11.209	5
1	308	4	in1	210	17.076	14.076	16.462	13.462	0.0483	13.521	5
1	307	4	in1	210	18.365	15.365	17.751	14.751	0.0558	15.634	5
1	306	4	in1	210	19.654	16.654	19.04	16.04	0.0639	17.901	5
1	305	4	in1	210	20.943	17.943	20.329	17.329	0.0726	20.321	5
1	304	4	fue	878	14.434	11.434	0	0	0.0479	13.409	4
1	303	4	in1	210	16.06	13.06	14.434	11.434	0.0431	12.077	4
1	302	4	in1	210	18.658	15.658	17.848	14.848	0.0569	15.938	4
1	301	4	in1	210	19.878	16.878	19.297	16.297	0.0654	18.307	4
1	300	4	in1	210	21.098	18.098	20.517	17.517	0.0736	20.618	4
1	299	4	in1	210	22.317	19.317	21.736	18.736	0.0824	23.066	4

1	298	4	in1	210	23.537	20.537	22.956	19.956	0.0916	25.652	4
1	297	4	fue	675	11.967	8.967	0	0	0.0253	7.086	4
1	296	4	in1	210	13.714	10.714	11.967	8.967	0.0316	8.849	4
1	295	4	in1	210	17.383	14.383	15.636	12.636	0.0505	14.147	4
1	294	4	in1	210	20.547	17.547	19.305	16.305	0.0676	18.933	4
1	293	4	in1	210	21.749	18.749	21.177	18.177	0.0782	21.908	4
1	292	4	in1	210	22.951	19.951	22.379	19.379	0.0871	24.392	4
1	291	4	sg1	410	24.725	21.725	23.581	20.581	0.1975	55.29	4
1	290	4	fue	754	14.321	11.321	0	0	0.0405	11.335	7
1	289	4	in1	210	16.195	13.195	14.321	11.321	0.044	12.313	7
1	288	4	in1	210	20.132	17.132	18.257	15.257	0.0645	18.062	7
1	287	4	in1	210	21.868	18.868	21.258	18.258	0.0791	22.152	7
1	286	4	sg1	410	23.759	20.759	22.539	19.539	0.1824	51.074	7
1	285	4	sg1	410	26.26	23.26	25.04	22.04	0.2227	62.367	7