

# Pier & Pile Structures:

The Determination of Current  
Structural Capacity  
&  
Future Utility

By  
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&  
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Millbrook, NY







# Above Waterline

- Check wood stringers, pile caps, batter & fender piles for missing or broken members.
- Visually examine piling for rot, fungi, and marine borer damage.
- Sound pile areas with a hammer and carefully probe with a thin-pointed tool such as an ice pick.
- If an area is in question, take a small boring for laboratory analysis using an increment borer.





Chronicle / Kat Wade



# Below Waterline

- Start at splash/tidal zone and work down.
- Identify areas of mechanical damage.
- Clear sections of marine growth –visually inspect for surface deterioration.
- Sound cleaned areas with a hammer & carefully probe with a thin pointed tool such as an ice pick.
- Record presence of marine borers, loss of cross sectional area, organism-caused deterioration, location and extent of damage.
- Where internal damage from marine borers is suspected, subcontract ultrasonic services.





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# “Fungi & Rot Damage”

- “Submerged timber will not rot because of a lack of air.”











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JOB LOCATION OF BENDING & LAMP SAMPLE

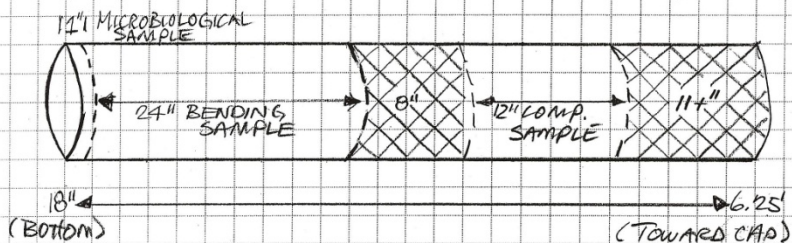
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CALCULATED BY \_\_\_\_\_ DATE 2/20/07

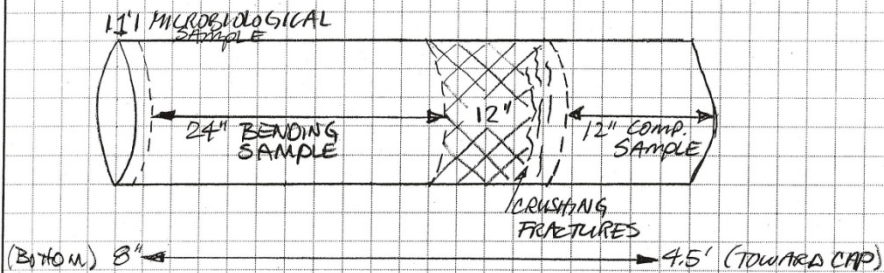
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SCALE \_\_\_\_\_

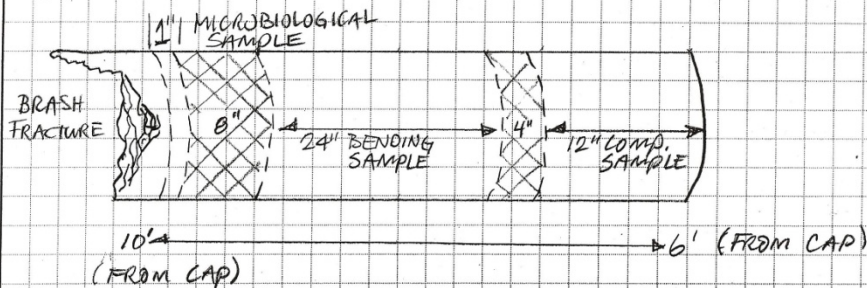
PILE #1 - 6+47 B



PILE #2 - 5+80 B



PILE #3 - 1+91 D

































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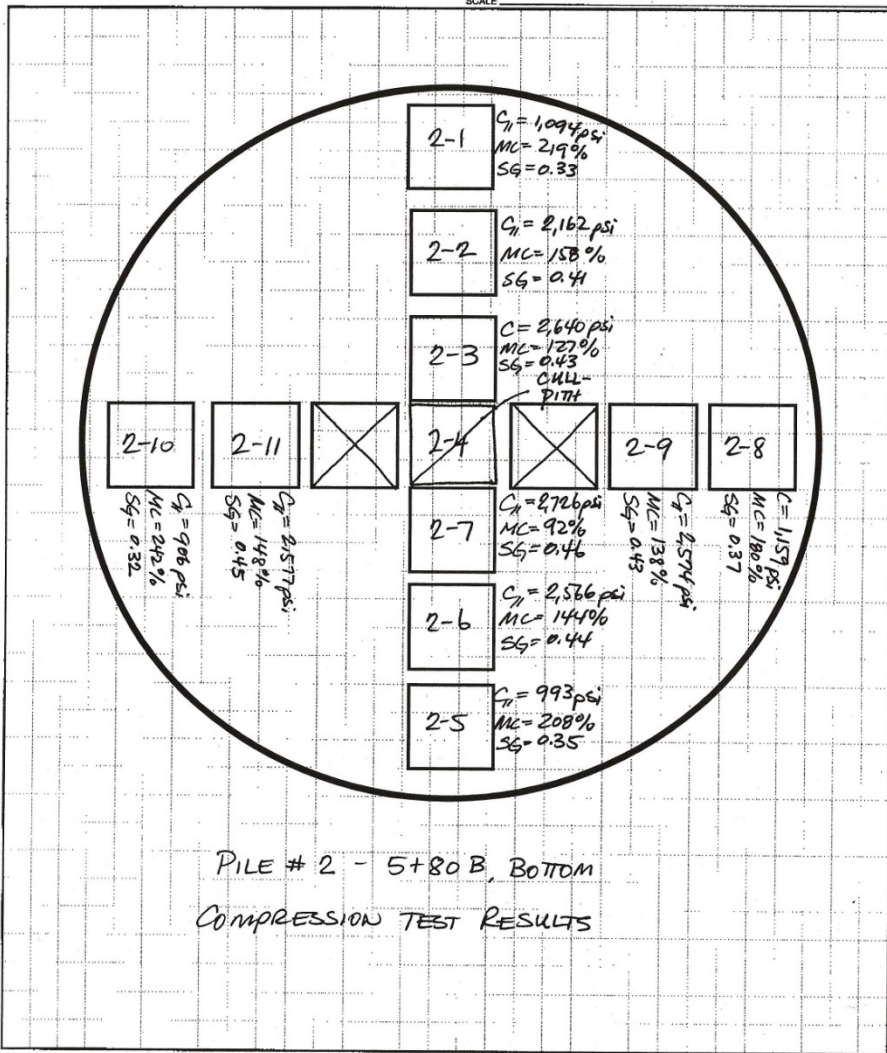
JOB PILE # 2 - COMPRESSION

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE \_\_\_\_\_

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_



PILE # 2 - 5+80 B, BOTTOM  
 COMPRESSION TEST RESULTS



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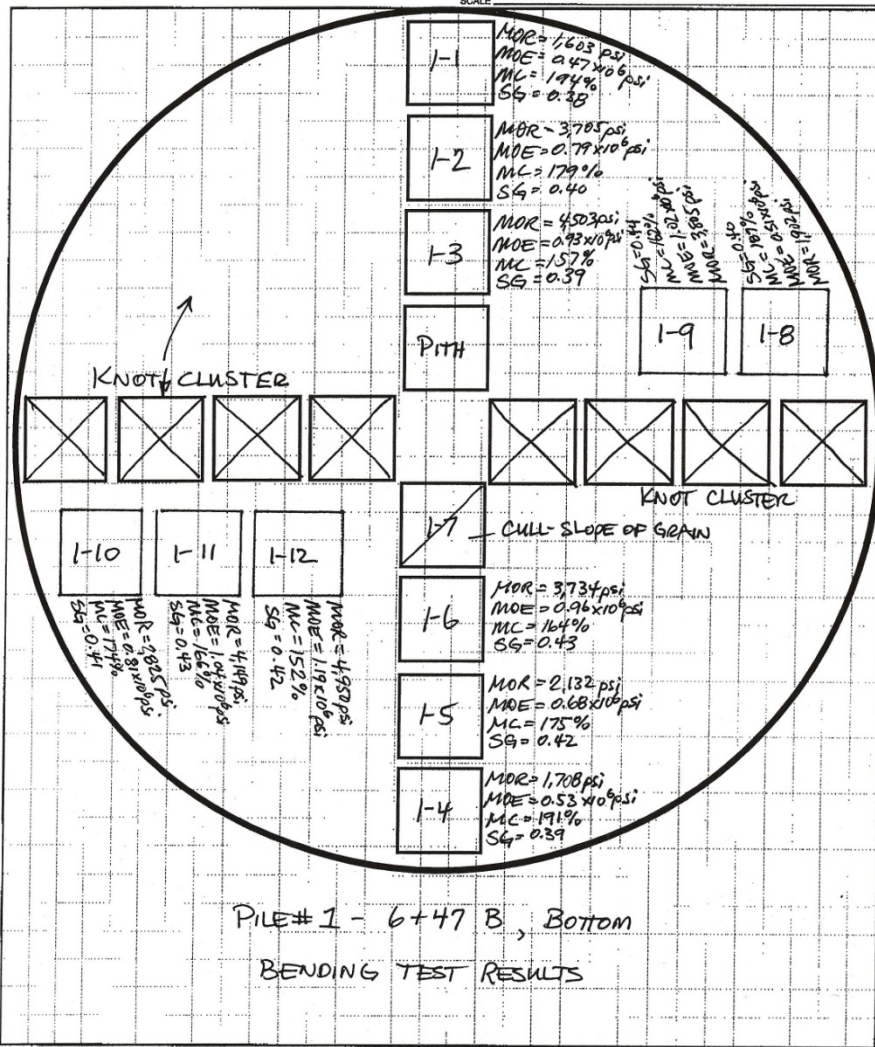
JOB: PILE #1 - BENDING

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE \_\_\_\_\_

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_



PILE #1 - 6+47 B, BOTTOM  
 BENDING TEST RESULTS

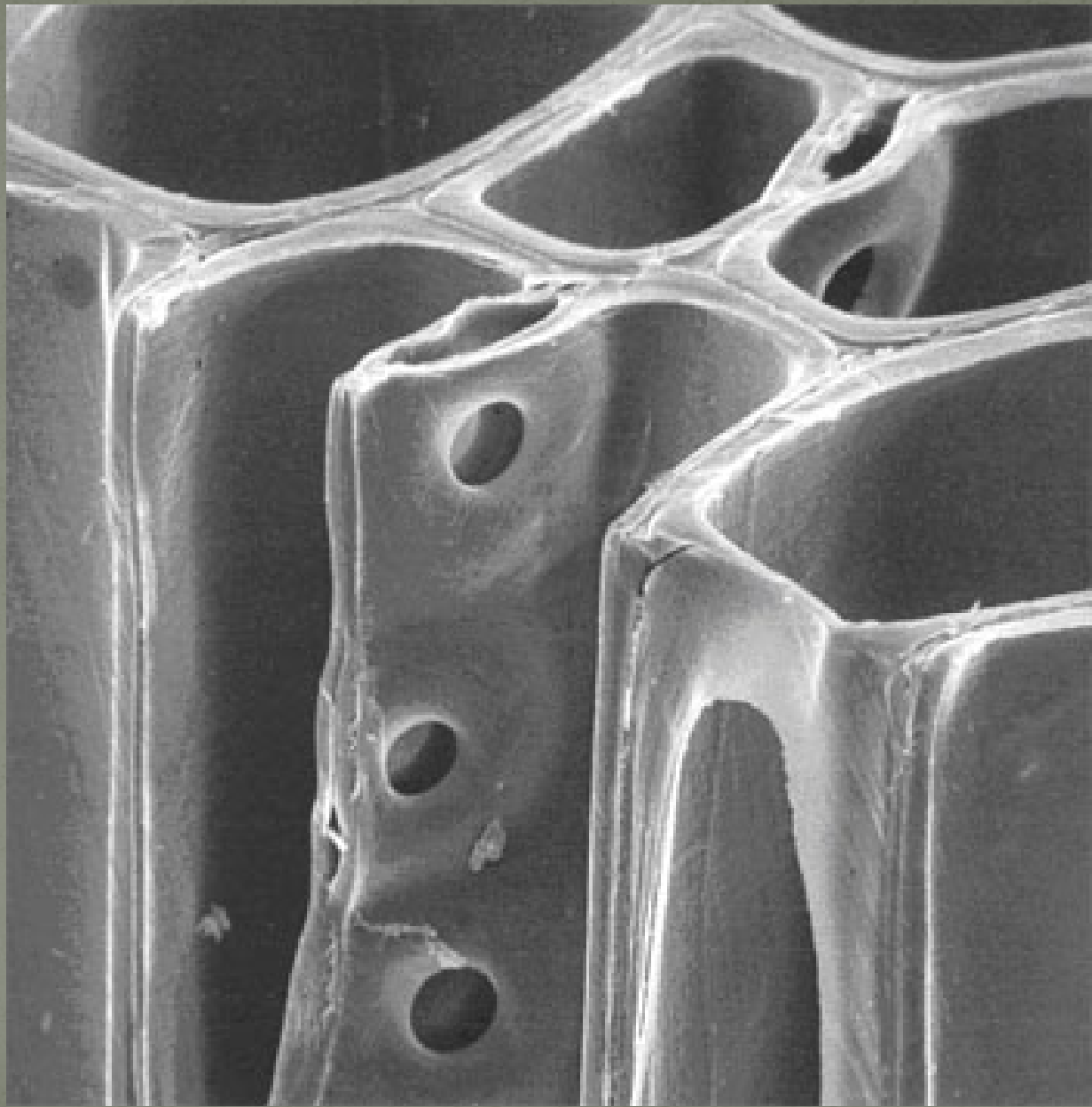


Client: [REDACTED]  
 Project Pier 2  
 Job No. [REDACTED]  
 Test ASTM D-143 Compression parallel to grain

**Southern Pine:**  
 Historical published value for Compression // = 3,596 psi  
 Historical published value for Specific Gravity = 0.48

Sample	L (in.)	W (in.)	Th (in.)	Pmax (lbs.)	Stress (psi)	Green Wt (g)	OD Wt (g)	OD Vol (g)	MC (%)	SG <sub>od</sub>	SG <sub>green</sub>
1-1	4	1.00	1.01	1355	1342	18.01	5.35	15.62	236.64	0.34	0.31
1-2	4	1.01	1.01	2095	2054	17.70	5.96	14.97	196.98	0.40	0.36
1-3	4	0.99	1.01	1651	1651	18.10	5.78	15.39	213.15	0.38	0.34
1-4	4	1.01	1.01	1181	1158	18.00	5.33	14.82	237.71	0.36	0.33
1-5	4	1.01	1.00	1438	1424	18.06	5.54	15.06	225.99	0.37	0.34
1-6	4	1.01	1.00	1511	1496	18.45	5.53	15.49	233.63	0.36	0.33
1-7	4	1.01	1.00	1591	1575	17.75	5.62	15.36	215.84	0.37	0.33
1-8	4	1.01	1.00	2002	1982	18.29	6.38	15.41	186.68	0.41	0.37
1-9	4	1.01	1.00	1820	1802	17.56	6.39	15.38	174.80	0.42	0.37
1-10	4	1.00	1.00	775	775	17.18	4.41	14.61	289.57	0.30	0.28
1-11	4	1.00	1.00	1508	1508	18.40	5.75	15.59	220.00	0.37	0.34
<b>Mean</b>					<b>1524</b>				<b>221</b>	<b>0.37</b>	<b>0.34</b>
<b>StDev</b>					<b>364</b>				<b>31</b>	<b>0.03</b>	<b>0.03</b>
2-1	4	1.01	1.00	1011	1001	17.59	4.67	14.87	276.66	0.31	0.29
2-2	4	1.01	1.00	1891	1872	18.27	6.14	14.88	197.56	0.41	0.37
2-3											
2-4											
2-5	4	1.00	0.92	522	567	16.21	3.91	13.62	314.58	0.29	0.27
2-6	4	1.00	0.99	1215	1227	17.77	5.10	14.62	248.43	0.35	0.32
2-7	4	0.99	0.99	1488	1518	17.40	5.32	14.26	227.07	0.37	0.34
2-8											
2-9	4	1.02	1.00	745	730	17.37	4.24	14.70	309.67	0.29	0.27
2-10	4	1.01	0.98	1729	1747	18.35	6.05	14.64	203.31	0.41	0.37
2-11	4	0.99	1.00	1934	1954	16.39	5.80	14.16	182.59	0.41	0.37
2-12	4	1.00	0.98	597	609	17.26	3.94	14.91	338.07	0.26	0.25
2-13	4	1.01	0.98	1613	1630	18.04	5.60	15.10	222.14	0.37	0.34
2-14	4	1.03	1.00	1723	1673	16.71	5.62	14.67	197.33	0.38	0.35
<b>Mean</b>					<b>1321</b>				<b>247</b>	<b>0.35</b>	<b>0.32</b>
<b>StDev</b>					<b>517</b>				<b>54</b>	<b>0.05</b>	<b>0.05</b>

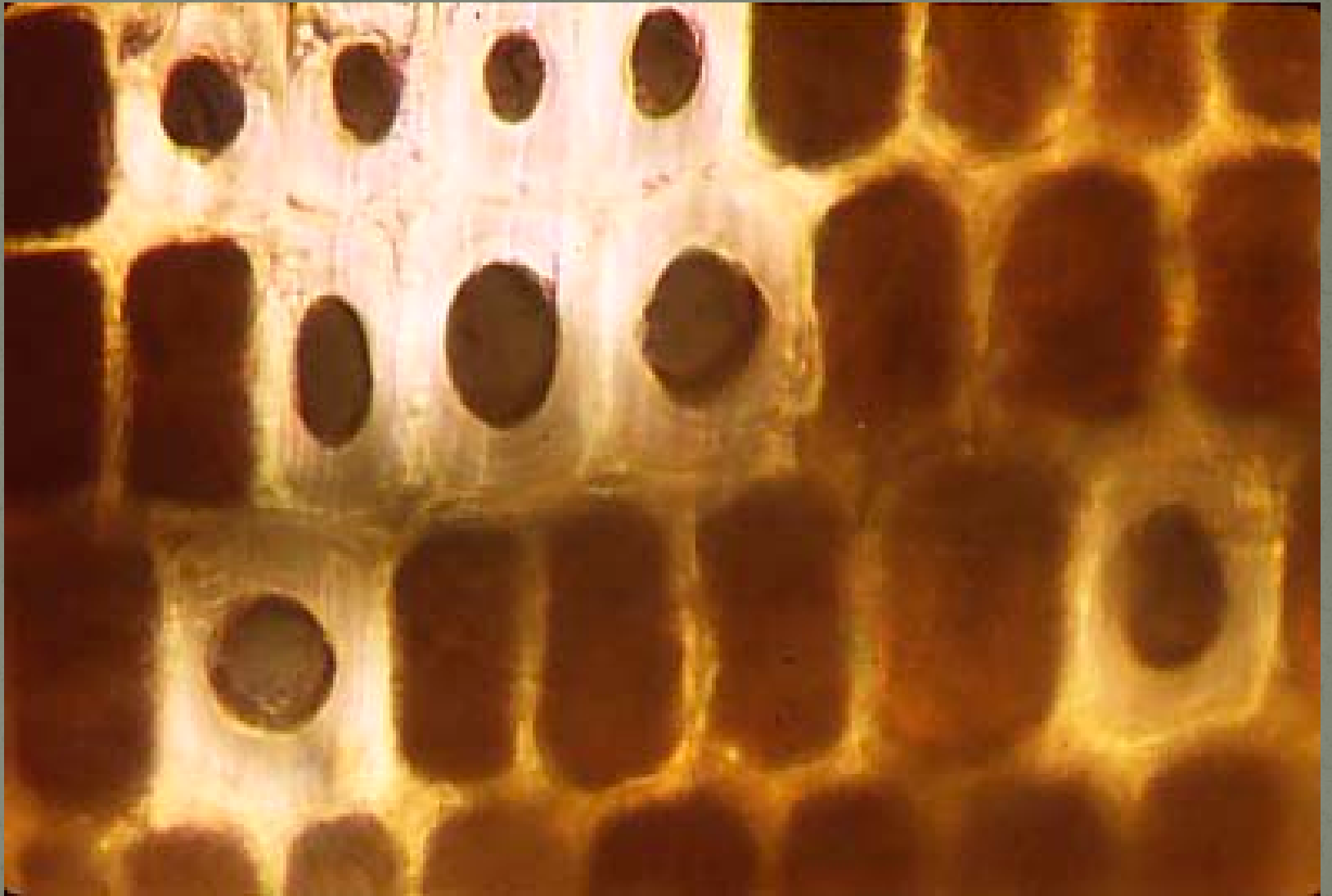




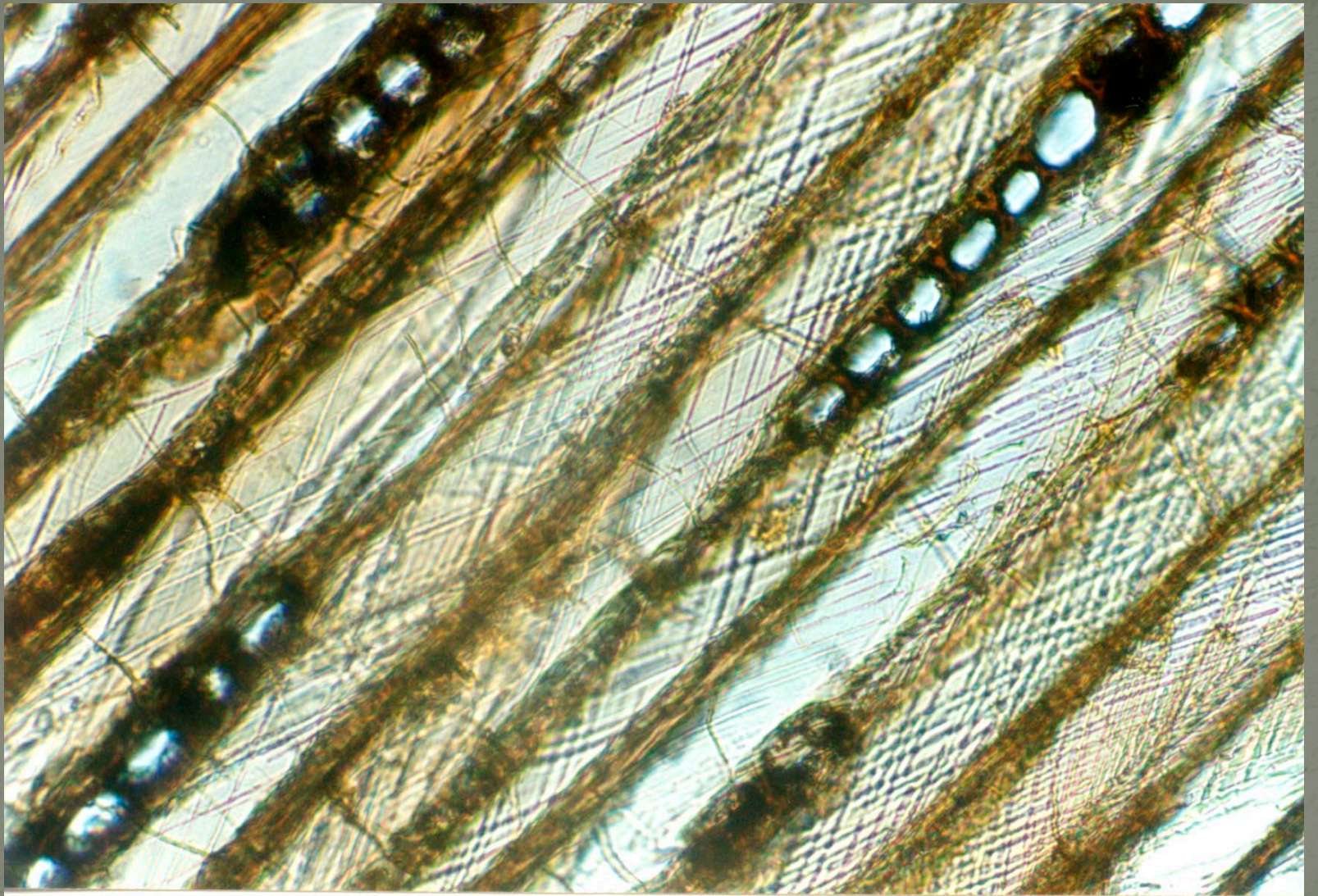




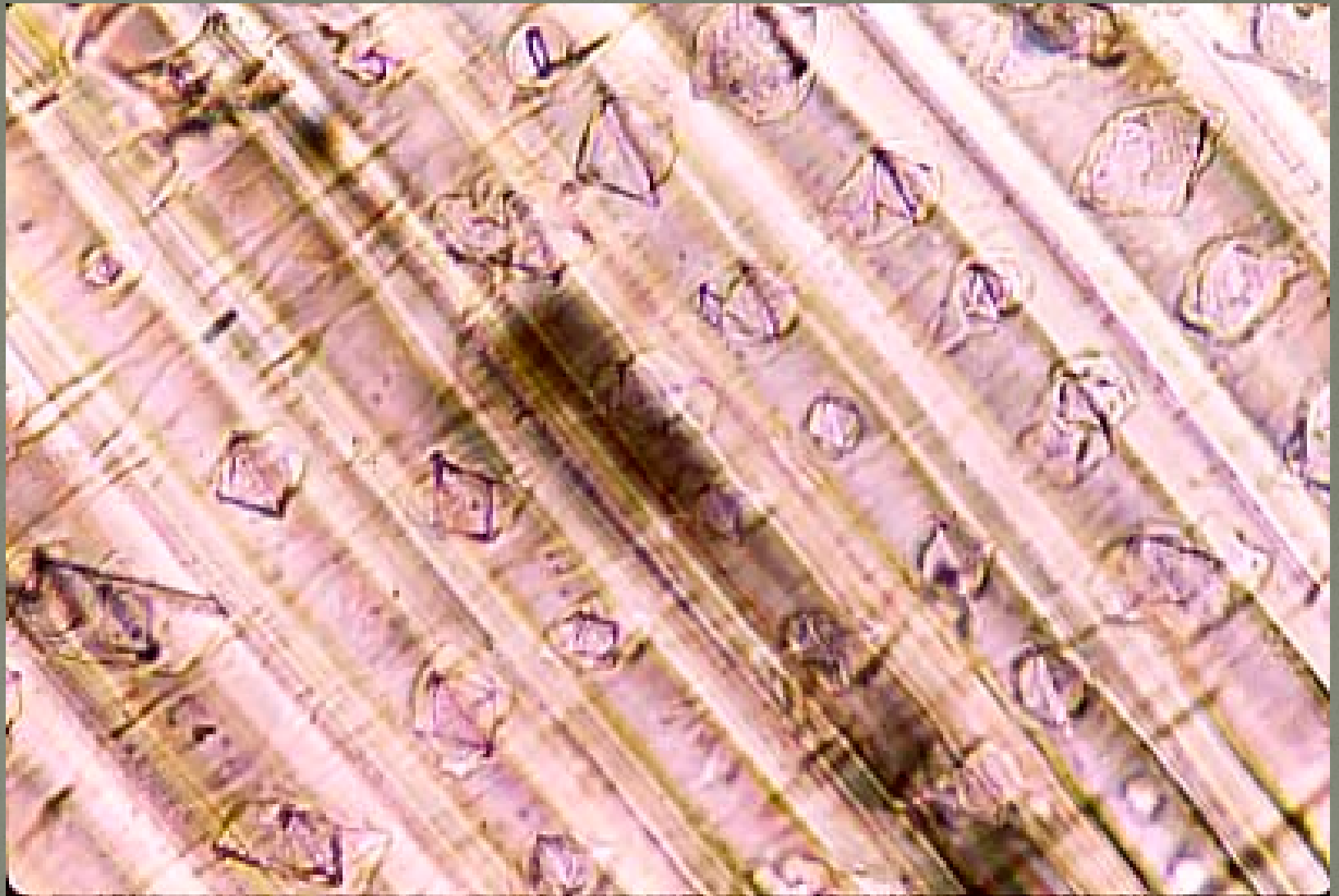














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JOB PIER 2 -  
 SHEET NO. 1 OF 3  
 CALCULATED BY MED DATE 12/15/09  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_

METHOD #1 DESIGN STRESS CALCULATED FOLLOWING  
 ASTM D 2899

$$C_{11}: \text{MEAN} = 1,508 \text{ psi} = \bar{x}$$

$$\sigma = 394 \text{ psi}$$

$$\text{MOR}: \text{MEAN} = 3,743 \text{ psi} = \bar{x}$$

$$\sigma = 1,100 \text{ psi}$$

$$\text{MOE}: \text{MEAN} = 0.83 \times 10^6 \text{ psi} = \bar{x}$$

$$\sigma = 0.24 \times 10^6 \text{ psi}$$

• CALCULATIONS

$$F_c = (f_{cos} C_{dol}) [C_{nv}] [C_d] [C_g]$$

$$f_{cos} = \bar{x} - 1.645 \sigma$$

$$C_{dol} = 1/1.9 = \text{DURATION OF LOAD / FACTOR OF SAFETY}$$

$$C_{nv} = \text{HEIGHT VARIABILITY} = 0.91$$

$$C_d = \text{DENSITY} \rightarrow \text{NOT APPLICABLE TO PIER 2 PILES}$$

$$C_g = \text{GRADE CHARACTERISTICS} = 0.93$$

$$F_c = [\bar{x} - 1.645 \sigma] [C_{dol}] [C_{nv}] [C_d] [C_g]$$

$$= [1,508 \text{ psi} - 1.645 \times 394 \text{ psi}] [1/1.9] [0.91] [0.93]$$

$$= 383 \text{ psi} - \text{ROUND TO NEAREST 25 psi PER D2899}$$

$$F_c = 375 \text{ psi}$$



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JOB PIER 2-  
SHEET NO. 1 OF 1  
CALCULATED BY MGA DATE 12/15/09  
CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
SCALE \_\_\_\_\_

METHOD #2

DESIGN STRESSES CALCULATED BY APPLYING  
MEAN RESIDUAL VALUES TO CURRENT DESIGN  
STRESSES IN TABLE 6A OF THE NDS.

PROPERTY	CLEAR WOOD MEAN VALUE FROM TEST DATA	CLEAR WOOD HISTORICAL MEAN	MEAN RESIDUAL VALUE
$C_{II}$	1,508 psi	3,596 psi	0.42
MOR	3,743 psi	7,560 psi	0.50
MOE	$0.83 \times 10^6$ psi	$1.425 \times 10^6$ psi	0.58

DESIGN STRESS	DESIGN VALUE FROM TABLE 6A OF NDS	MEAN RESIDUAL VALUE	CURRENT DESIGN VALUE	CURRENT ROUNDED DESIGN VALUE
$F_c$	1,200 psi	x 0.42	504 psi	500 psi
$F_b$	2,400 psi	x 0.50	1,200 psi	1,200 psi
MOE	$1.5 \times 10^6$ psi	x 0.58	$0.87 \times 10^6$ psi	$0.9 \times 10^6$ psi
MOE <sub>OS</sub>	$0.79 \times 10^6$ psi	x 0.58	$0.46 \times 10^6$ psi	$0.46 \times 10^6$ psi



Property <sup>1</sup>	Method #1 D2899	Method #2 Residual Values/NDS
F <sub>c</sub>	375 psi	500 psi
F <sub>b</sub>	600 psi	1,200 psi
MOE	0.8 x 10 <sup>6</sup> psi	0.9 x 10 <sup>6</sup> psi
MOE <sub>05</sub>	0.4 x 10 <sup>6</sup> psi	0.5 x 10 <sup>6</sup> psi



**Table 1A. Results of the Microbiological Analyses for  
Pier 2, 1916 Vintage.**

Core	Depth (in.)	Soft Rot Wood Decay	Cellular Structure
00+10B	Surface-1/2	Heavy-very heavy	Poor-very poor
	1	Heavy	Poor
	2	Light-moderate	Good-fair
	3	Light	Good
	4	None	Good
00+10G	5	None	Good
	Surface-1/2	Moderate	Fair
	1	Moderate	Fair
	2	Light	Fair
	3	Light	Fair
1+25B	4	Light	Fair
	5	None	Good
	Surface-1/2	Heavy	Poor
	1	Heavy	Poor
	2	Moderate	Good-fair
1+25G	3	Moderate	Good-fair
	4	None	Good
	5	None	Good
	Surface-1/2	Very heavy	Very poor
	1	Heavy	Poor
2+60B	2	Heavy	Poor
	3	Heavy	Poor
	4	Heavy	Poor
	5	Heavy	Poor
	Surface-1/2	Heavy	Poor
2+60G	1	Heavy	Poor
	2	Moderate-heavy	Poor
	3	Moderate	Fair-poor
	4	Moderate	Fair-poor
	5	Light-moderate	Fair
		Light-moderate	Fair

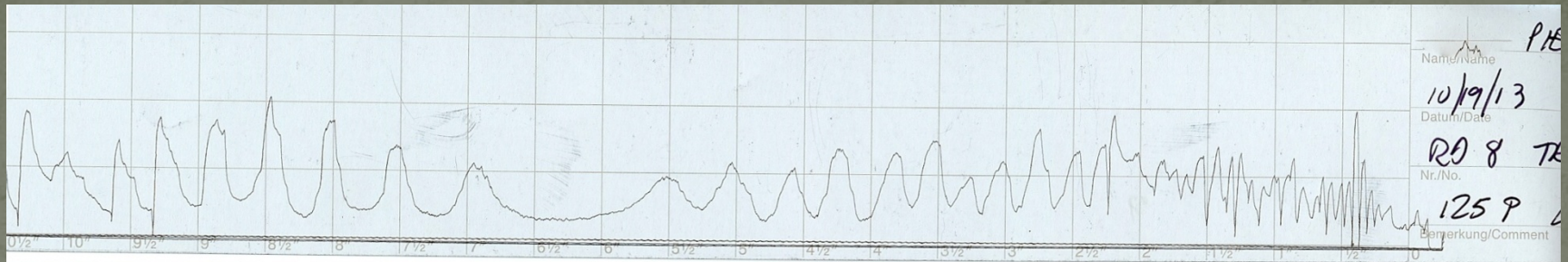




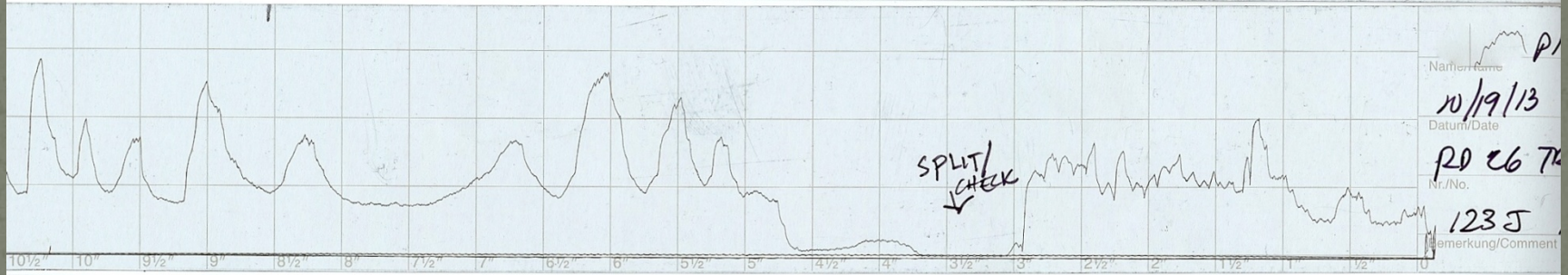






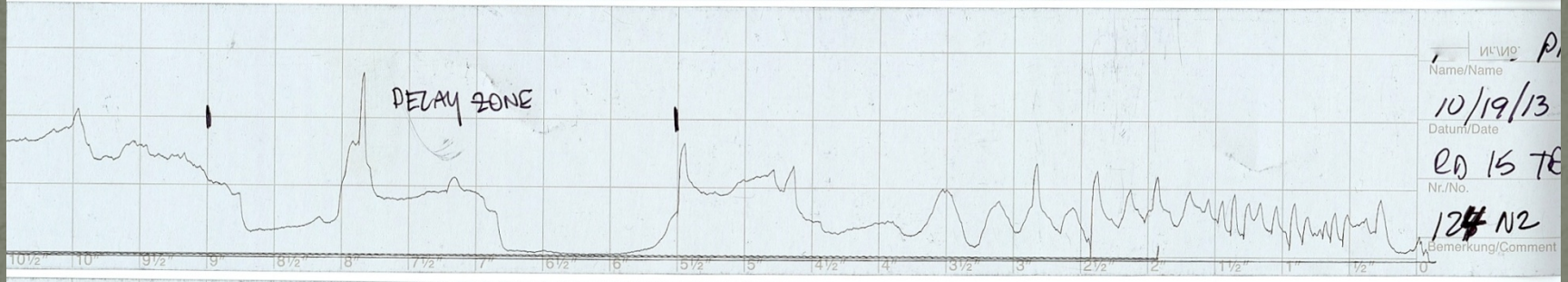


Name/Name P15  
 Datum/Date 10/19/13  
 Rd 8 T8  
 Nr./No. 125 P  
 Bemerkung/Comment



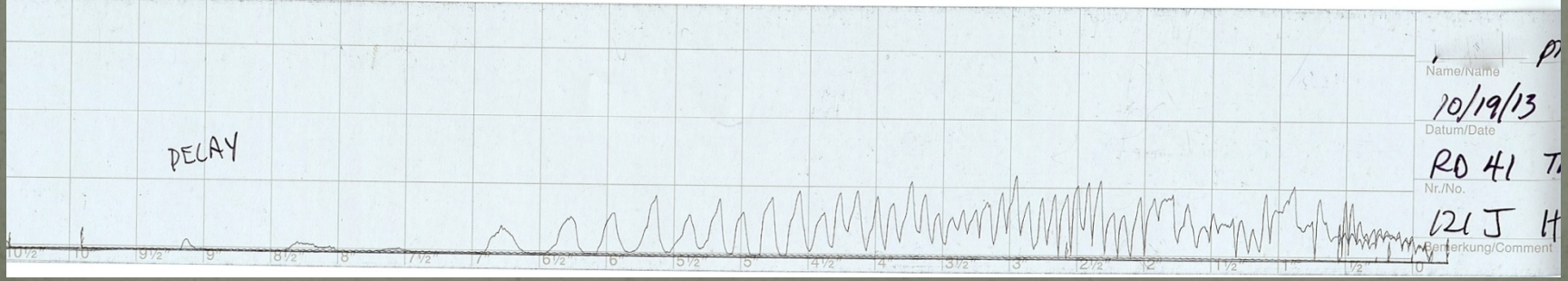
SPLIT/CHECK  
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 Datum/Date 10/19/13  
 Rd 26 T8  
 Nr./No. 123 J  
 Bemerkung/Comment



DELAY ZONE

Name/Name P1  
 Datum/Date 10/19/13  
 Rd 15 T8  
 Nr./No. 124 N2  
 Bemerkung/Comment



DELAY

Name/Name P1  
 Datum/Date 10/19/13  
 Rd 41 T8  
 Nr./No. 121 J H  
 Bemerkung/Comment