Integrity Testing Pty Ltd

The Built Infrastructure Testing Specialists

Non Destructive testing of poles

Developments in Mod-Shock-InSafe™ in evaluation of Transmission Poles

Written by

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Presented by David Tongue to the ESSA Poles Committee
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Structural Testing Consultants

AGENDA

- **Background**
- **Appendix Paper submitted to poles committee March 2003**
- **Holistic approach**
- **Safety**
- **Economics**
- **Development of “InSafe”**
- **Verification of “InSafe”**
- **Future**

HOLISTIC APPROACH

- Industry appeared to require more definitive information on the poles condition
- Pole-Test™ proved that system would identify defective poles.
- The system also generally determined where the defects were
- Industry wanted more, such as pole strength, an accurate loss of section and safety of the pole

Pole Testing-Benefits

- Data on length, buried depth, capacity, defects
- Test time significantly faster than digging
- Quantative data on which to base Asset decisions
- Avoid unnecessary costly pole replacement
- Following are a few examples of Pole-Test™ procedures and data

Pole Testing-Method

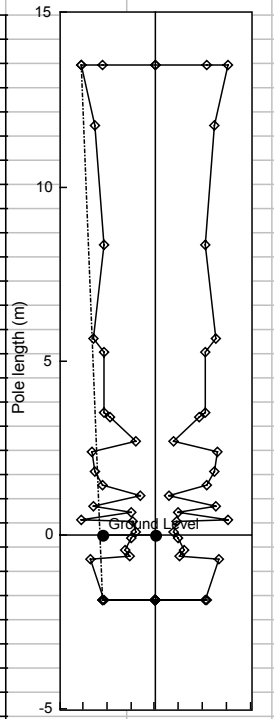
- Excite Pole by using striking with a suitable hammer.
- Record response in laptop computer and analyse.
- Analysis using established parameters yields results on pole length, buried depth, defects and load capacity

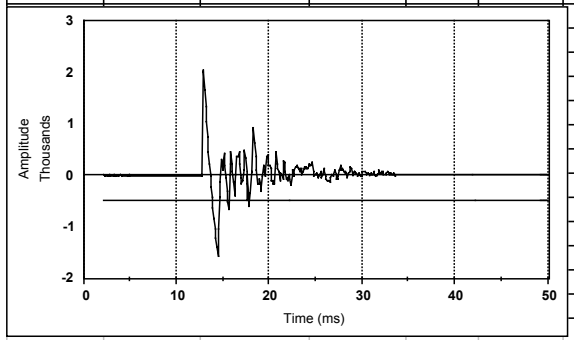
ModShockPole

Test No	49A	Pole No:	MIR049			
Pole capacity rating		14	Kn to	11	Kn BM	145

Depth	Diameter	Corrected	Rating	Cor %	True %	Cap kN
13.5	0.455	0.377	1	99.3%	119.8%	11
13.5	0.370	0.307	2	80.8%	97.5%	11
12.9	0.467	0.387	1	101.9%	123.0%	11
12.2	0.370	0.307	2	80.8%	97.5%	12
11.2	0.522	0.432	1	113.7%	137.3%	13
10.5	0.462	0.383	1	100.8%	121.6%	14
9.8	0.295	0.244	3	64.2%	77.5%	15
9.1	0.295	0.244	3	64.2%	77.5%	16
9.1	0.309	0.256	3	67.3%	81.2%	16
8.4	0.337	0.279	3	73.5%	88.7%	17
8.0	0.370	0.307	2	80.8%	97.5%	18
7.2	0.449	0.372	1	97.9%	118.2%	20
6.9	0.426	0.353	1	92.9%	112.1%	21
6.9	0.295	0.245	3	64.4%	77.8%	21
6.1	0.469	0.388	1	102.2%	123.4%	24
6.1	0.449	0.372	1	97.9%	118.2%	24
5.6	0.455	0.377	1	99.3%	119.8%	26
5.4	0.459	0.380	1	100.1%	120.8%	27
4.8	0.337	0.279	3	73.5%	88.7%	30
4.7	0.426	0.353	1	92.9%	112.1%	31
4.3	0.435	0.360	1	94.8%	114.4%	34
3.9	0.467	0.387	1	101.9%	123.0%	37
3.0	0.459	0.380	1	100.1%	120.8%	49
2.4	0.385	0.319	2	84.0%	101.3%	61
1.5	0.469	0.388	1	102.2%	123.4%	94

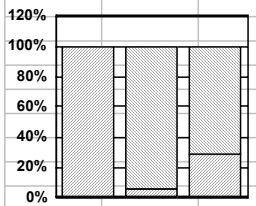
Model





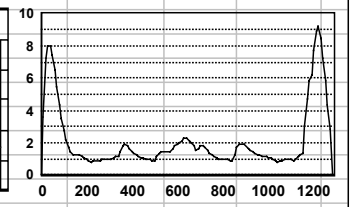
Deflection	Load
mm	KN.
0.00	0.00
1.55	15.43
2.79	25.40
4.34	35.35
25.00	168.26

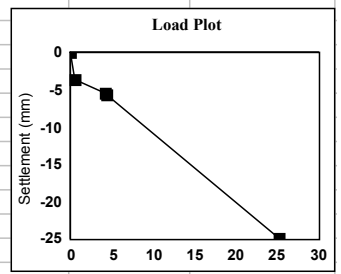
Stiffness Rating



Caution below

Mechanical Admittance Plot





Climb Status Caution Check before climbing

Integrity Testing Pty. Ltd. Programme: EngAus25.EXE-24-10-02

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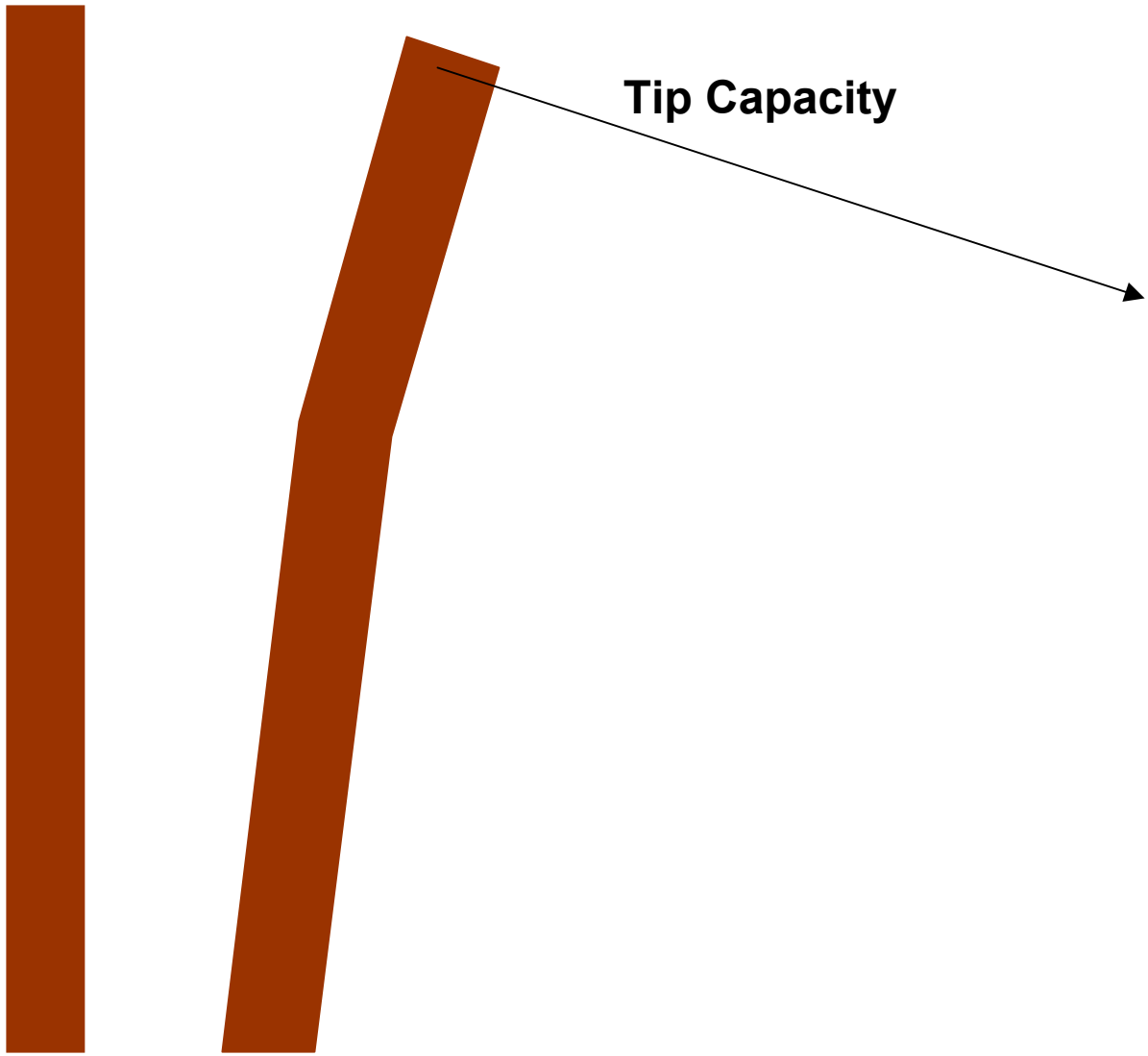
Pole Testing-Benefits

- What the industry needed was more definitive information to enable more full classification of the pole's serviceability.
- "InSafe" was developed from this need.
  - Capacity as tip capacity
  - Section loss – defined as wall thickness
  - Health and safety

Capacity



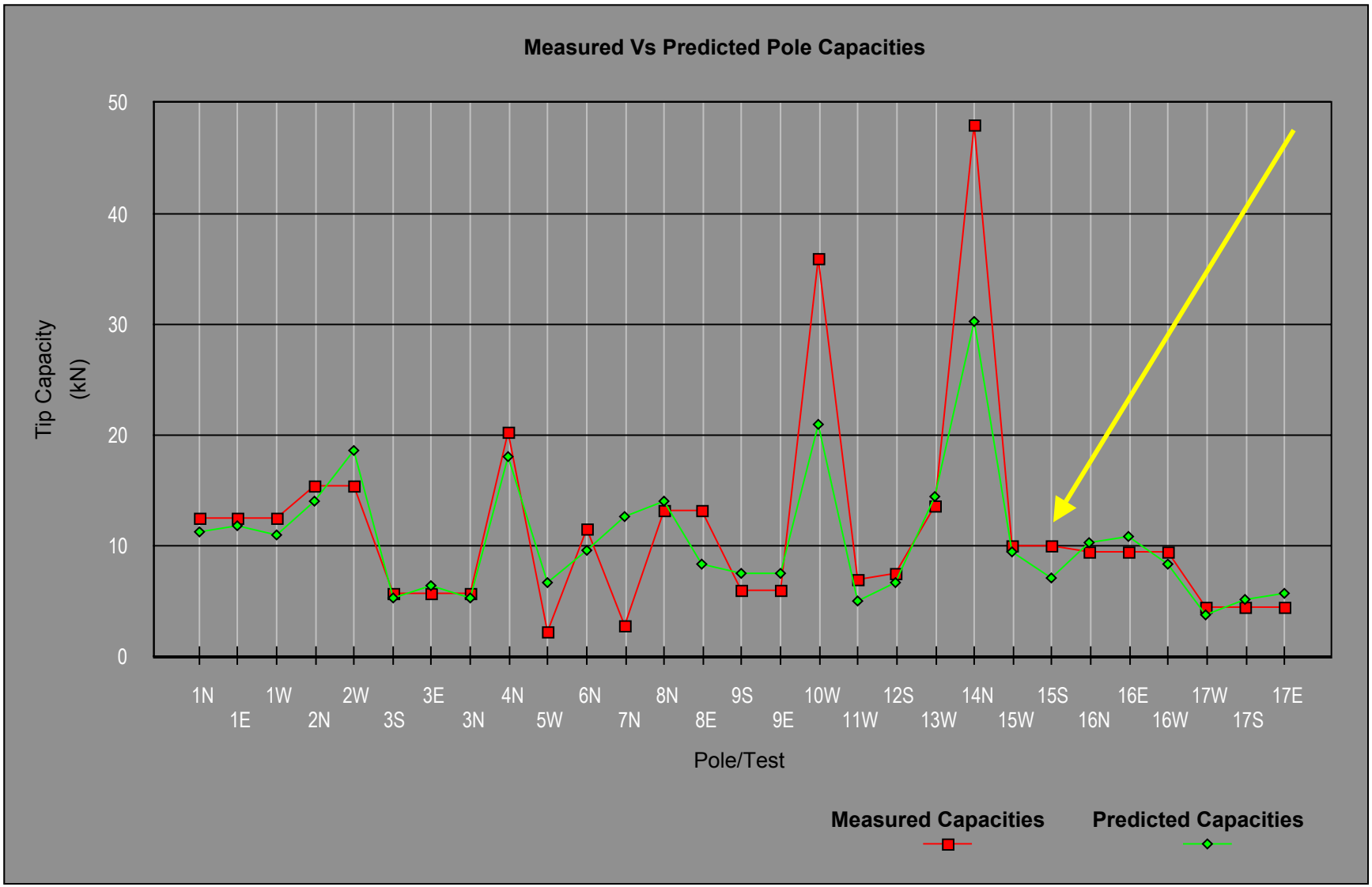
Capacity

- Pole at rest

Capacity

- Pole at failure

Pole Capacities Predictions



Courtesy of ***EnergyAustralia***

InSafe™

InSafe

Test No	R02	Pole No:	414213			
Pole capacity rating		27	Kn to	15	Kn BM	177

Depth	Diameter	Corrected	Rating	Cor %	True %	Cap kN
9.0	0.288	0.287	1	89.7%	89.9%	20
8.7	0.240	0.239	3	74.8%	74.9%	20
8.1	0.288	0.287	1	89.7%	89.9%	22
7.6	0.408	0.407	1	127.1%	127.4%	23
7.4	0.298	0.297	1	92.8%	93.0%	24
6.8	0.421	0.420	1	131.1%	131.4%	26
5.0	0.247	0.246	3	76.9%	77.1%	35
3.8	0.311	0.311	1	97.1%	97.3%	47
3.7	0.374	0.373	1	116.5%	116.8%	48
3.4	0.288	0.287	1	89.7%	89.9%	53
2.7	0.408	0.407	1	127.1%	127.4%	66
2.2	0.355	0.354	1	110.7%	111.0%	79
1.9	0.206	0.205	3	64.1%	64.2%	91
0.8	0.296	0.295	1	92.3%	92.5%	---
0.6	0.357	0.356	1	111.3%	111.6%	---
0.1	0.421	0.420	1	131.1%	131.4%	---
-0.5	0.247	0.246	3	76.9%	77.1%	---
-0.9	0.374	0.373	1	116.5%	116.8%	---
-1.0	0.236	0.236	3	73.7%	73.9%	---
-1.1	0.355	0.354	1	110.7%	111.0%	---
-1.3	0.357	0.356	1	111.3%	111.6%	---
-1.3	0.236	0.236	3	73.7%	73.9%	---
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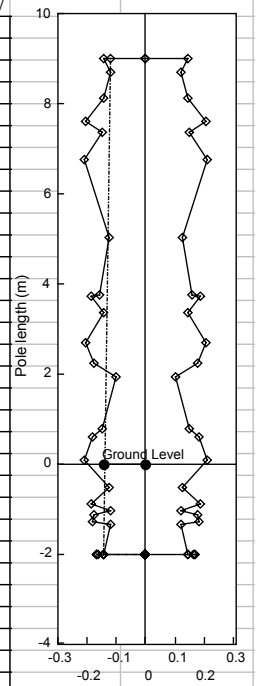
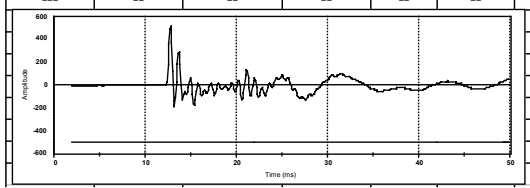
Model

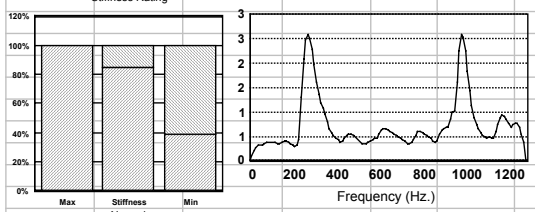




Deflection	Load
mm	KN.
0.00	0.0
2.60	20.8
4.21	30.2
6.42	38.2
25.00	105.5

Mechanical Admittance Plot

Stiffness Rating



Imp Dia	320
EqMin	206
Wall	75
Stiffness	8.01
Emax	9.41
Emin	3.62

Climb Status **Probable sufficient**

Integrity Testing Pty. Ltd. Programme: Mdpole06.EXE-28-10-03 PROBABLE RESULT

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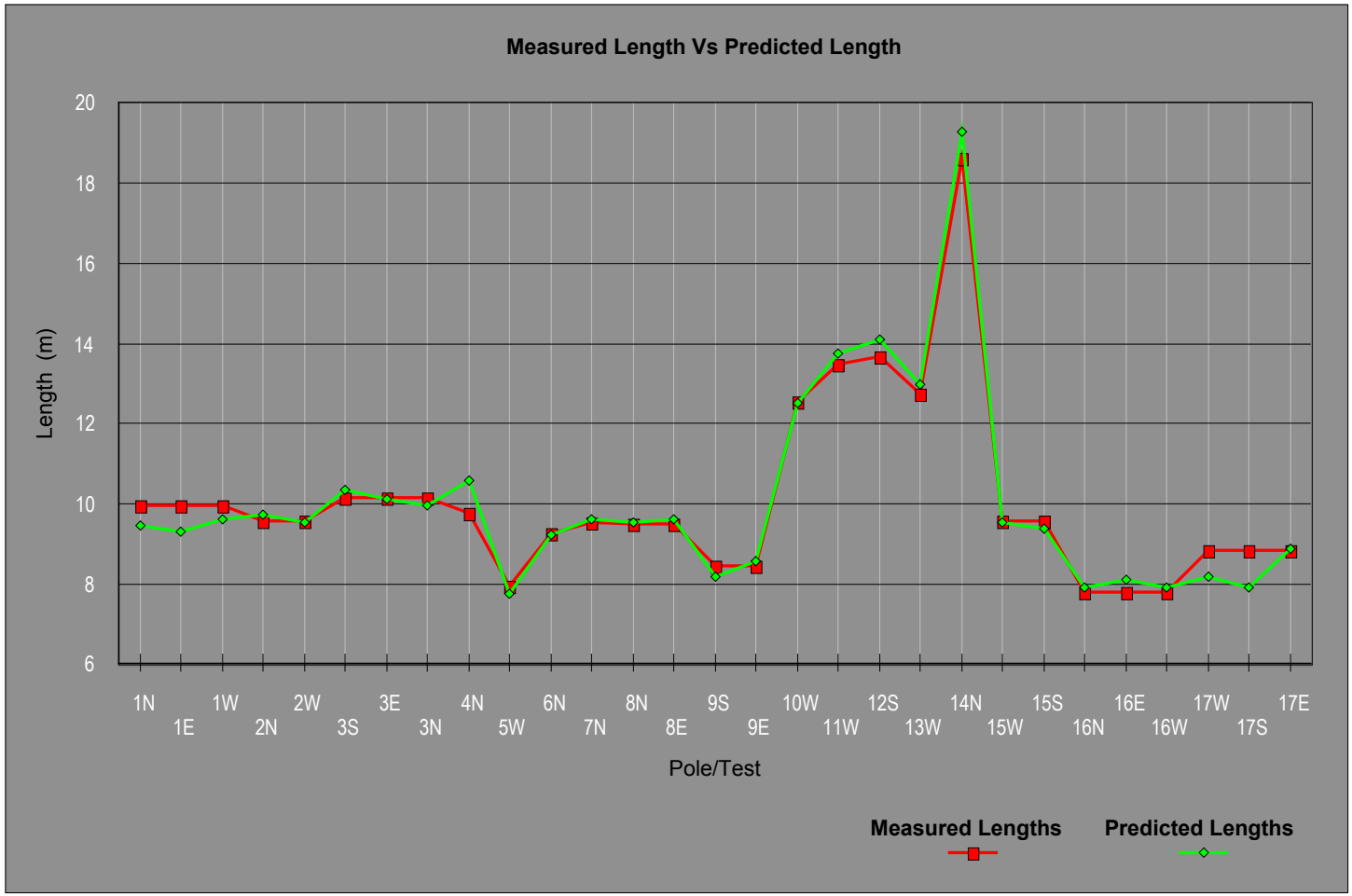
Accuracy

- In order to measure the accuracy
- Of InSafe™ length correlations were
- Made the following plot indicates our accuracy

Accuracy



Courtesy of ***EnergyAustralia***

Health and Safety

- Health and Safety is one of the major aspects of the Industry.
- Accidents to operatives.
- Accidents to the general public.
- And the financial implications of.
  - Damage to property
  - Outages and loss of supply to customers

Health and Safety

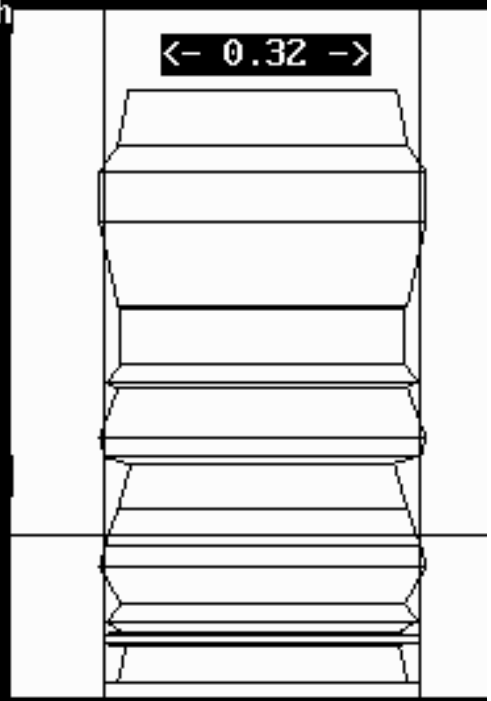
- Accidents to operatives.
  - We designed “InSafe” to measure whether the pole is safe to climb or not.
  - InSafe determines whether it is safe or not safe to climb based on two parameters
    - Minimum diameter/wall thickness of the pole
    - Measured bending moment capacity as tip capacity.
    - InSafe displays to the operator a safe or not safe notice to climb on site.

Health and Safety

POLE 414213 TEST NUMBER R02 MODEL
MIN Dia 27 CAP 6
CAPACITY 18 KN. STIFF 7.455915E+07 2.73E+05

Depth	Dia	Corr	Rate	Cor%	true%	Cap
6.6	0.385		1	98.2	28	
5.7	0.392	High	1	100.0	32	
4.2	0.300	Low	3	76.5	76.5	44
4.1	0.281	Low	3	71.6	71.6	44
3.1	0.288	Low	3	73.4	73.4	58
2.8	0.346		1	88.1	66	
2.7	0.296	Low	3	75.6	75.6	68
1.8	0.385		1	98.2	103	
1.4	0.356		1	90.7	---	
1.3	0.234	Low	3	59.7	59.7	---
0.5	0.297	Low	3	75.6	75.6	---
-0.2	0.360		1	91.8	---	
-0.6	0.392	High	1	100.0	---	
-1.2	0.281	Low	3	71.6	71.6	---
-1.5	0.346		1	88.1	---	
-1.7	0.261	Low	3	66.6	66.6	---
-1.8	0.356		1	90.7	---	
Ave dia	.3194968		1	91.8	---	

Depth
8.00 m.
GL 0.00
2.65 m.



C = RETRY X = Return W= Write

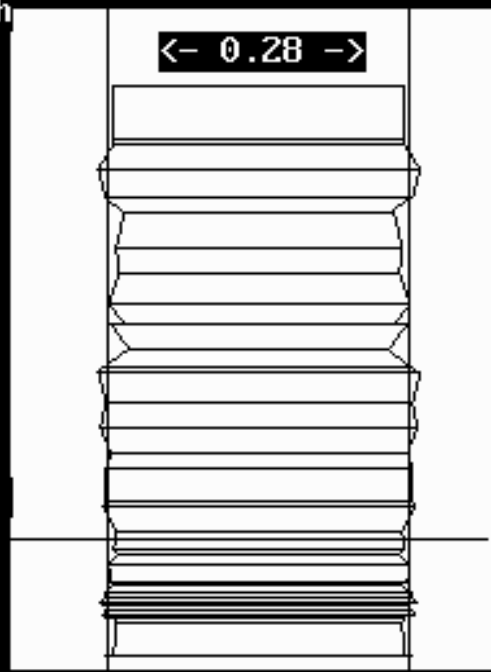
Screen dump from InSafe™

Health and Safety

POLE 414211 TEST NUMBER B03 MODEL
MIN Dia 23 CAP 6 Depth
CAPACITY 10 KN. STIFF 2.841451E+07 6.74E+04

Depth	Dia	Corr	Rate	Cor%	true%	Cap
0.1	0.268		1	85.2	---	
-0.2	0.280		1	89.1	---	
-0.3	0.267	Medium	2	85.0	85.0	---
-0.5	0.295		1	93.6	---	
-0.8	0.290		1	92.0	---	
-0.8	0.270		1	85.7	---	
-1.0	0.305		1	96.9	---	
-1.1	0.304		1	96.7	---	
-1.2	0.315	High	1	100.0	---	
-1.2	0.288		1	91.5	---	GL 0.00
-1.3	0.299		1	95.1	---	
-1.4	0.312	1		99.0	---	
-1.5	0.280		1	89.1	---	

8.00 m.



2.20 m.

Ave dia .299261
C = RETRY X = Return W= Write

NOT SAFE TO CLIMB (STRENGTH)

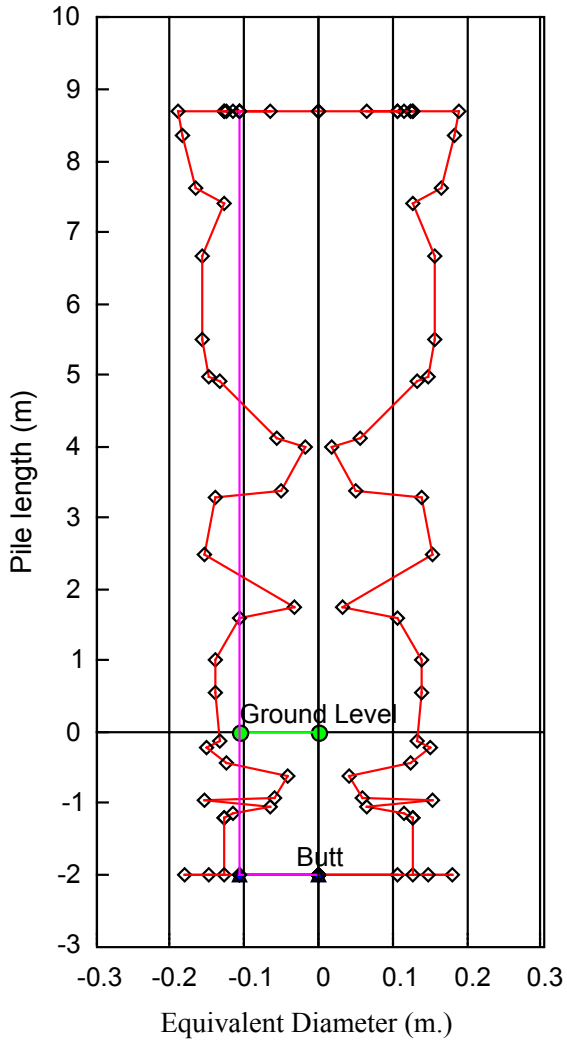
Screen dump from InSafe™

Verification of InSafe™

- We have been fortunate in obtaining a number of contracts where we could verify the results.
- Using Industry standards for residual tip capacity measurement we have obtained a good correlation.
- InSafe Tip capacity appears to take into account the strength of the pole timber as well as the loss of section.
- Loss of section was easily measured as our client removed certain poles and cut them up.

Pole 255

- Pole classed as serviceable
- Model shows loss at GL –400mm
- Also at GL + 4.0m
- Pole was removed for inspection

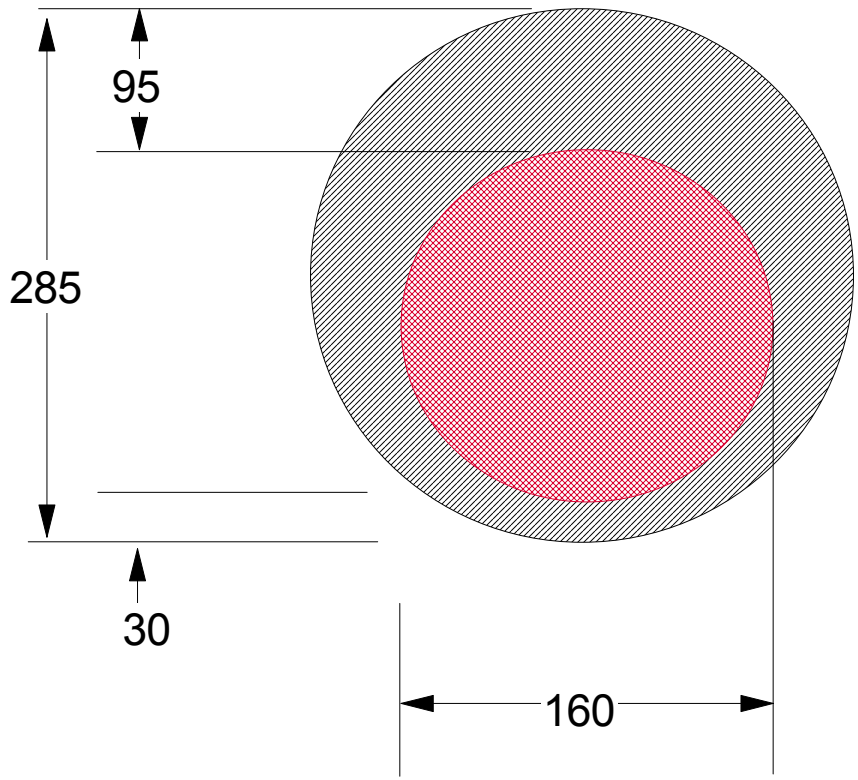


Pole 255

Pole
Sectioned
At Ground
level
Good wood
shaded yellow

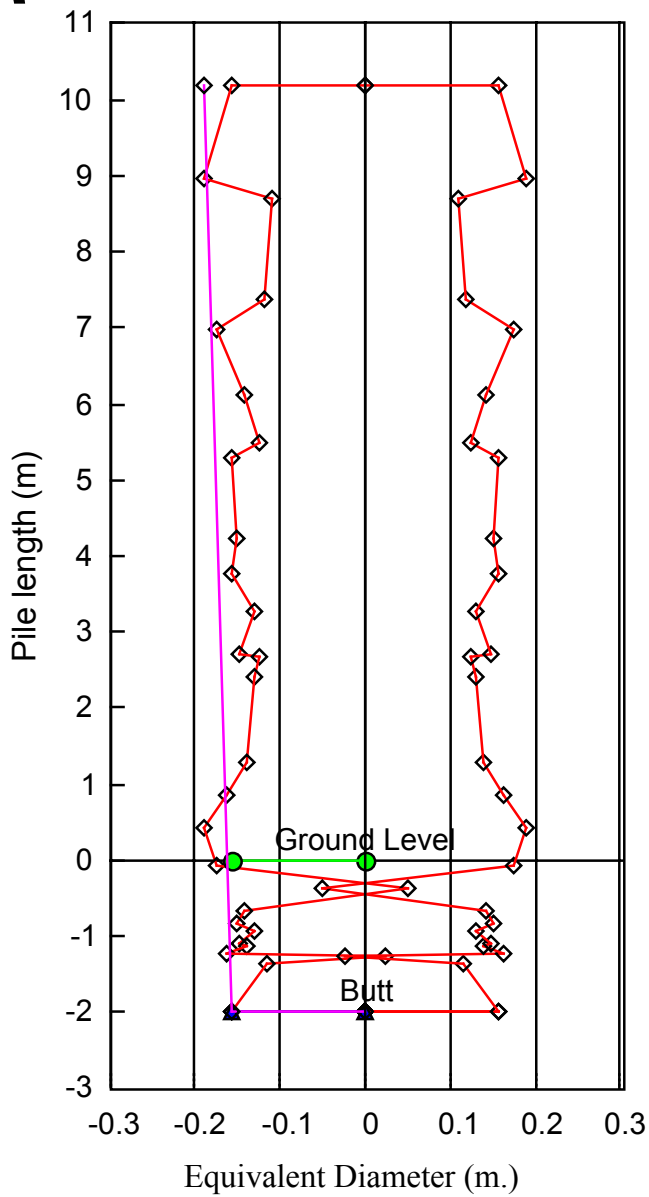
Pole 255

- A measured cross section is given
- Approximately 160mm pipe is found
- Filled with wet rot wood



Pole 43

- Pole classed as limited life with 40mm wall
- Inspected this year
- Model from test shown
- Major loss shown below ground line



Pole 43

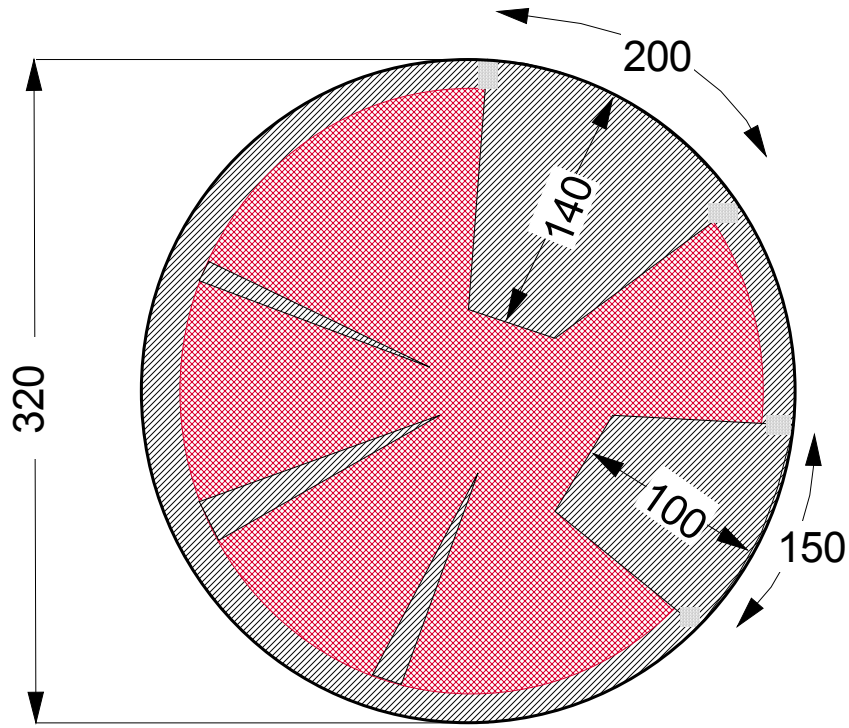
One third of the pole remains
With clay segments seen as the dark bands

Pole 43


The pole Section split into pieces only the right hand side shows any good wood.

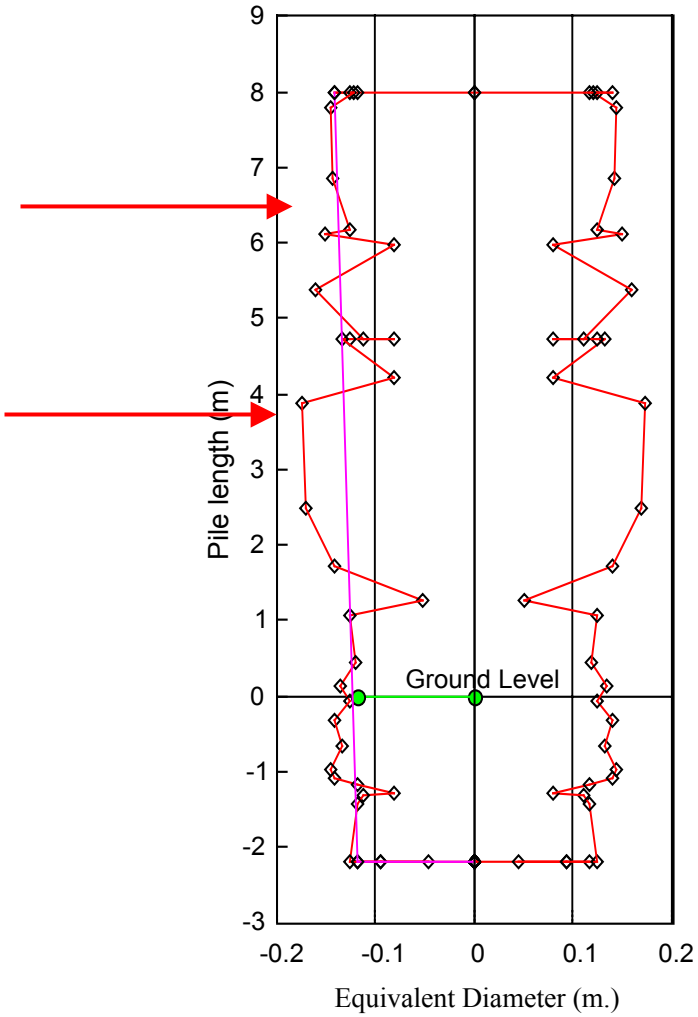
Pole 43

- Cross hatch section red section is the loss due to termites



Pole 239 Non-Traditional search area

- The model showed loss of section from GL + 4.0 to GL +6.2 m also areas 0.1 GL and –0.9 GL.
- After removal and cutting the pole at level +4.0 to + 6.2 m, the exposed pole indicated rot and termite.
- At +5.5 metre the wall was measured to be 55 mm.
- At + 4.9 metre the wall thickness was measured 20mm.
- InSafe™ model showed a 17mm wall thickness.




Non- Traditional search area
GL+4.0
GL+5.5

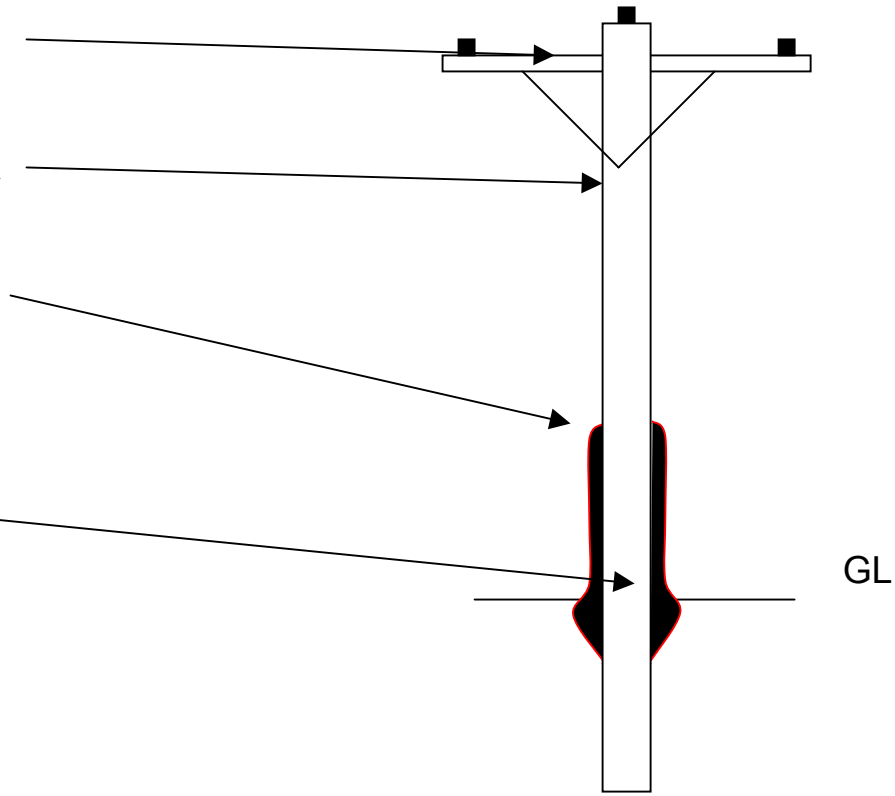

Non- Traditional search area
GL+6.2
GL+5.5
Termite nest starting at 4.0m major loss at 5.0m and 6.0m

Future

- A large number of the aspects of InSafe™ have been verified over the past five years.
- These new features answers the questions the Industry posed about Pole-Test. **Particularly defects outside the traditional inspection areas**.
- In our opinion it is time to utilize InSafe™ commercially for large scale inspections.
- The way the system is set up particularly for safety, with the linesmen equipped, then a safety test becomes an inspection test as well.
- With the success of InSafe ™ Integrity Testing Pty. Ltd. are developing related topics where their expertise can be utilised.

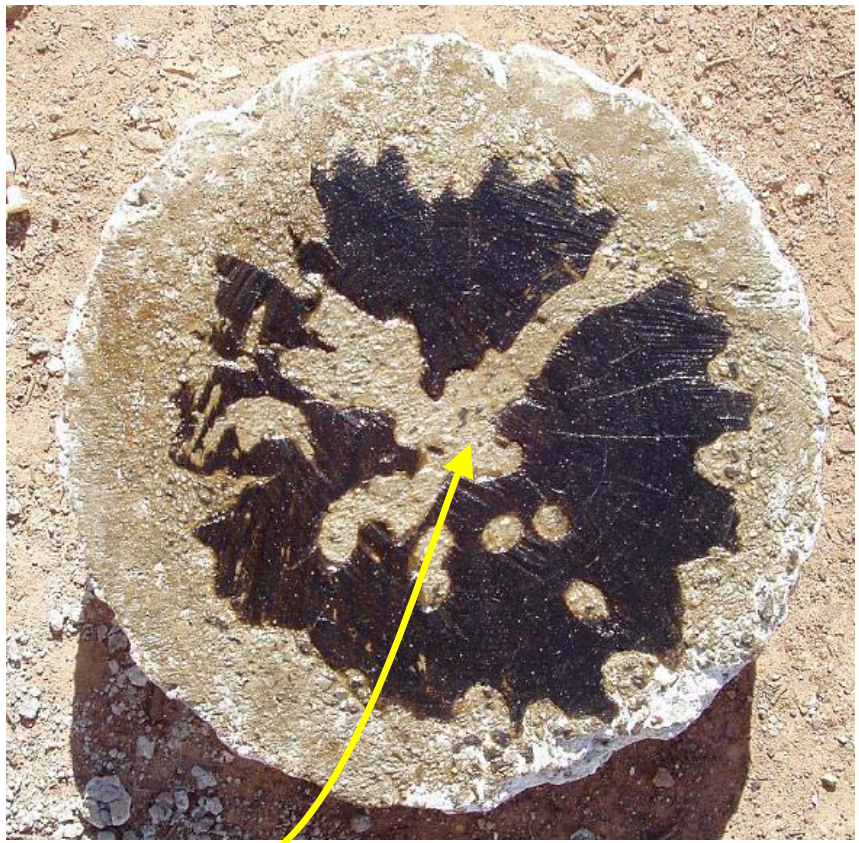
Recent Developments

- Infra Red defect detection of cross arms
- Conceptional methods for pole fires.
- Repair of timber and concrete piles and poles.
- Termite protection with environmentally friendly materials.
- Total asset management with serviceability linked to GPS and GIS.



Example of Concreted pole

- Concrete can be used
- Tip capacity can be increased by 10KN.
- A special RASC 40 Mpa concrete is needed
- Integrity Has produced 100 Mpa
- Part of ongoing development



Concrete penetrates
to the center of the pole

Integrity Testing Pty Ltd

- **THANKYOU**