Assessing the ability of hardwood and softwood brush mats to distribute applied loads

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Outline

o Background and problem statement

o Research objectives

o Methodology

o Results and discussion

o Conclusion

Background and problem statement

- Increased importance of mechanized forest operations
- Harvesting residue (brush) can be used as a soil protective layer
- The effect of brush quantity on load distribution is well documented but more information on the influence of brush quality is needed

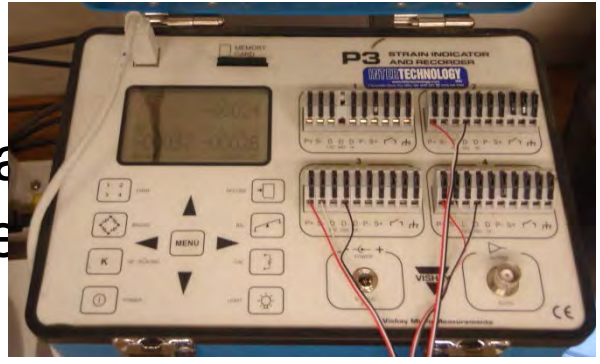
Research objectives

- Determine and quantify the difference in loading resistance between HW and SW small-scale brush mats of different amounts compared to no brush.

- Quantify the effect of repetitive loadings of brush mats on their ability to reduce strain recorded beneath the mats.

Methodology

- Three strain gauges were installed on separate steel channels at the bottom of the load box.



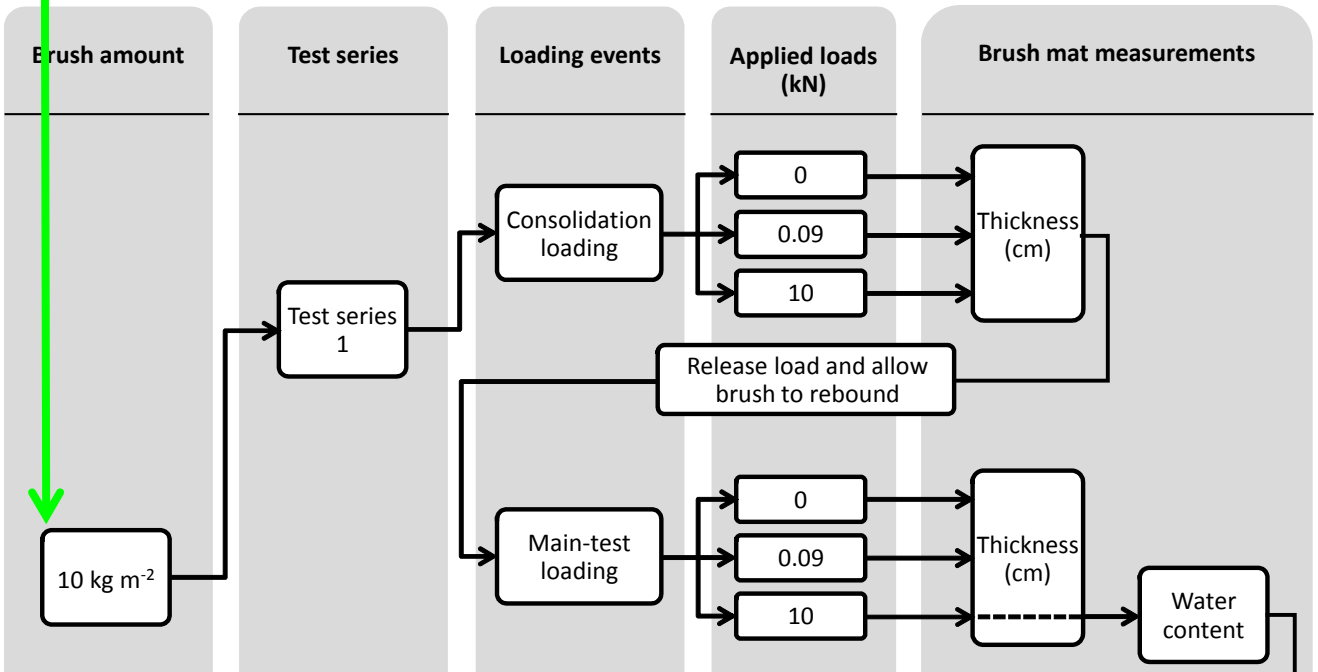
- Strain gauges were covered by a 15 cm la
equally assess load distributing capabilitie
brush amounts.

kg m^{-2}

Hardwood (HW)		Softwood (SW)	
Test 1	Test 2	Test 1	Test 2
~~10~~	~~10~~	**10**	10
20	20	20	20
30	30	30	30
40	40	40	40

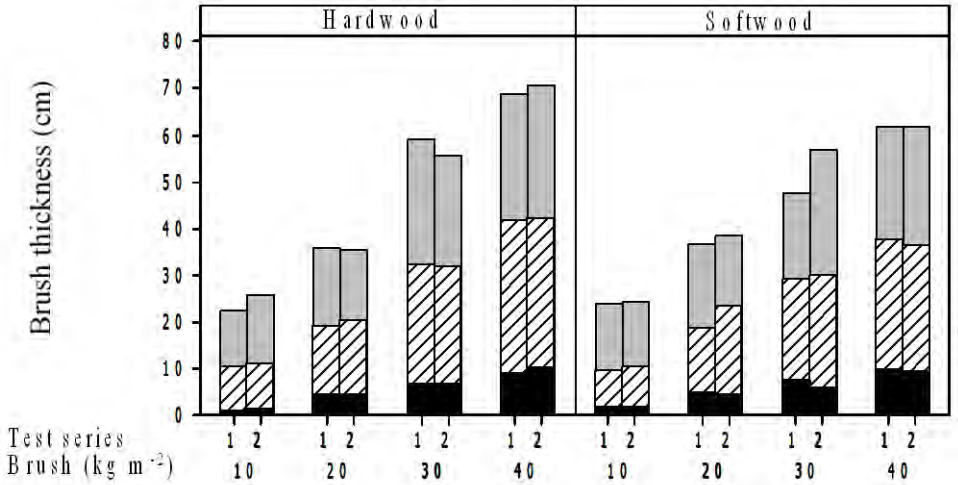
0.09 kN = 4.8 kPa

10 kN = 537 kPa

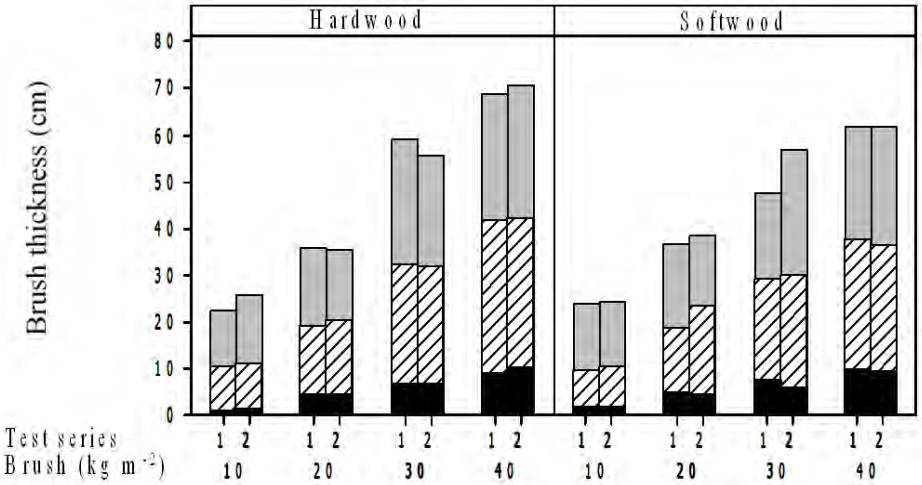


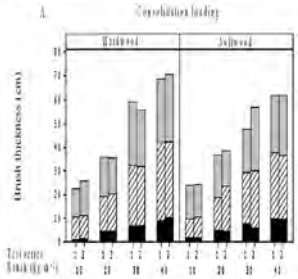
Results

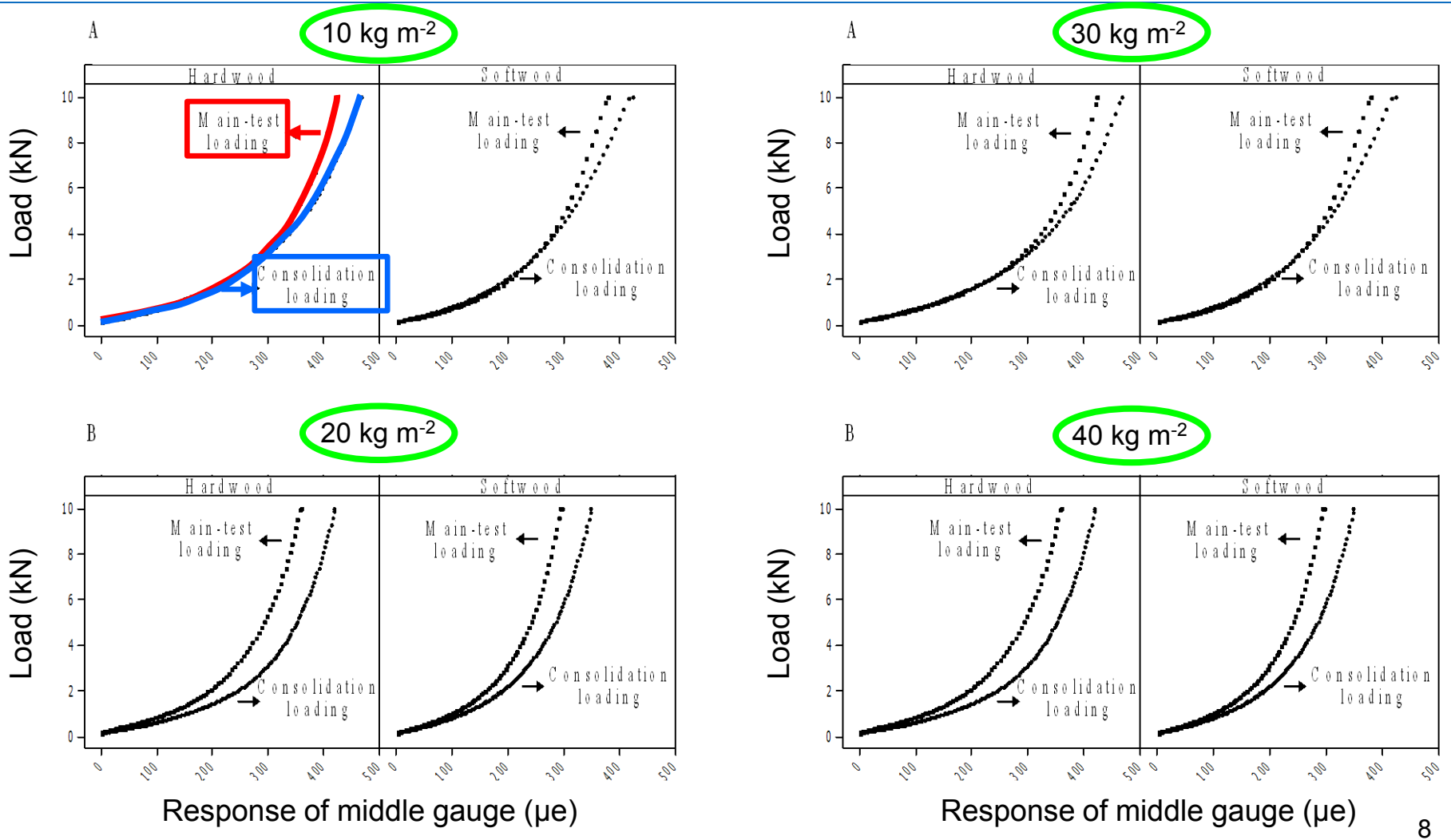
Consolidation loading



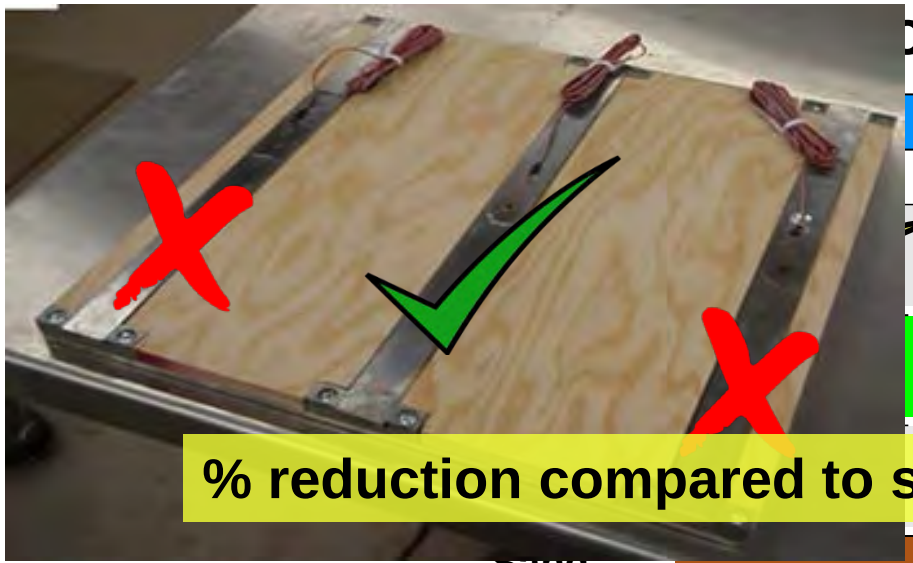
Main-test loading






A
10 kg m-2
Hardwood
Softwood
Main-test loading
Consolidation loading
Load (kN)
A
30 kg m-2
B
20 kg m-2
B
40 kg m-2
Response of middle gauge (με)

# of middle gauge

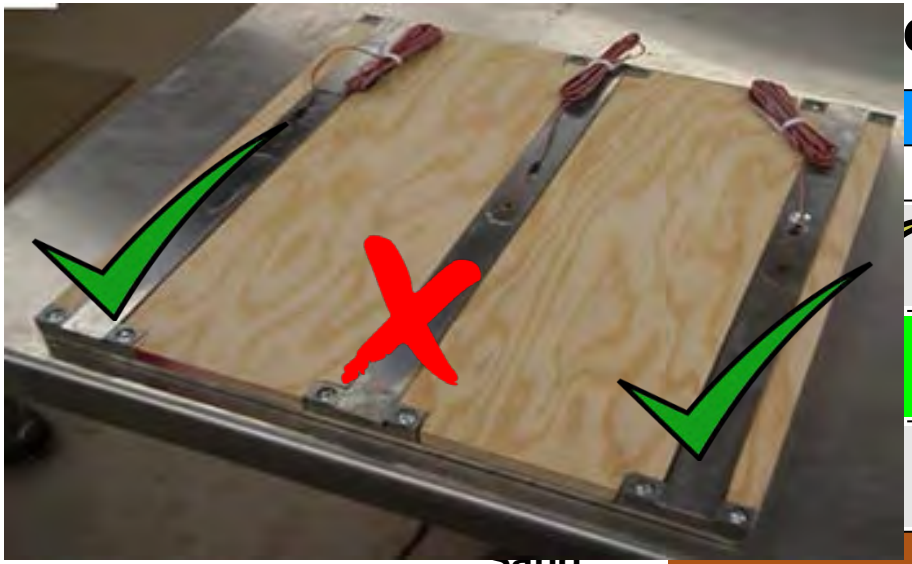


% reduction compared to sand

		Sand	Hardwood		
		0 kg m^{-2}	20 kg m^{-2}	30 kg m^{-2}	40 kg m^{-2}
1	(με)	337.0	123.0 *ab*	80.5 *bc*	61.9 *c*
	(%)	100.0	63.5	76.1	81.6
5	(με)	864.1	296.0 *ab*	224.9 *b*	177.0 *b*
	(%)	100.0	65.7	74.0	79.5
10	(με)	1310.0	362.0 *ab*	276.0 *bc*	222.0 *c*
	(%)	100.0	72.4	78.8	83.1

		Sand	Softwood			
		0 kg m^{-2}	10 kg m^{-2}	20 kg m^{-2}	30 kg m^{-2}	40 kg m^{-2}
1	(με)	337.0	125.8 *a*	112.7 *ab*	75.1 *bc*	60.1 *c*
	(%)	100.0	62.7	66.6	77.7	82.2
5	(με)	864.1	292.8 *a*	261.8 *ab*	214.5 *bc*	186.4 *c*
	(%)	100.0	66.1	69.7	75.2	78.4
10	(με)	1310.0	369.5 *a*	320.5 *ab*	266.0 *bc*	233.0 *c*
	(%)	100.0	71.8	75.5	79.7	82.2

# of side gauges



		Hardwood		
		20 kg m^{-2}	30 kg m^{-2}	40 kg m^{-2}
	(με)	25.5 *a*	19.9 *ab*	13.9 *b*
	(%)	20.7	24.7	22.4
	(με)	79.5 *a*	70.3 *ab*	59.5 *b*
	(%)	26.8	31.3	33.6
	(με)	103.3 *ab*	87.5 *ab*	78.3 *b*
	(%)	28.5	31.7	35.2

		Sand	Softwood			
		0 kg m^{-2}	10 kg m^{-2}	20 kg m^{-2}	30 kg m^{-2}	40 kg m^{-2}
1	(με)	17.2	39.3 *a*	34.4 *ab*	24.2 *bc*	16.9 *c*
	(%)	5.[illegible]	31.[illegible]	30.[illegible]	32.[illegible]	28.2
5	(με)	53.9	109.8 *a*	100.2 *a*	85.2 *a*	75.5 *a*
	(%)	6.2	37.5	38.3	39.7	40.5
10	(με)	51.8	147.0 *a*	130.0 *a*	109.5 *a*	100.5 *a*
	(%)	4.0	39.8	40.6	41.2	43.1

Conclusion

- Small-scale brush mats reduced strain directly below loading disk and increased lateral strain

- SW brush mats performed slightly better than HW mats

- Further studies with full-scale (unconfined) brush mats of varying species and branch water contents should be performed

Thank you - Vielen Dank!

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New Brunswick Forest Products Association

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FI NB IF INNOVATION
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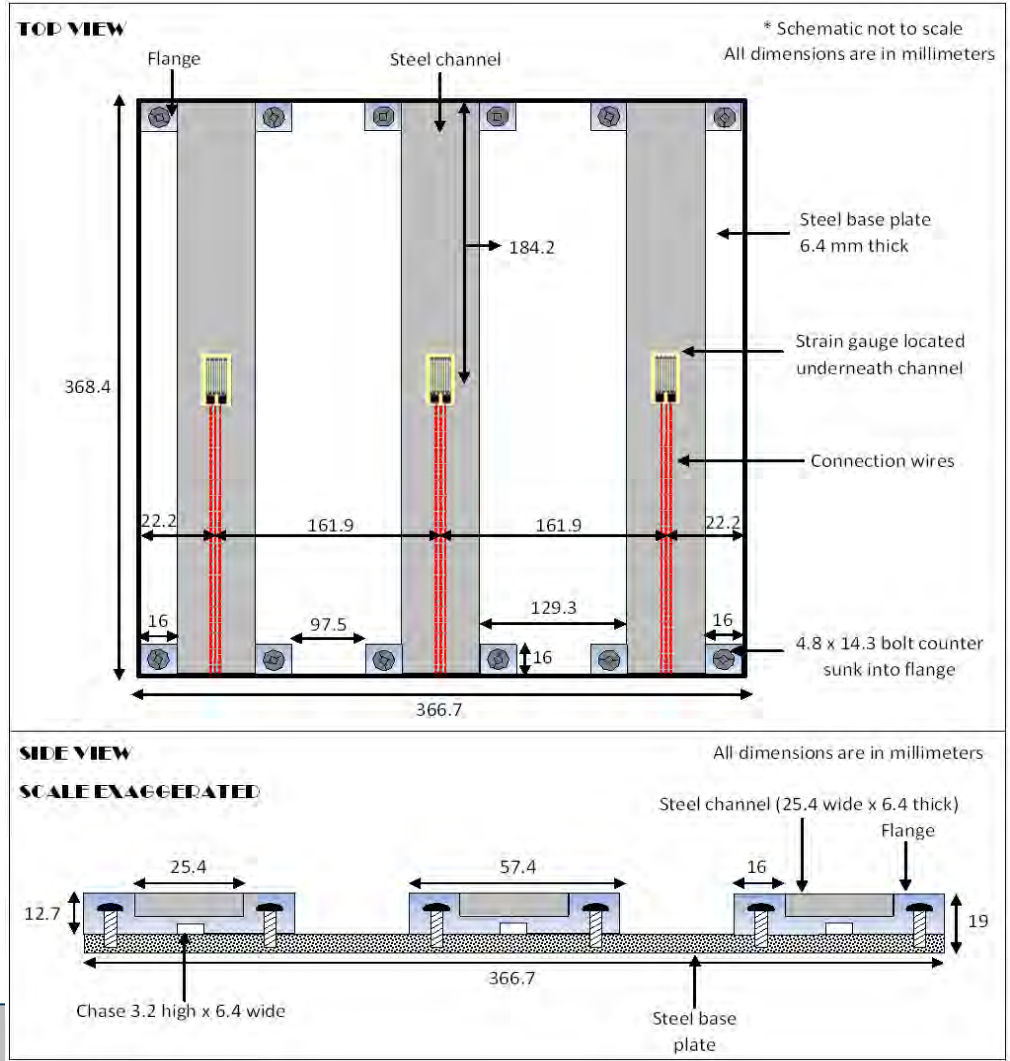
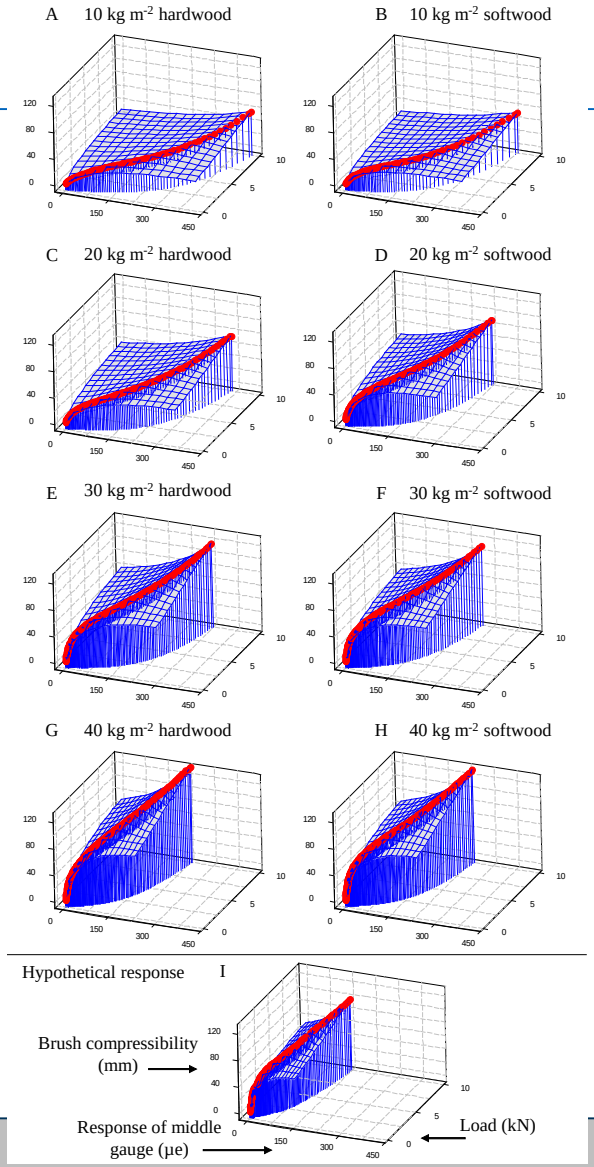
D'une idée à la réalité, en inspirant l'innovation!

Appendices


TOP VIEW
* Schematic not to scale
All dimensions are in millimeters
Flange
Steel channel
184.2
Steel base plate
6.4 mm thick
Strain gauge located
underneath channel
368.4
Connection wires
22.2
161.9
161.9
22.2
16
97.5
129.3
16
16
4.8 x 14.3 bolt counter
sunk into flange
366.7
SIDE VIEW
SCALE EXAGGERATED
All dimensions are in millimeters
Steel channel (25.4 wide x 6.4 thick)
Flange
25.4
57.4
16
12.7
19
366.7
Chase 3.2 high x 6.4 wide
Steel base
plate


A 10 kg m-2 hardwood
B 10 kg m-2 softwood
C 20 kg m-2 hardwood
D 20 kg m-2 softwood
E 30 kg m-2 hardwood
F 30 kg m-2 softwood
G 40 kg m-2 hardwood
H 40 kg m-2 softwood
Hypothetical response
I
Brush compressibility (mm)
Response of middle gauge (με)
Load (kN)