INTELLIGENT COMPACTION

Bomag Americas

BOMAG
FAYAT GROUP

Light Eqpt.

Tandem Rollers

Refuse Compactors

Single Drum Rollers

Asphalt Pavers

Milling Machines

BOMAG
FAYAT GROUP

BOMAG
FAYAT GROUP

BOMAG
FAYAT GROUP

COMPACTION IS ACHIEVED BY

VIBRATION

MANIPULATION

PRESSURE

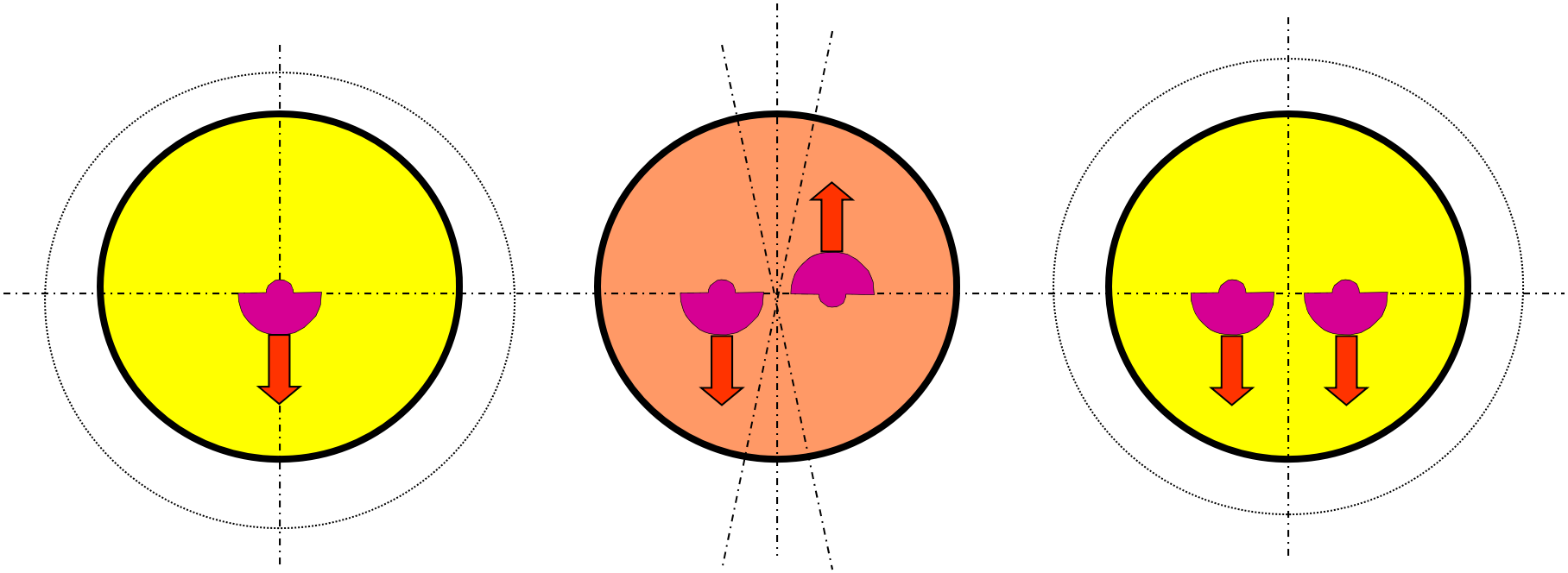
IMPACT

Vibration Systems

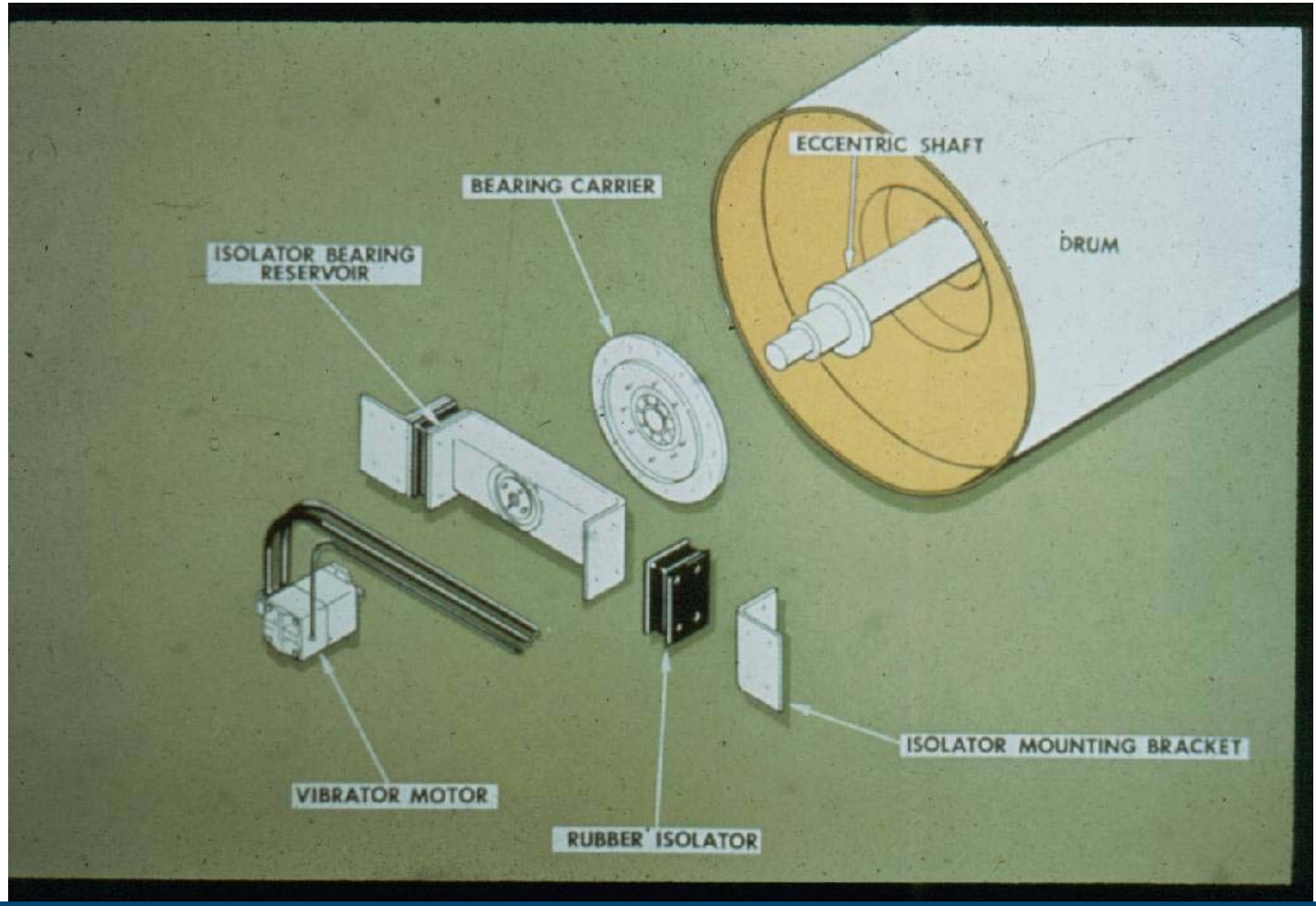
Rotary exciter

Oscillation

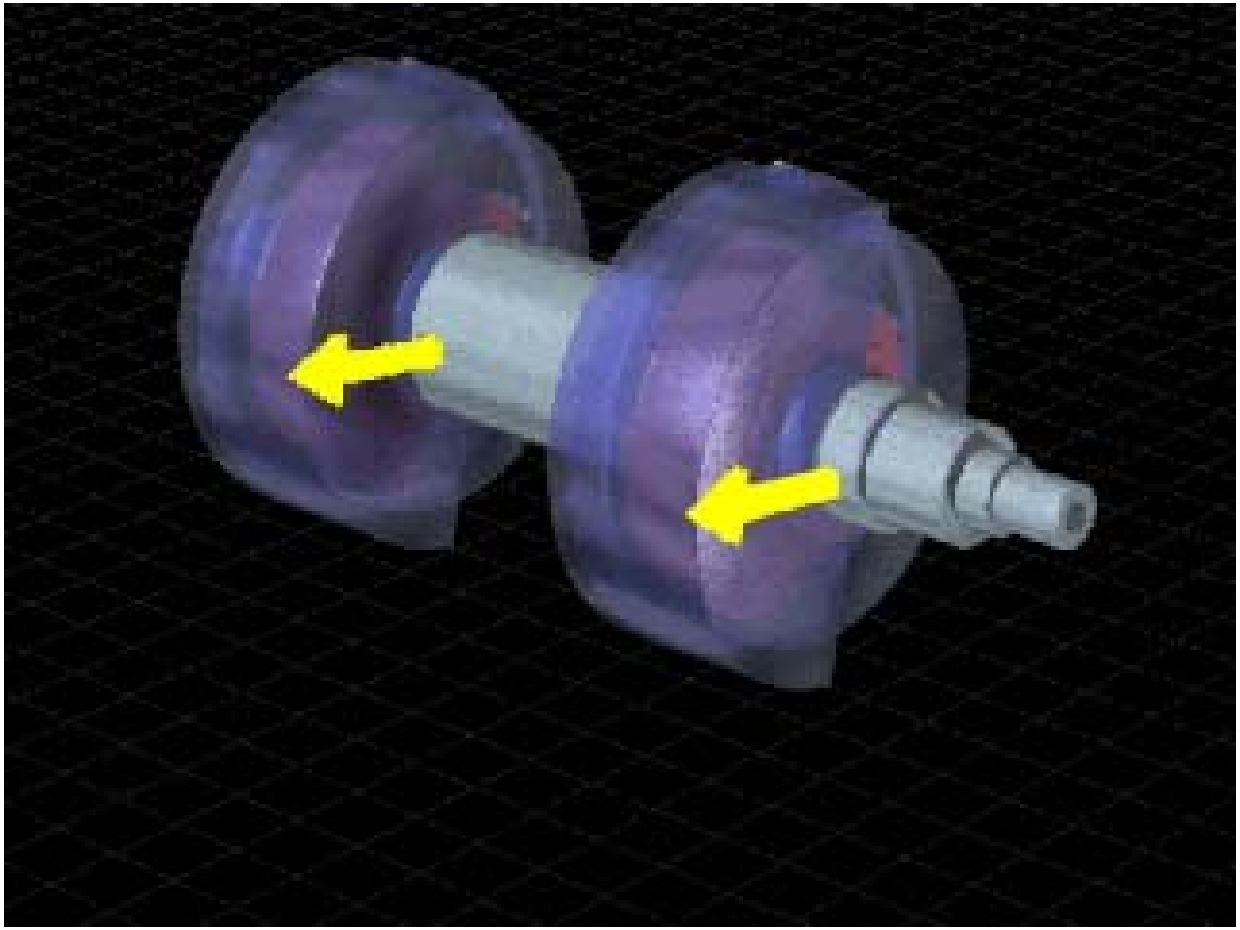
directed



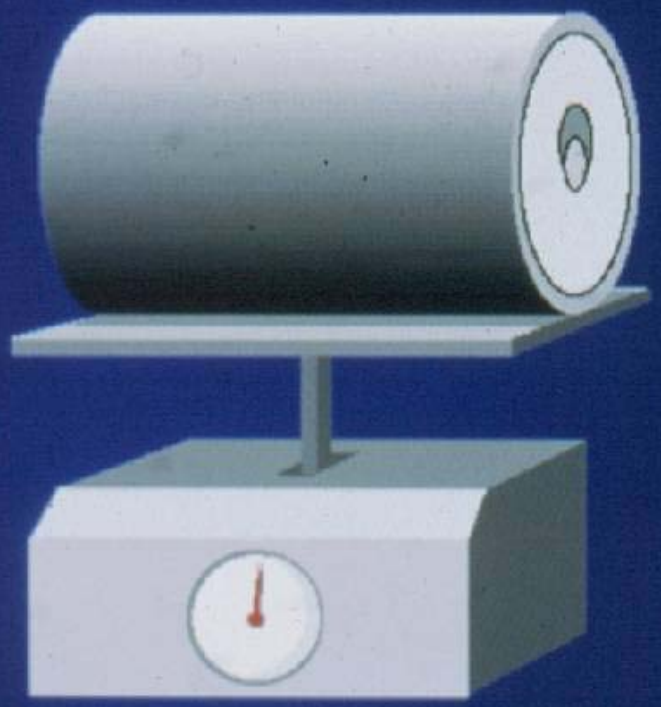
Vibratory System



Rotary Exciter



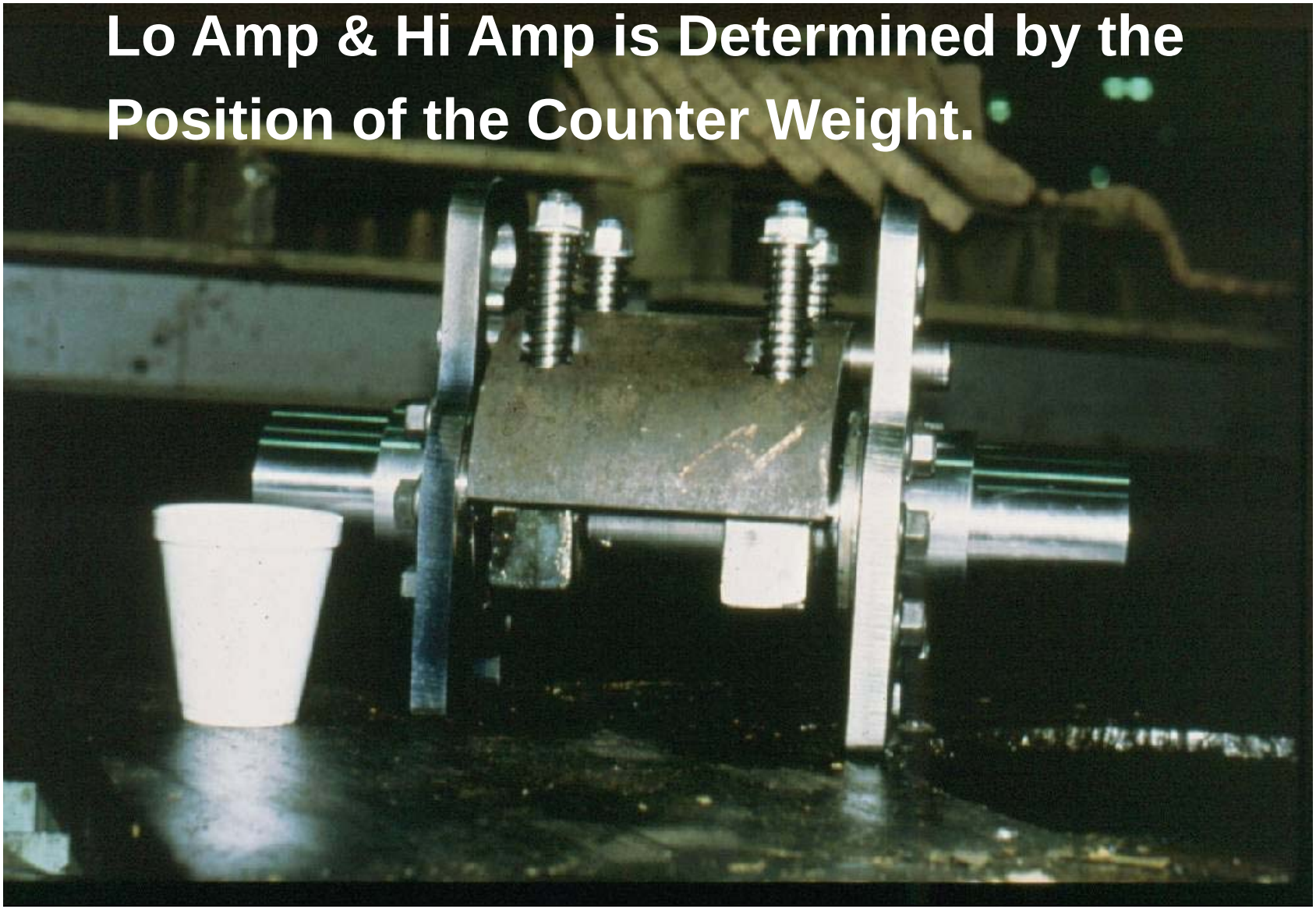
Centrifugal Force

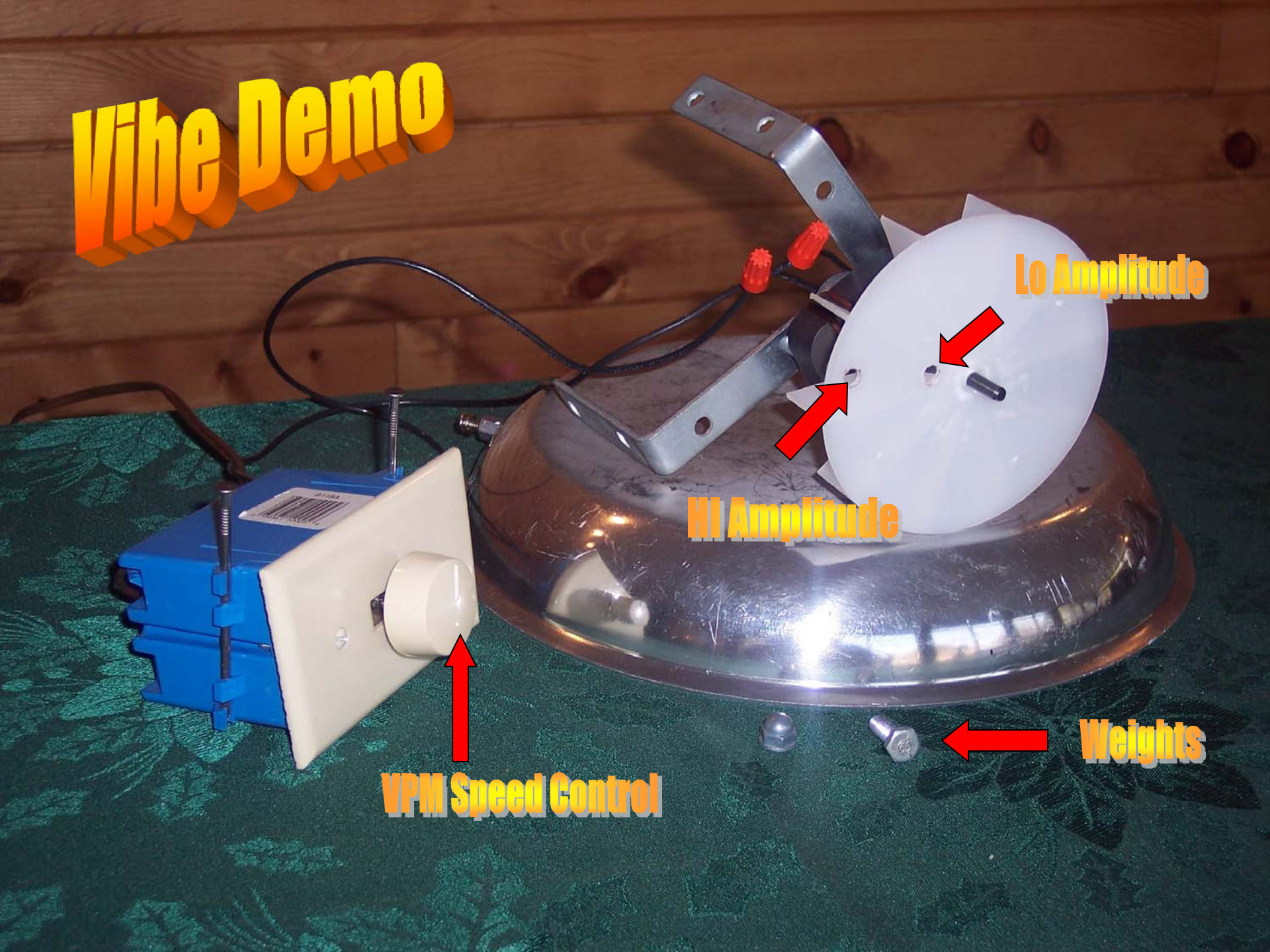


Force generated by vibratory mechanism at a stated amplitude and frequency.

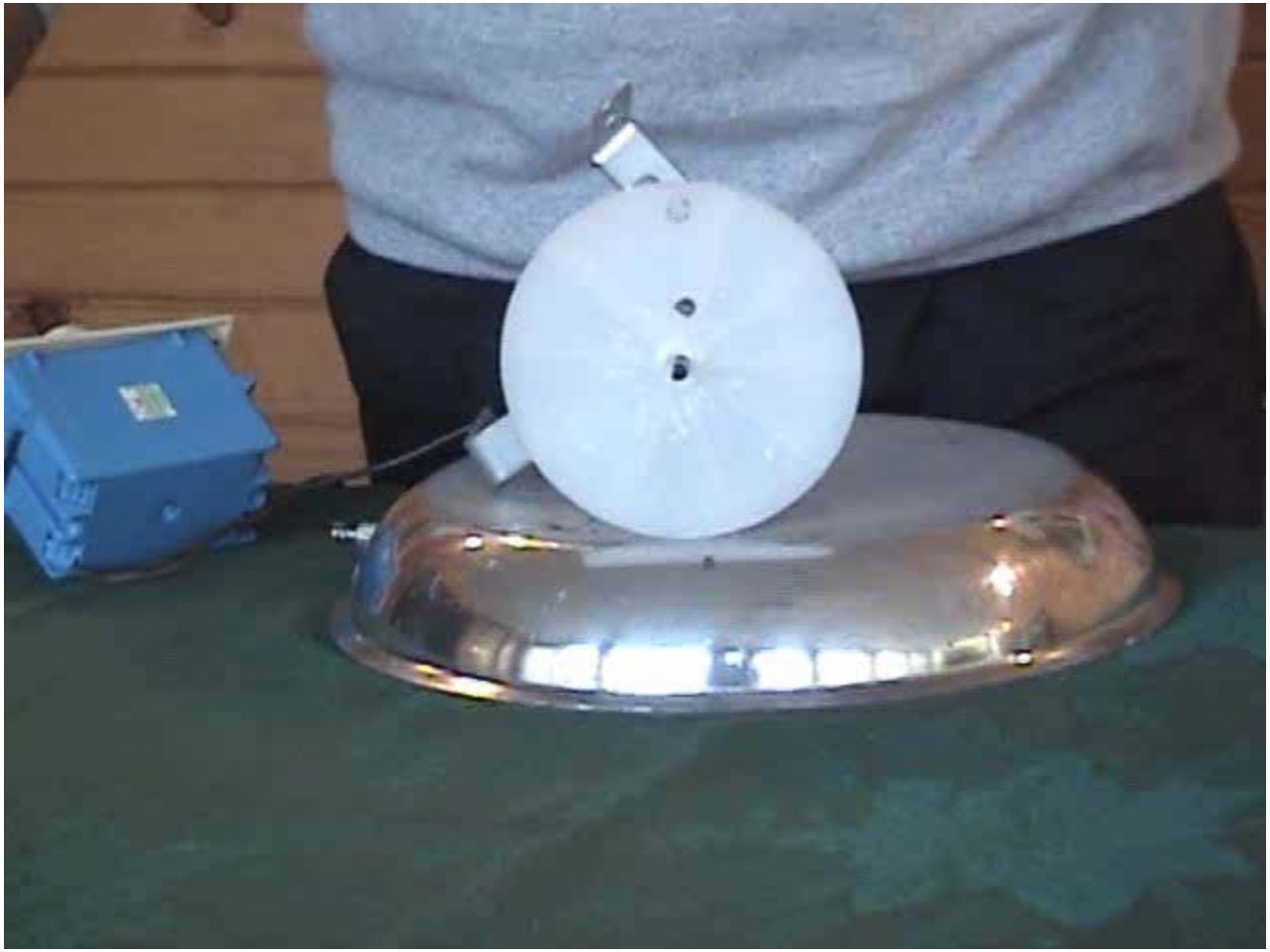
Force changes when amplitude and/or frequency changes

Lo Amp & Hi Amp is Determined by the Position of the Counter Weight.

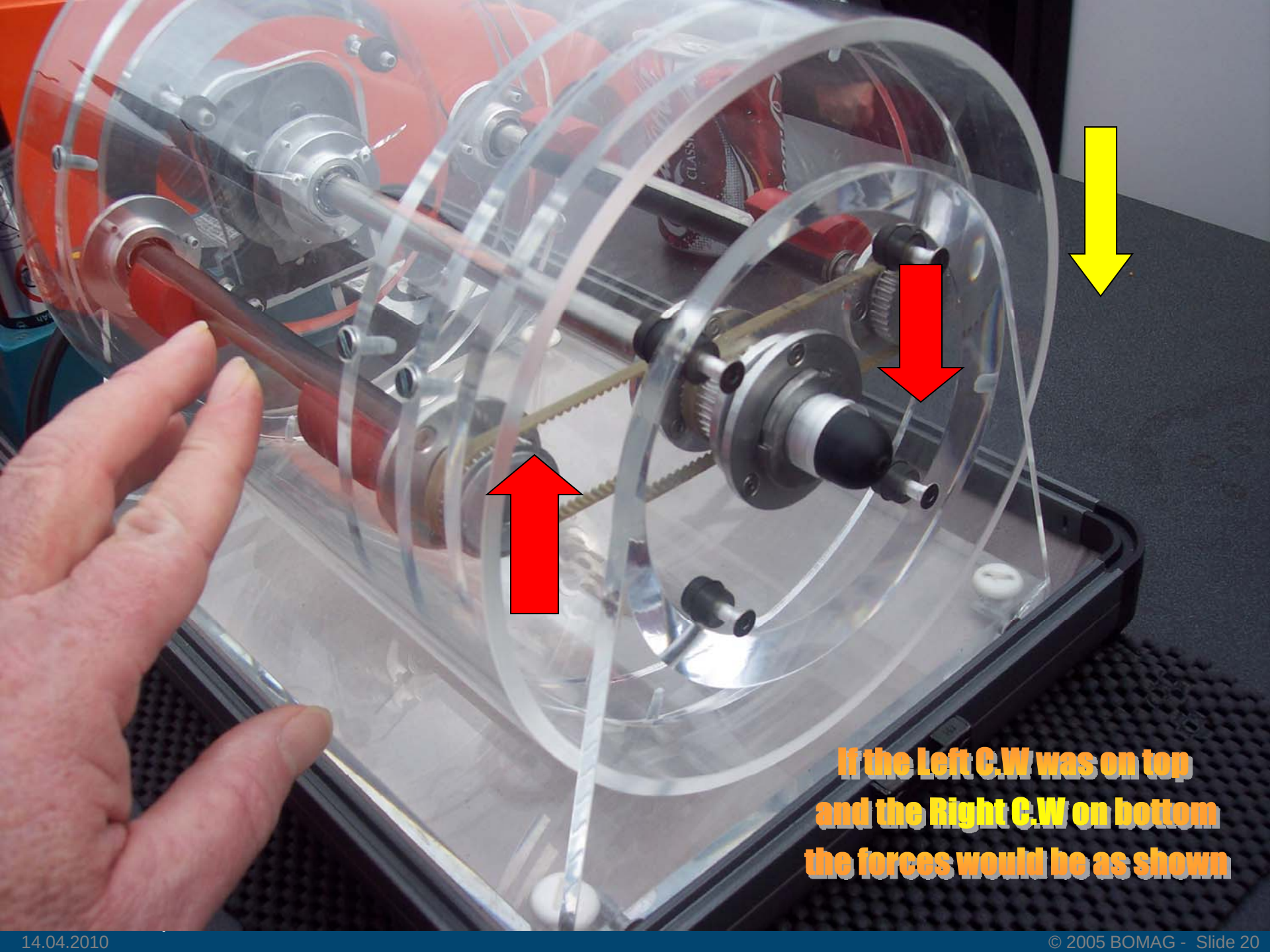



Vibe Demo
Lo Amplitude
HI Amplitude
VPM Speed Control
Weights

Vibe Demo



Changing Amp. & Frequency


If the Left C.W was on top
and the Right C.W on bottom
the forces would be as shown

INTELLIGENT COMPACTION

WHAT IS INTELLIGENCE

1)Collect Information

2)Use the Collected Information to Make a Decision

3) Execute the Decision

Key steps for the development of BOMAG IC rollers

1982 First compaction measurement system for soil compaction Terrameter BTM01

1995 First compaction management system BCM for large projects

1999 First soil compactor (IC) with automated controled variable amplitude and stiffness measurement system (Evib) / BOMAG Variocontrol

2001 First asphalt compactor (IC) with automated controled variable amplitude and stiffness measurement system (Evib) / BOMAG Asphalt Manager

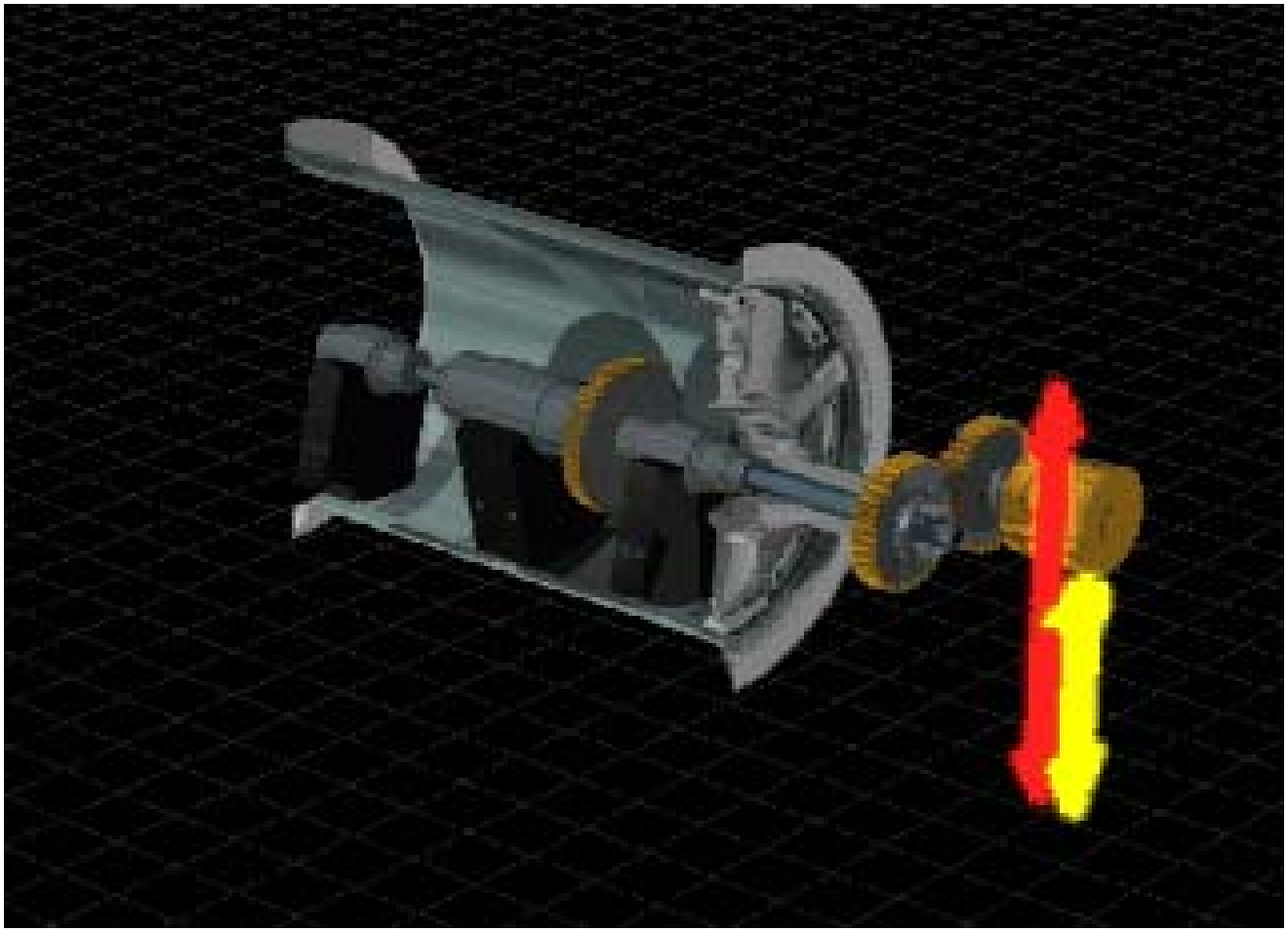
2004 BOMAG IC rollers equipped with GPS technology

278/778 AM

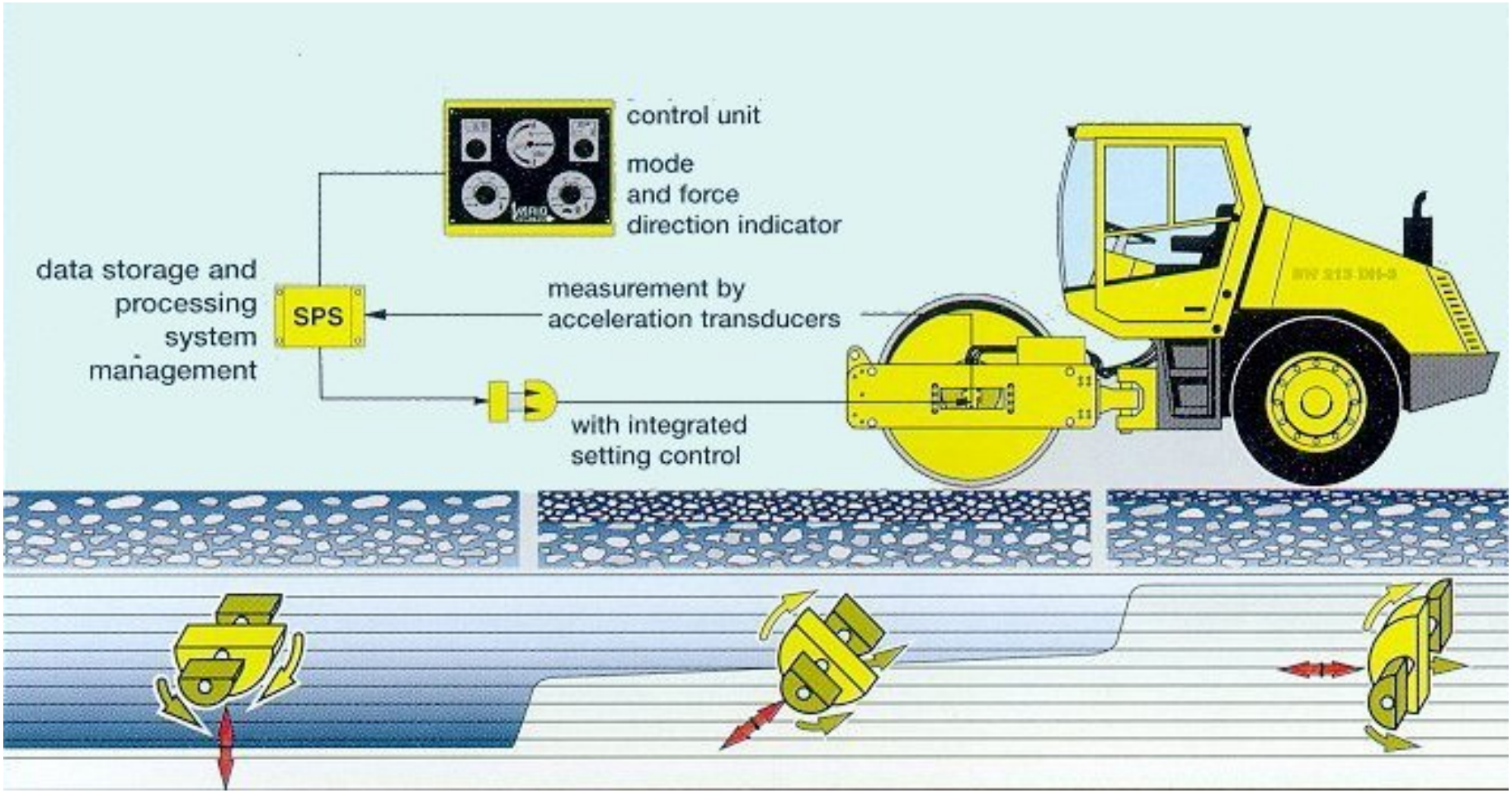
BOMAG VARIOCONTROL

Force Direction Control:

adjustment of exciter housing from horizontal to vertical.



VARIOCONTROL system for single drum rollers



Vibe 4

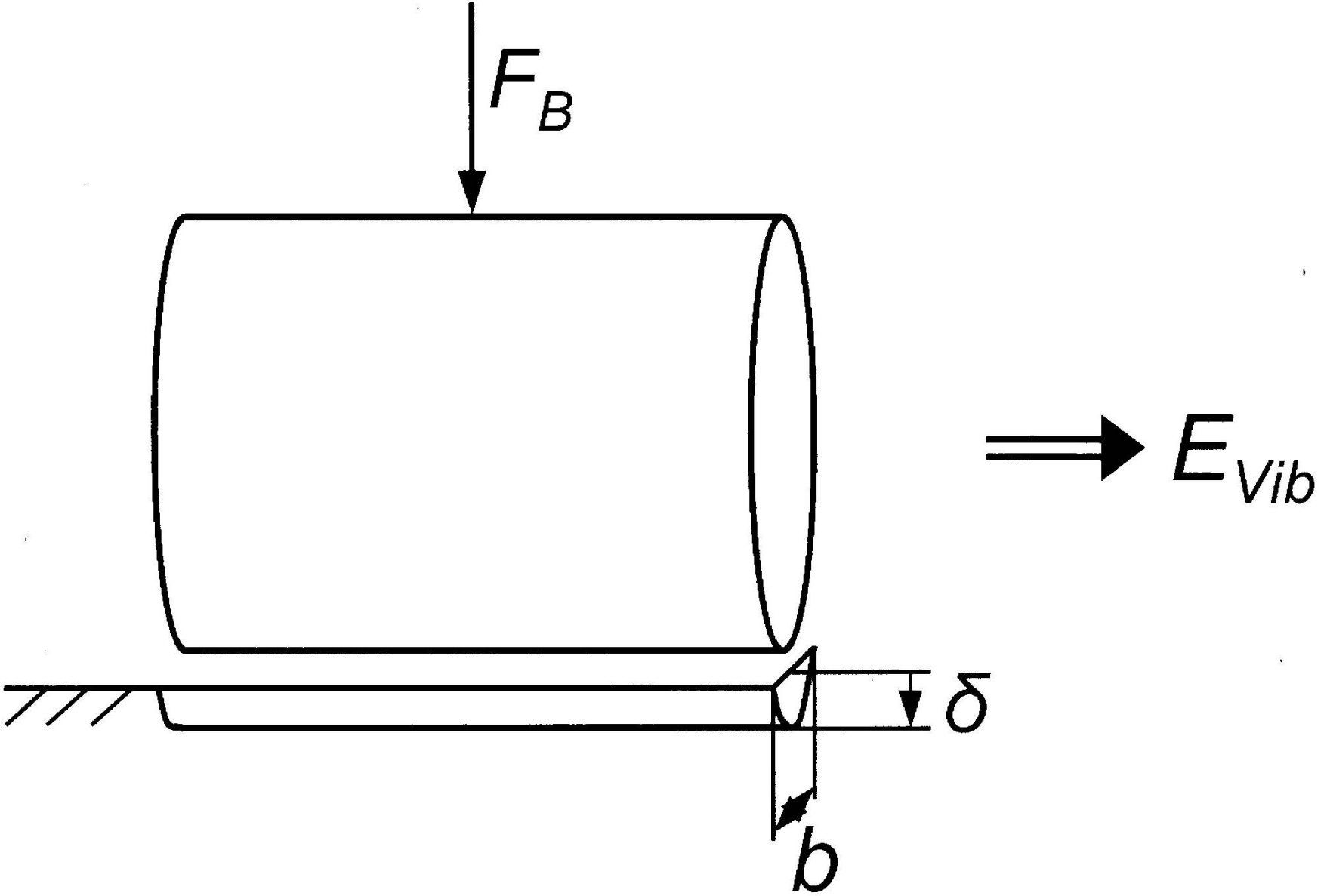
Force & Amp. are in the #4 Vector

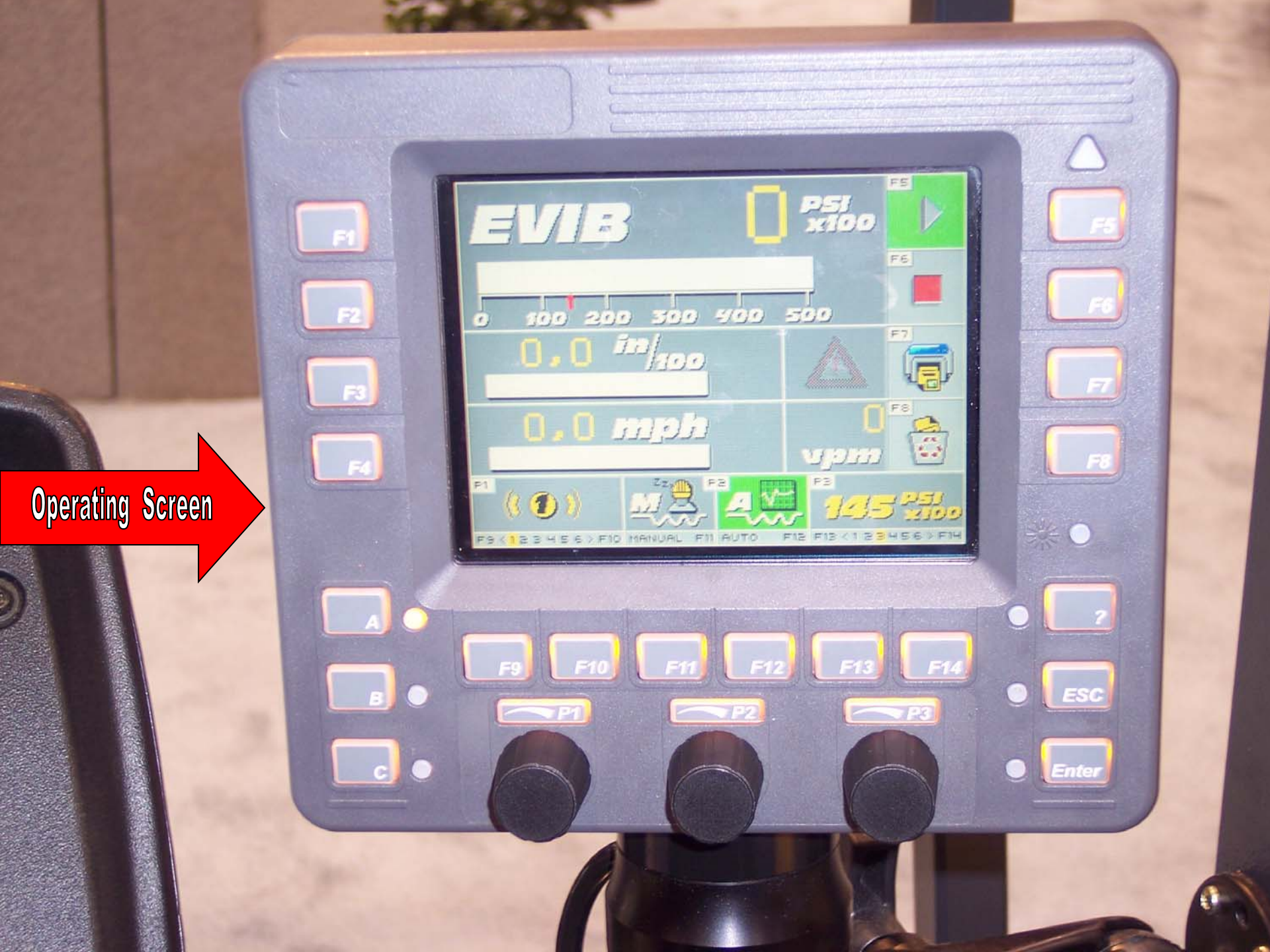
Vibe 1

Force & Amp. in Horizontal Position

Cent. Force Calculations

	1	2	3	4	5	6
213 BVC						
C.F. lbs	0.0	22,995	36,135	45,990	59,130	82,125
190 AM-4						
C.F. lbs	0.0	13,893	27,730	37,050	44,768	55,575




Operating Screen
EVIB
PSI x100
0 100 200 300 400 500
0.0 in/100
0.0 mph
vpm
145 PSI x100
F1
F2
F3
F4
F5
F6
F7
F8
A
B
C
?
ESC
Enter
F9
F10
F11
F12
F13
F14
P1
P2
P3

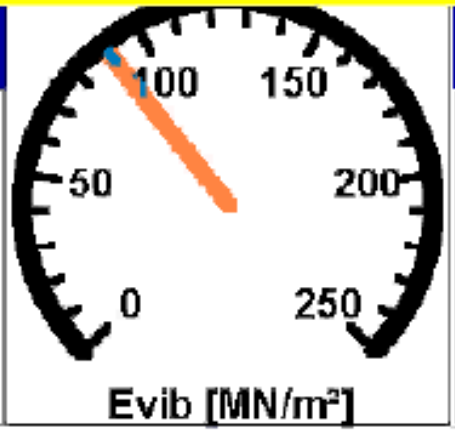
Bomag Operational Panel

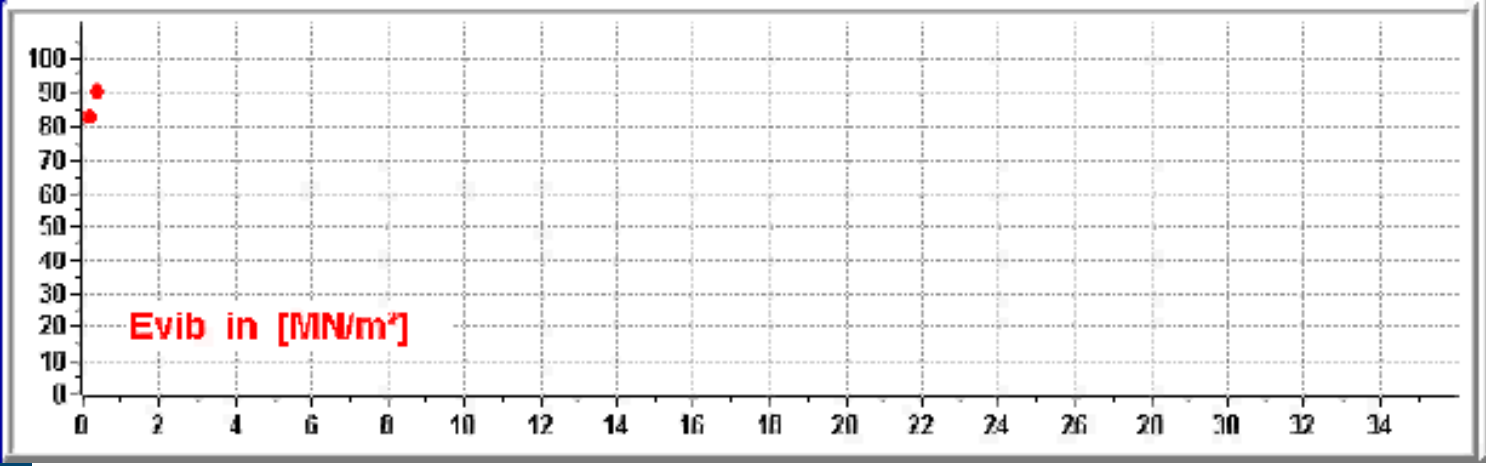
PRINTER
- **Start**
- **Stop**
- **Print out**
- **Delete**

Test procedure:

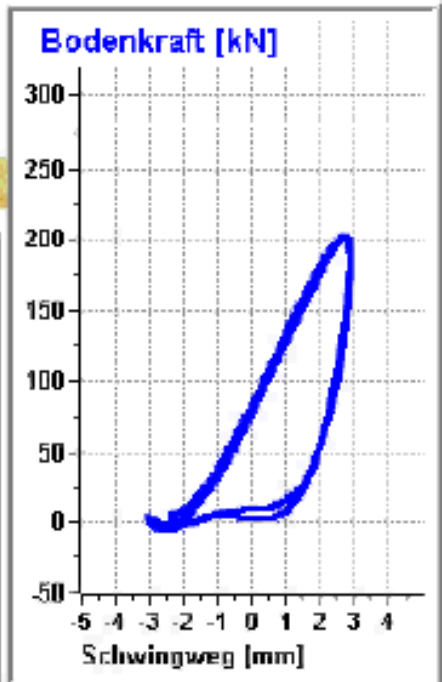
- **Mark the track to be compacted**
- **Manual operation mode with**
- **Fixed amplitude**
- **Fixed working speed**

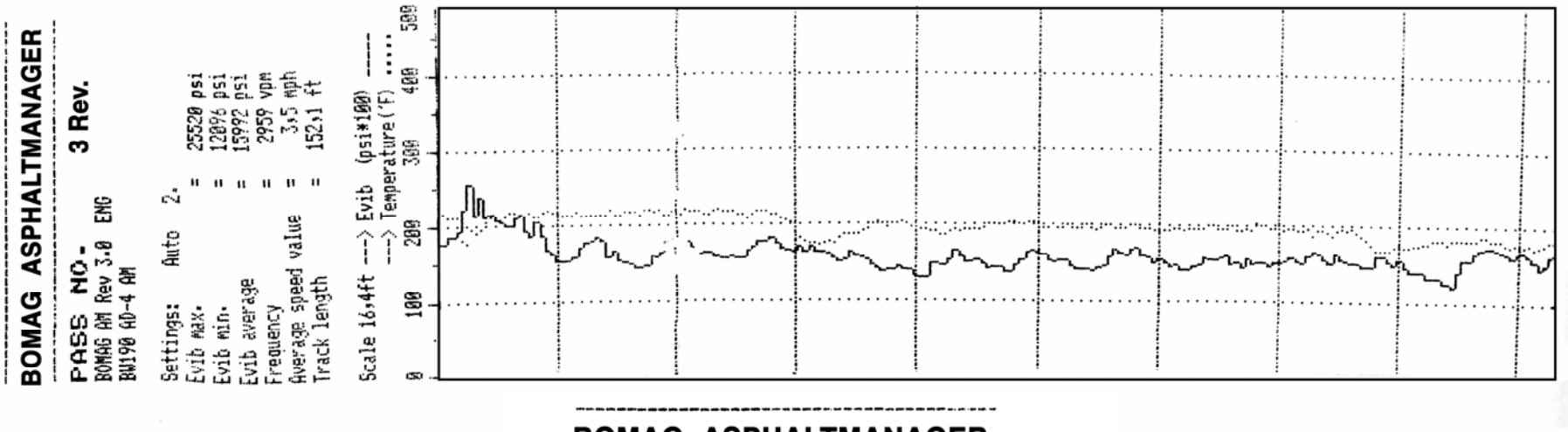
Dynamischer Steifigkeitsmodul "Evib" als flächendeckende Verdichtungskontrolle beim Fahren





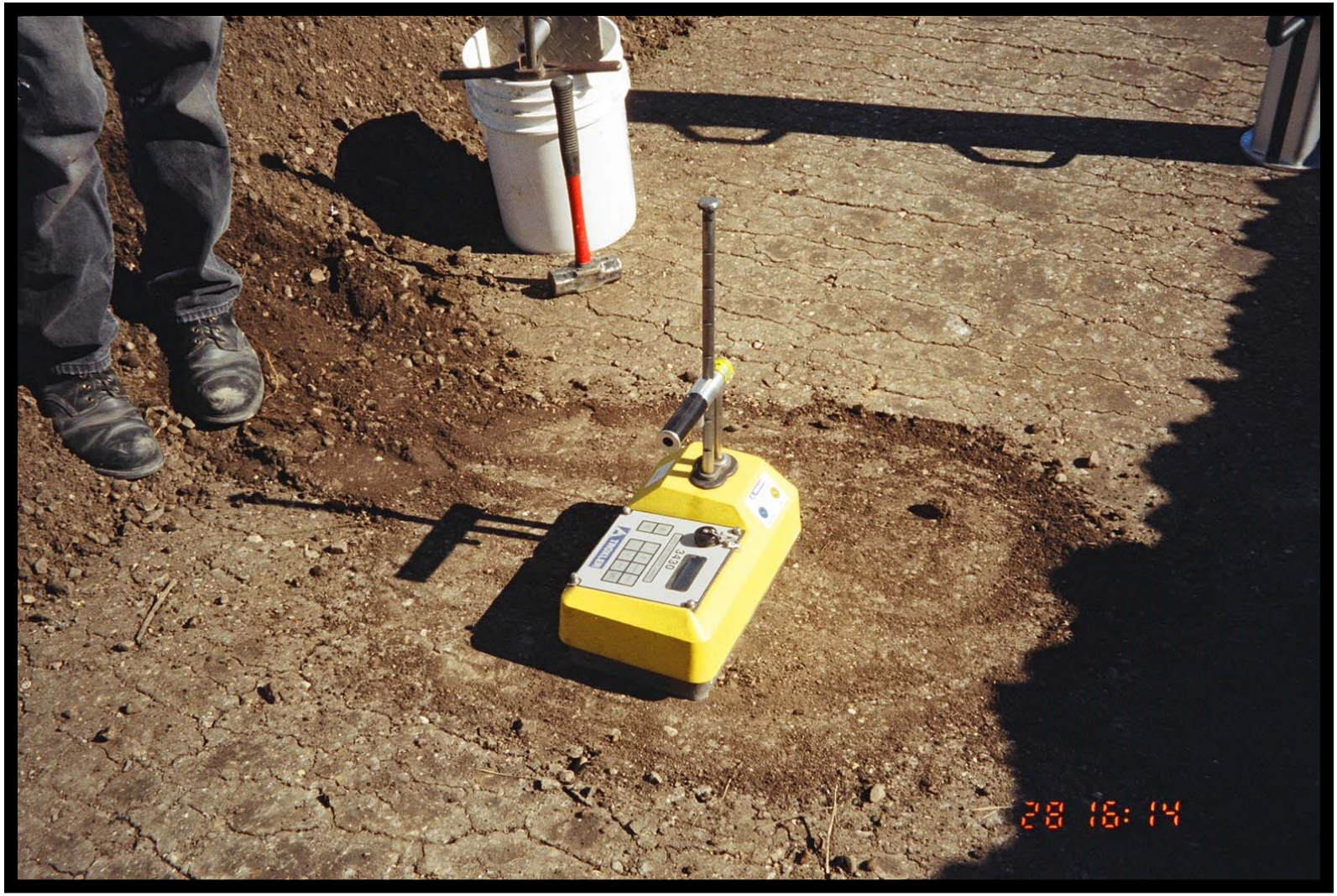
Indikatordiagramm





BOMAG ASPHALTMANAGER
PASS NO. 3 Rev.
BOMAG AM Rev 3.0 ENG
BW190 AD-4 AM
Settings: Auto 2.
Evib max. = 25520 psi
Evib min. = 12096 psi
Evib average = 15992 psi
Frequency = 2959 vpm
Average speed value = 3,5 mph
Track length = 152,1 ft
Scale 16,4ft ---> Evib (psi*100) _____
---> Temperature (°F) .....
0 100 200 300 400 500

Evib / density calibration on asphalt



BW190AD - 4 AM

Intelligent Compaction

1. The VARIOCONTROL System will measure the stiffness of the compacted material.

2. Automatically adjust the vertical Centrifugal Force Vector.


Colorado State Highway 2008

Roller Compacted Concrete

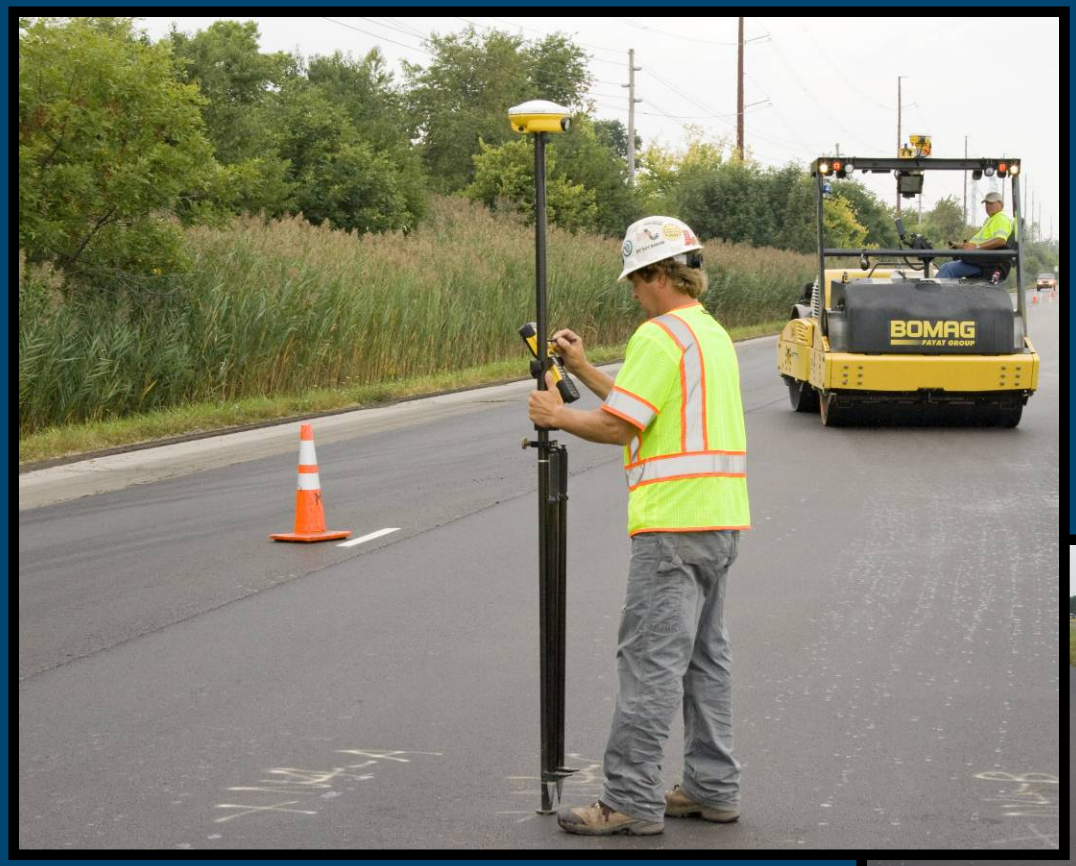
Illinois Residential Area 2008

W Layfayette IN - ICPF Site 2009

Mapping
HMA Layer

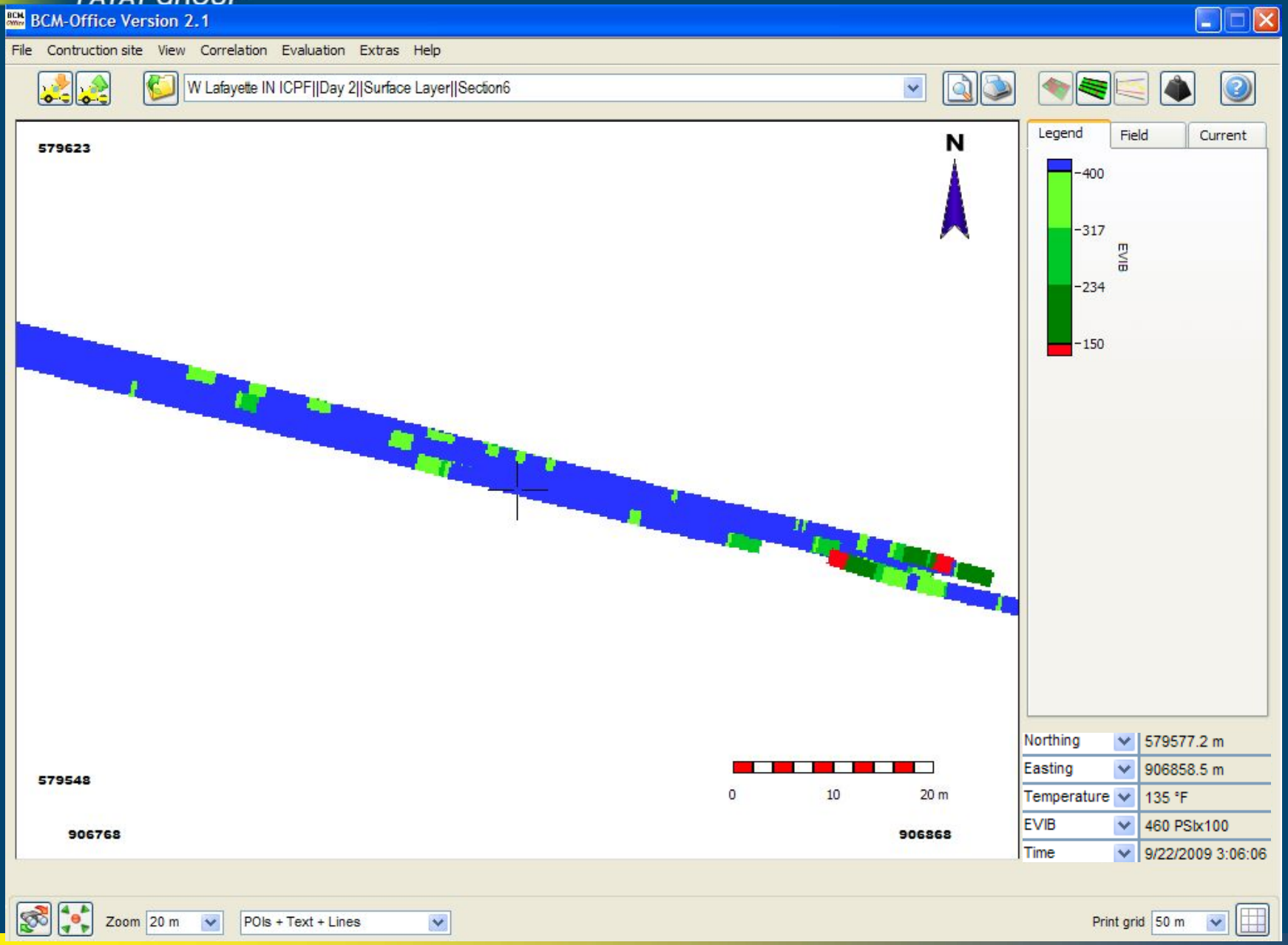
W Layfayette IN - ICPF Site 2009

W Layfayette IN - ICPF Site 2009

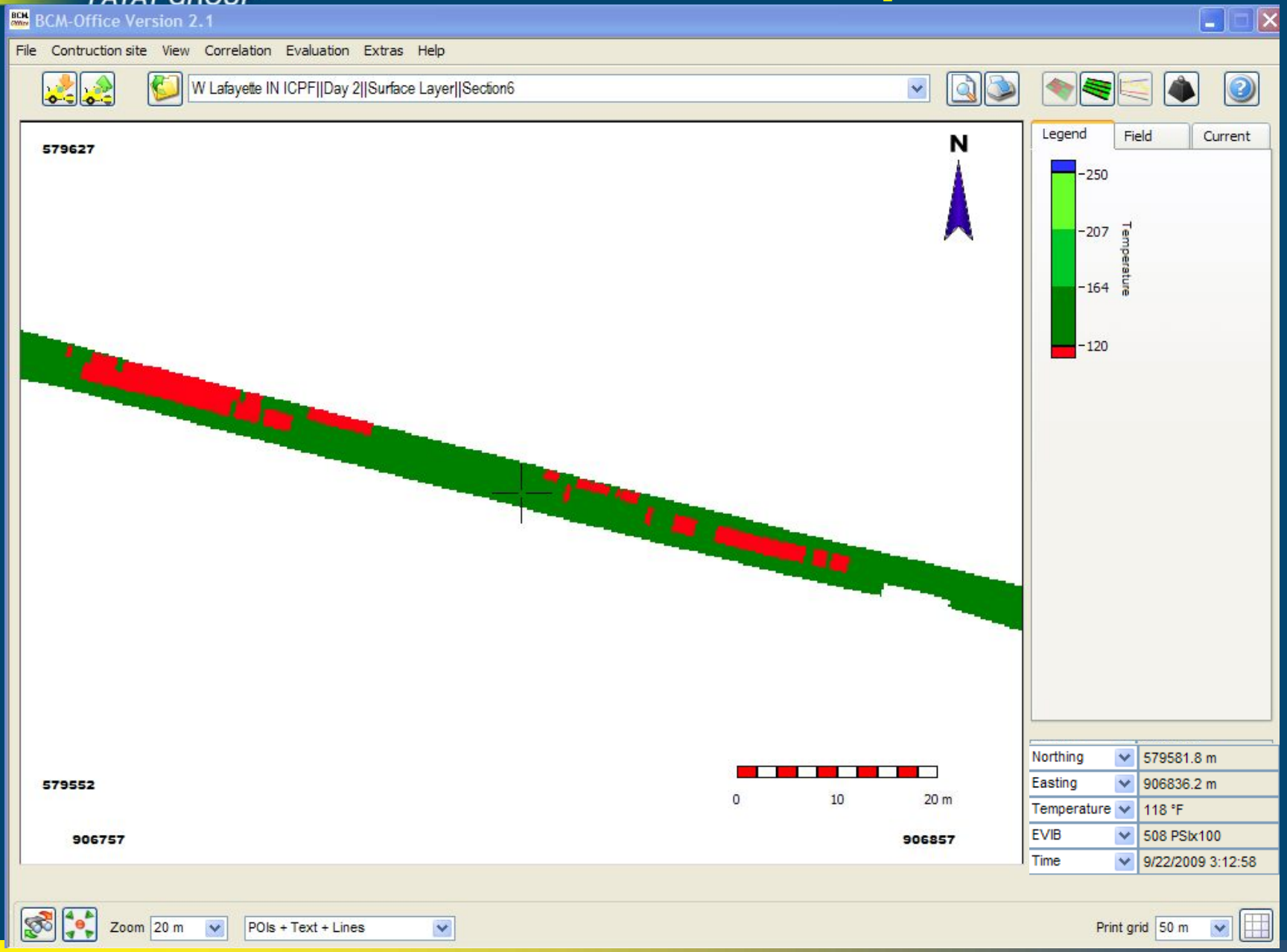


On Site QA Tests

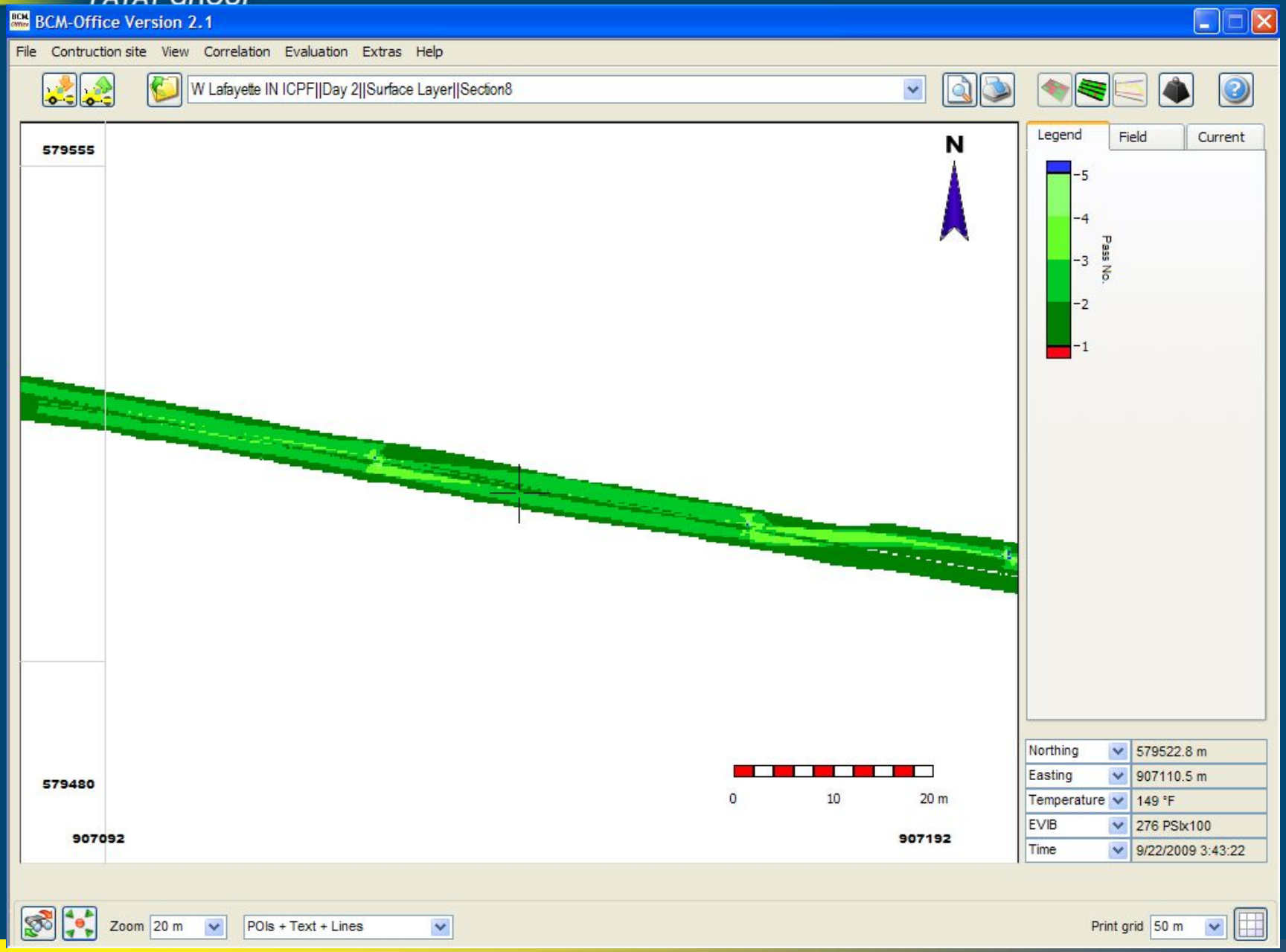
BCM05 Evib Stiffness



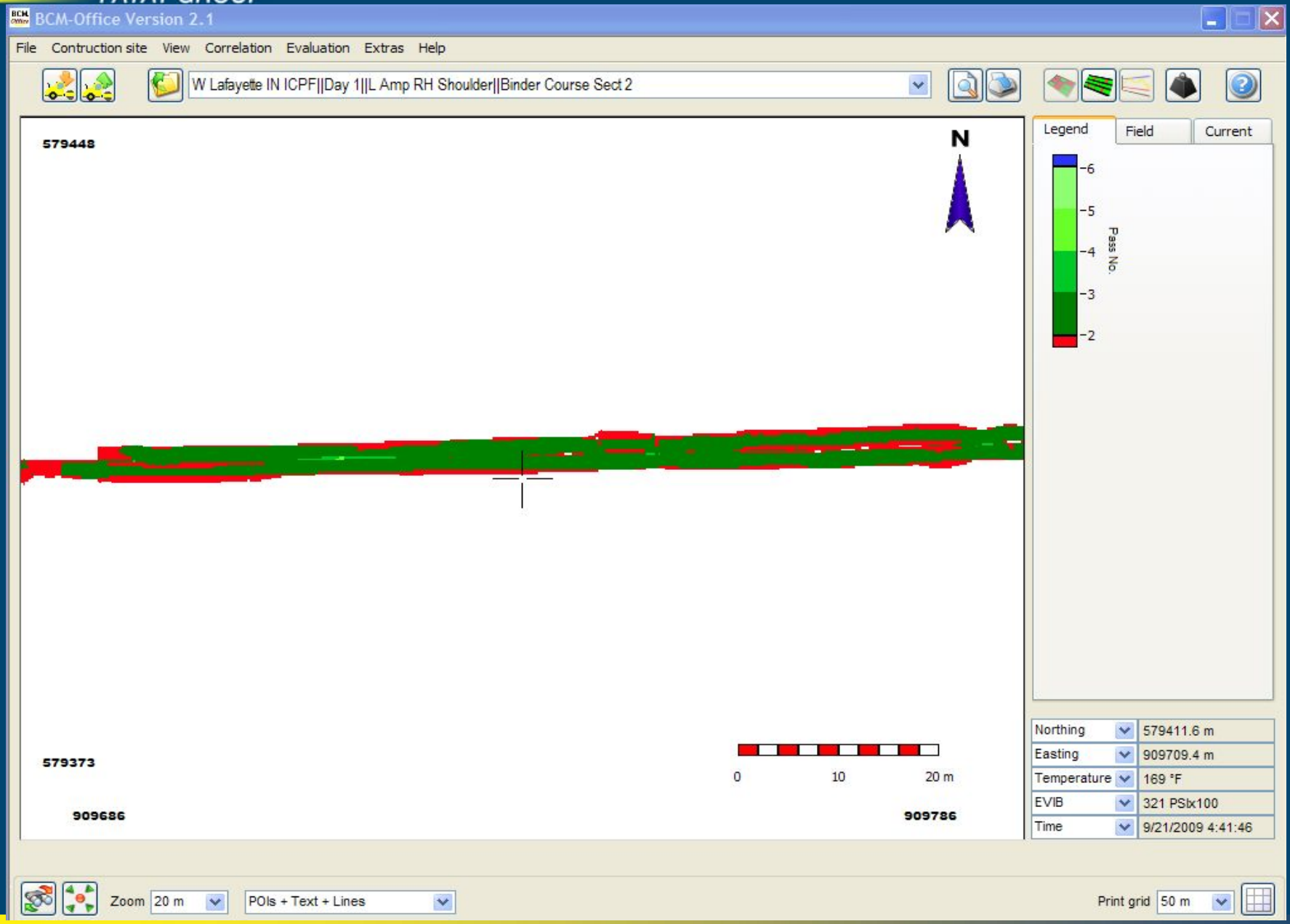
BCM05 Temperature



BCM05 Roller Pass Count



BCM05 Roller Pass Count



Asphalt Manager

Benefits for Contractors:

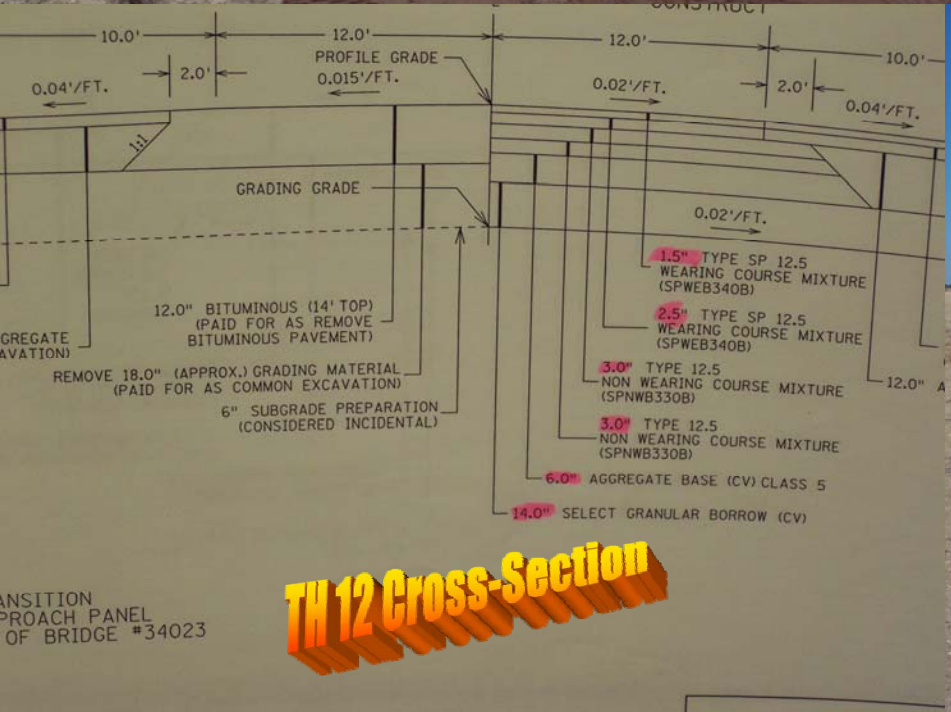
Compaction

- Uniform and predictable results while rolling
- Avoids under / overcompaction
- Eliminates drum bouncing
- Improves smoothness

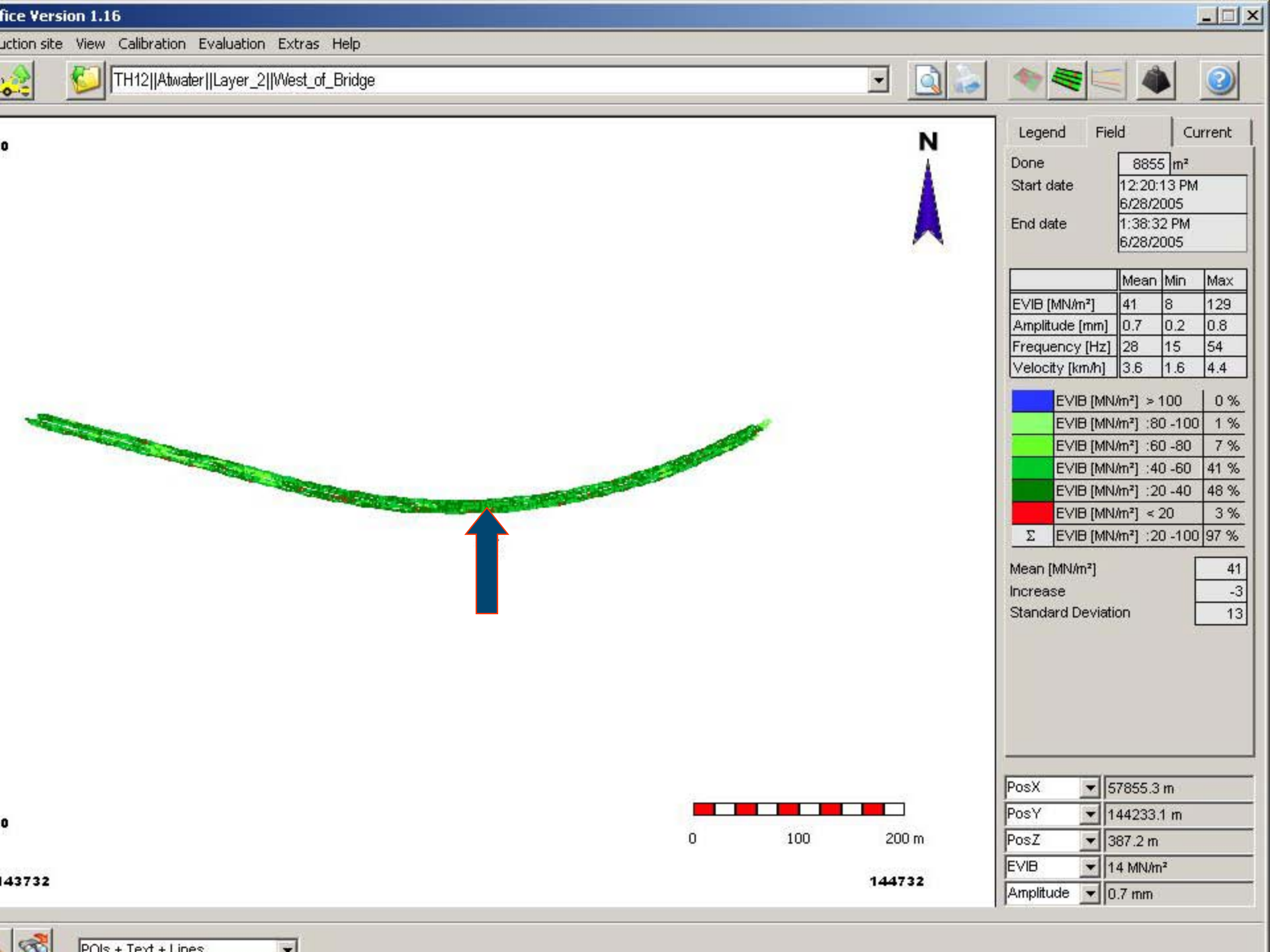
- More efficient roller utilization with fewer passes
- Reduced shock loads in sensitive environment
  e.g. buildings, bridges


BOMAG
14" Lift


class 5 aggregate base


10.0'
12.0'
PROFILE GRADE
0.015'/FT.
12.0'
10.0'
0.04'/FT.
2.0'
0.02'/FT.
2.0'
0.04'/FT.
1:1
GRADING GRADE
0.02'/FT.
1.5" TYPE SP 12.5
WEARING COURSE MIXTURE
(SPWEB340B)
2.5" TYPE SP 12.5
WEARING COURSE MIXTURE
(SPWEB340B)
12.0" BITUMINOUS (14' TOP)
(PAID FOR AS REMOVE
BITUMINOUS PAVEMENT)
3.0" TYPE 12.5
NON WEARING COURSE MIXTURE
(SPNWB330B)
REMOVE 18.0" (APPROX.) GRADING MATERIAL
(PAID FOR AS COMMON EXCAVATION)
6" SUBGRADE PREPARATION
(CONSIDERED INCIDENTAL)
3.0" TYPE 12.5
NON WEARING COURSE MIXTURE
(SPNWB330B)
6.0" AGGREGATE BASE (CV) CLASS 5
14.0" SELECT GRANULAR BORROW (CV)
TH 12 Cross-Section

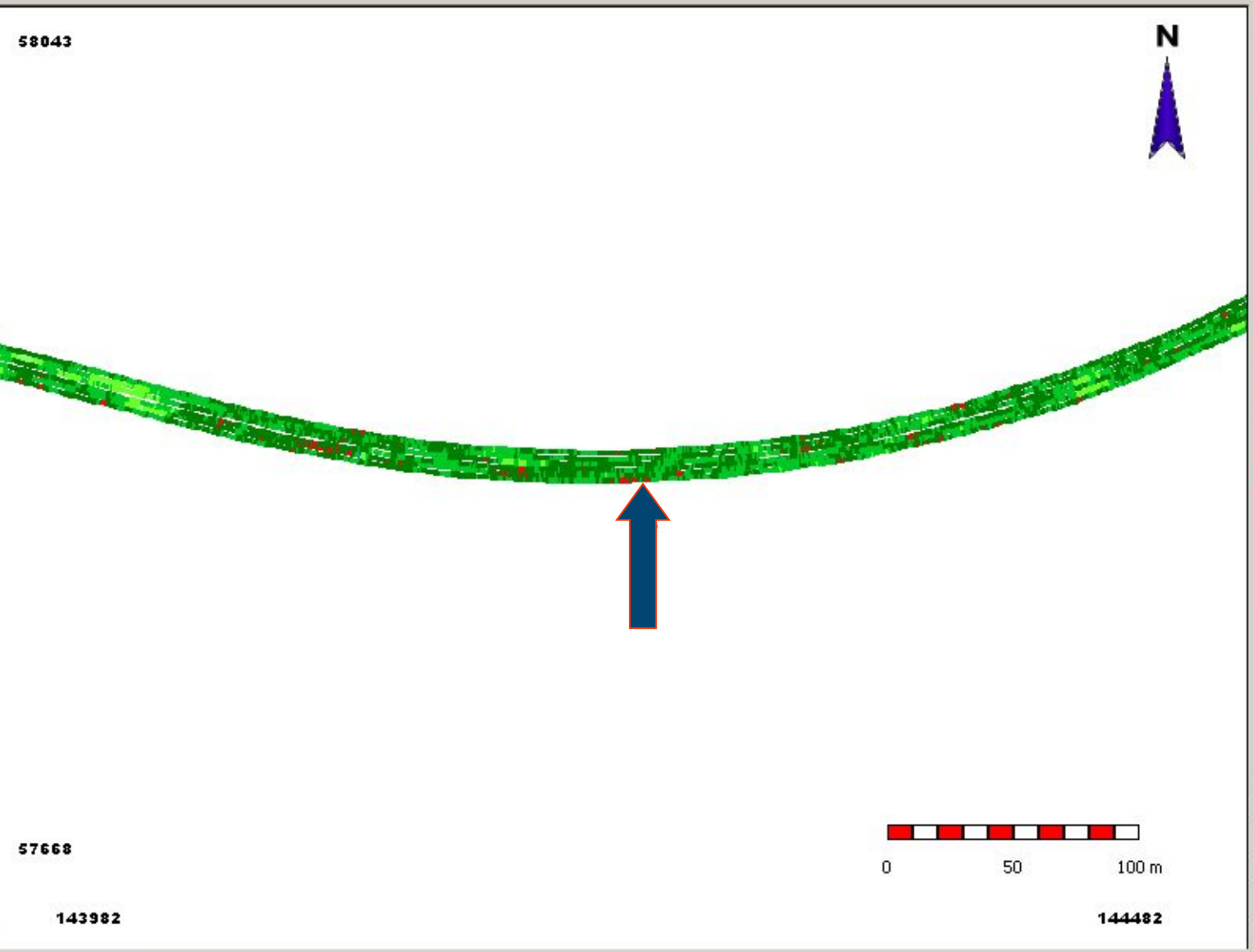

400 cu yds / hr


fice Version 1.16
uction site View Calibration Evaluation Extras Help
TH12||Atwater||Layer_2||West_of_Bridge
N
Legend
Field
Current
Done 8855 m²
Start date 12:20:13 PM 6/28/2005
End date 1:38:32 PM 6/28/2005
Mean Min Max
EVIB [MN/m²] 41 8 129
Amplitude [mm] 0.7 0.2 0.8
Frequency [Hz] 28 15 54
Velocity [km/h] 3.6 1.6 4.4
EVIB [MN/m²] ≥ 100 0 %
EVIB [MN/m²] :80 -100 1 %
EVIB [MN/m²] :60 -80 7 %
EVIB [MN/m²] :40 -60 41 %
EVIB [MN/m²] :20 -40 48 %
EVIB [MN/m²] < 20 3 %
Σ EVIB [MN/m²] :20 -100 97 %
Mean [MN/m²] 41
Increase -3
Standard Deviation 13
0
100
200 m
143732
144732
PosX 57855.3 m
PosY 144233.1 m
PosZ 387.2 m
EVIB 14 MN/m²
Amplitude 0.7 mm
POIs + Text + Lines

BCM-Office Version 1.16

Contruction site View Calibration Evaluation Extras Help

TH12||Atwater||Layer_2||West_of_Bridge



Legend | Field | Current

Done	8855 m²
Start date	12:20:13 PM 6/28/2005
End date	1:38:32 PM 6/28/2005

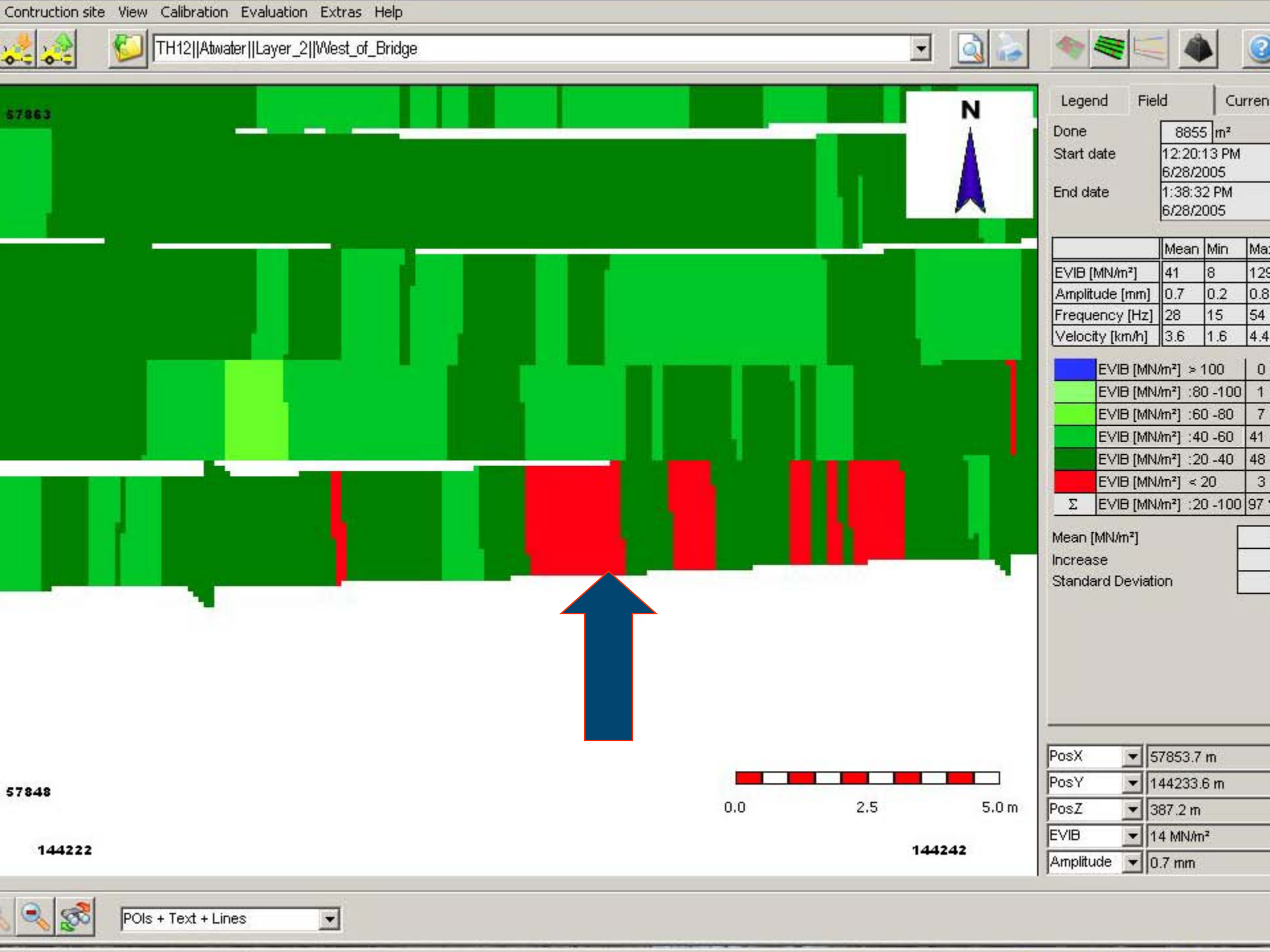
	Mean	Min	Max
EVIB [MN/m²]	41	8	129
Amplitude [mm]	0.7	0.2	0.8
Frequency [Hz]	28	15	54
Velocity [km/h]	3.6	1.6	4.4

	EVIB [MN/m²] > 100	0 %
	EVIB [MN/m²] :80 -100	1 %
	EVIB [MN/m²] :60 -80	7 %
	EVIB [MN/m²] :40 -60	41 %
	EVIB [MN/m²] :20 -40	48 %
	EVIB [MN/m²] < 20	3 %
Σ	EVIB [MN/m²] :20 -100	97 %

Mean [MN/m²]	41
Increase	-3
Standard Deviation	13

PosX	57854.1 m
PosY	144233.8 m
PosZ	387.2 m
EVIB	14 MN/m²
Amplitude	0.7 mm

POIs + Text + Lines


Contruction site View Calibration Evaluation Extras Help
TH12||Atwater||Layer_2||West_of_Bridge
57863
N
57848
144222
144242
0.0
2.5
5.0 m
Legend
Field
Curren
Done
8855
m²
Start date
12:20:13 PM
6/28/2005
End date
1:38:32 PM
6/28/2005
Mean
Min
Max
EVIB [MN/m²]
41
8
129
Amplitude [mm]
0.7
0.2
0.8
Frequency [Hz]
28
15
54
Velocity [km/h]
3.6
1.6
4.4
EVIB [MN/m²] > 100
0
EVIB [MN/m²] :80 -100
1
EVIB [MN/m²] :60 -80
7
EVIB [MN/m²] :40 -60
41
EVIB [MN/m²] :20 -40
48
EVIB [MN/m²] < 20
3
Σ
EVIB [MN/m²] :20 -100
97
Mean [MN/m²]
Increase
Standard Deviation
PosX
57853.7 m
PosY
144233.6 m
PosZ
387.2 m
EVIB
14 MN/m²
Amplitude
0.7 mm
POIs + Text + Lines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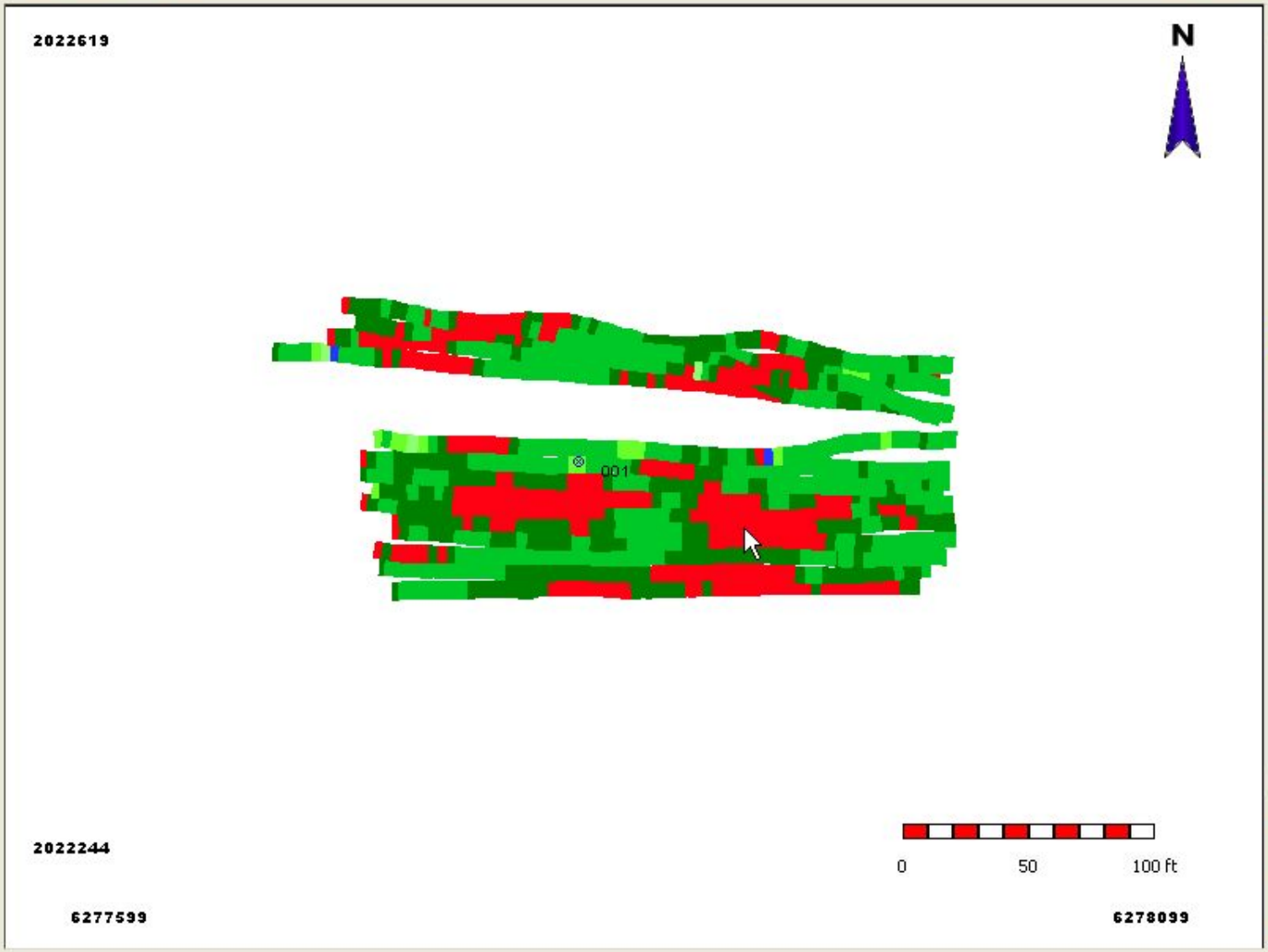
BCM-Office Version 1.18

File Contruction site View Calibration Evaluation Extras Help



Legend | Field | Current

Done	19812 ft²
Start date	5:45:07 PM 3/9/2006
End date	6:13:19 PM 3/9/2006

	AVG	Min	Max
EVIB [MN/m²]	61	0	245
Amplitude [mm]	2.5	0.3	2.5
Frequency [Hz]	28	14	30
Speed [km/h]	3.9	0.1	4.5

	EVIB [MN/m²] ≥ 145	0 %
	EVIB [MN/m²] :120 -14	0 %
	EVIB [MN/m²] :95 -120	2 %
	EVIB [MN/m²] :70 -95	43 %
	EVIB [MN/m²] :45 -70	28 %
	EVIB [MN/m²] < 45	27 %
Σ	EVIB [MN/m²] :45 -145	73 %

AVG-value [MN/m²]	61
Increase	4
Standard deviation	24

PosX	2022417.4 ft
PosY	6277886.3 ft
PosZ	1094.3 ft
EVIB	6 MN/m²
Speed	3.9 km/h

Zoom 100 m | POIs + Text + Lines

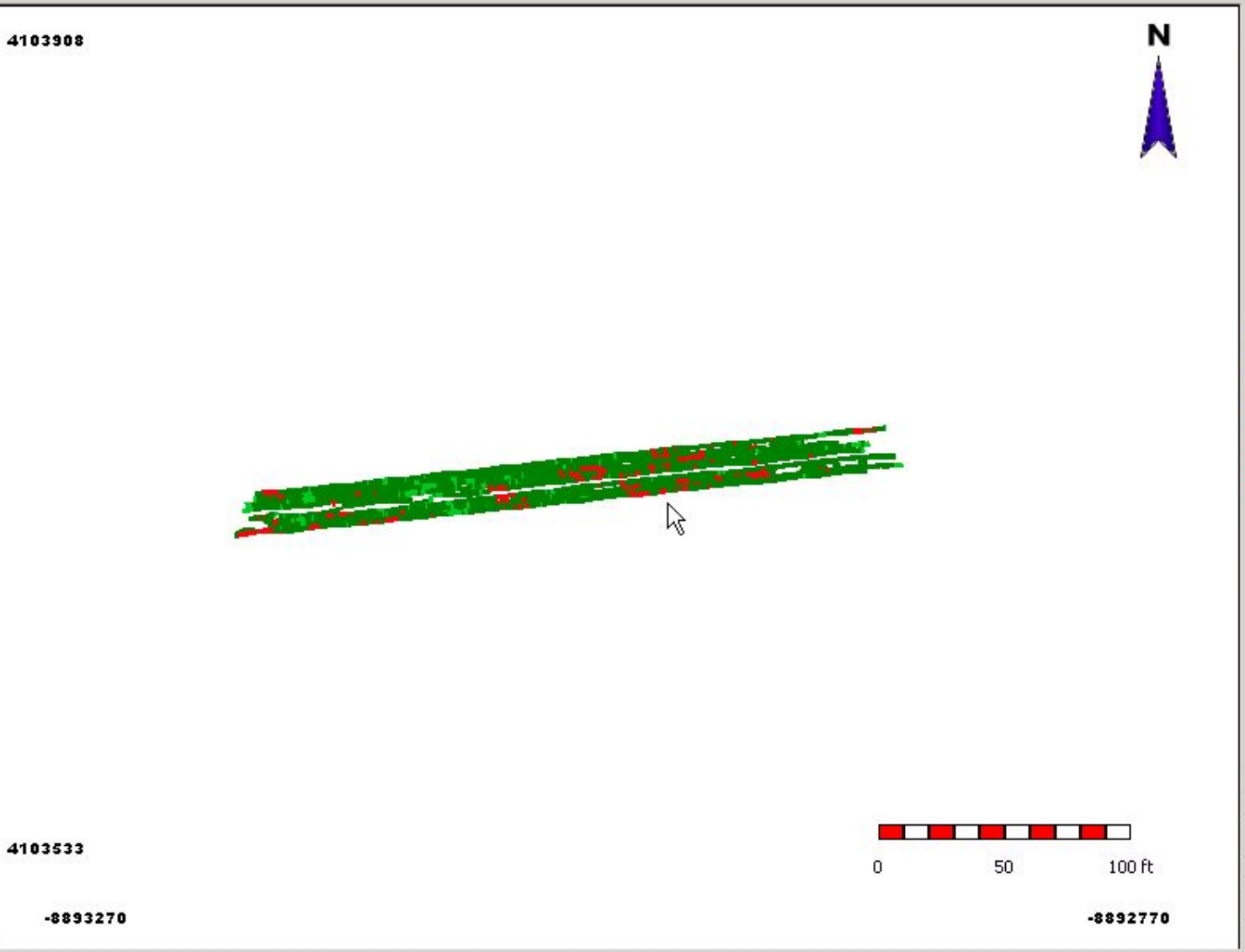
start | BCM-Office Version 1... | 99% | 9:32 PM

I-55 Ramp Chicago 2007

BCM-Office Version 1.18

File Contruction site View Calibration Evaluation Extras Help

Elwood||walmart||parking_lot_base||illinois



Legend | Field | Current

Done	4033 ft²
Start date	11:39:14 PM 8/7/2006
End date	12:14:07 AM 8/8/2006

	AVG	Min	Max
EVIB [MN/m²]	35	8	89
Amplitude [mm]	0.7	0.5	0.7
Frequency [Hz]	28	16	28
Speed [km/h]	5.5	1.4	6.4

	EVIB [MN/m²] ≥ 145	0 %
	EVIB [MN/m²] :114 -14	0 %
	EVIB [MN/m²] :83 -114	0 %
	EVIB [MN/m²] :52 -83	7 %
	EVIB [MN/m²] :20 -52	82 %
	EVIB [MN/m²] < 20	11 %
Σ	EVIB [MN/m²] :20 -145	89 %

AVG-value [MN/m²]	35
Increase	2
Standard deviation	12

PosX	4103716.4 ft
PosY	-8893004.2 ft
Amplitude	0.7 mm
EVIB	44 MN/m²
Speed	6.0 km/h

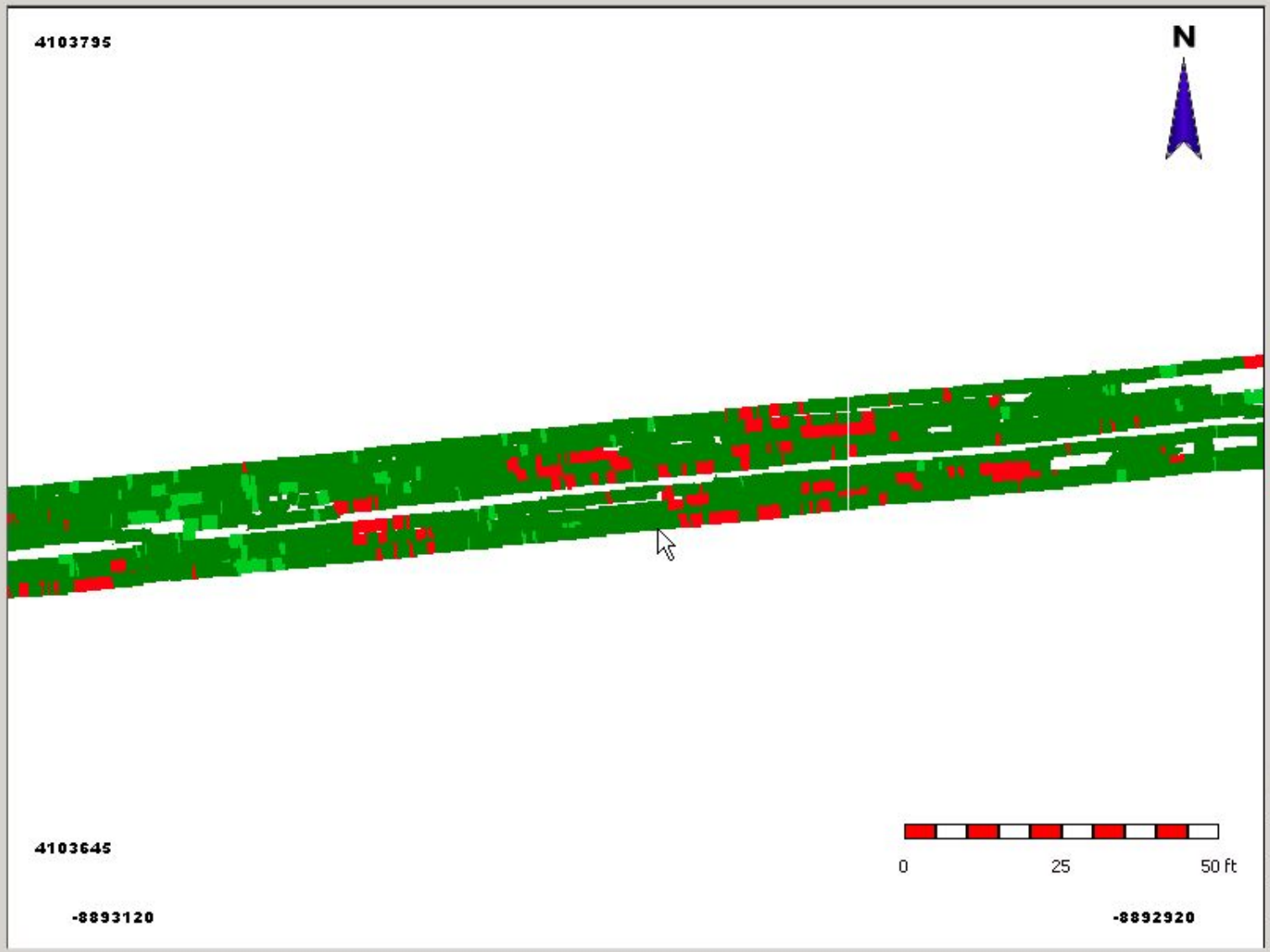
Zoom 100 m | POIs + Text + Lines

Start | BCM-Office Version 1.... | 60% | 10:23 PM

BCM-Office Version 1.18

File Contruction site View Calibration Evaluation Extras Help

Elwood||walmart||parking_lot_base||illinois



Legend | Field | Current

Done	4033 ft²
Start date	11:39:14 PM 8/7/2006
End date	12:14:07 AM 8/8/2006

	AVG	Min	Max
EVIB [MN/m²]	35	8	89
Amplitude [mm]	0.7	0.5	0.7
Frequency [Hz]	28	16	28
Speed [km/h]	5.5	1.4	6.4

	EVIB [MN/m²] > 145	0 %
	EVIB [MN/m²] :114 -14	0 %
	EVIB [MN/m²] :83 -114	0 %
	EVIB [MN/m²] :52 -83	7 %
	EVIB [MN/m²] :20 -52	82 %
	EVIB [MN/m²] < 20	11 %
Σ	EVIB [MN/m²] :20 -145	89 %

AVG-value [MN/m²]	35
Increase	2
Standard deviation	12

PosX	4103714.6 ft
PosY	-8893019.7 ft
Amplitude	0.7 mm
EVIB	26 MN/m²
Speed	6.0 km/h

Zoom 50 m | POIs + Text + Lines

Start | BCM-Office Version 1.... | 59% | 10:26 PM

BW 213 BVC High Speed Rail

Benefits

No critical decsions required by the operator.

More uniform compaction.

The operator has a constant readout giving compaction Evibe stiffness values.

Larry.Keach@BOMAG.com

309-825-9246

BOMAG
FAYAT GROUP

THANK YOU!

California – Water Treatment Plant 2006

Illinois Warehouse Site 2007

Minnesota Highway Site 2007

Minnesota Highway Site 2007

Optional Pad Shell Kit

Colorado – Highway Extension 2008

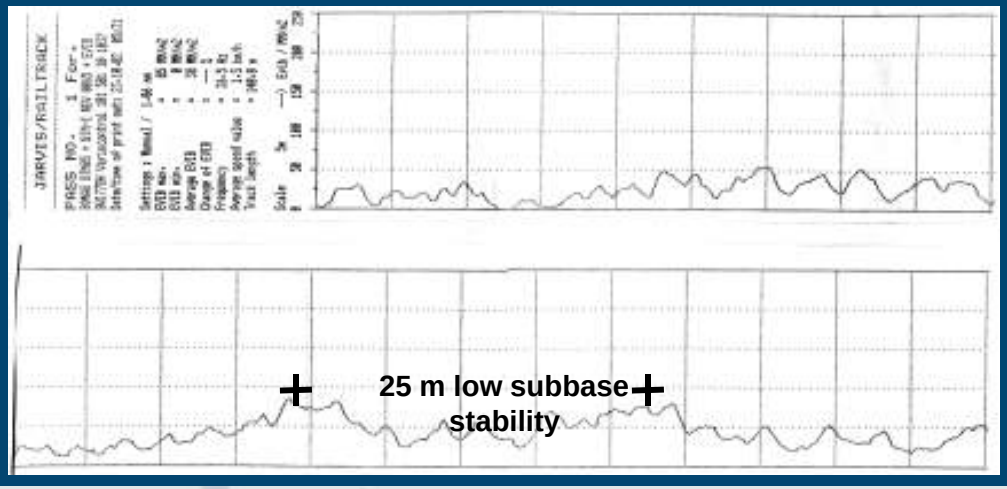
Mexico – Warehouse Site 2008

Springville NY - ICPF Site 2009

BW 213 BVC High Speed Rail

BW 177 BVC at Manchester GB Rail

Proof rolling
Base compaction on rail track section



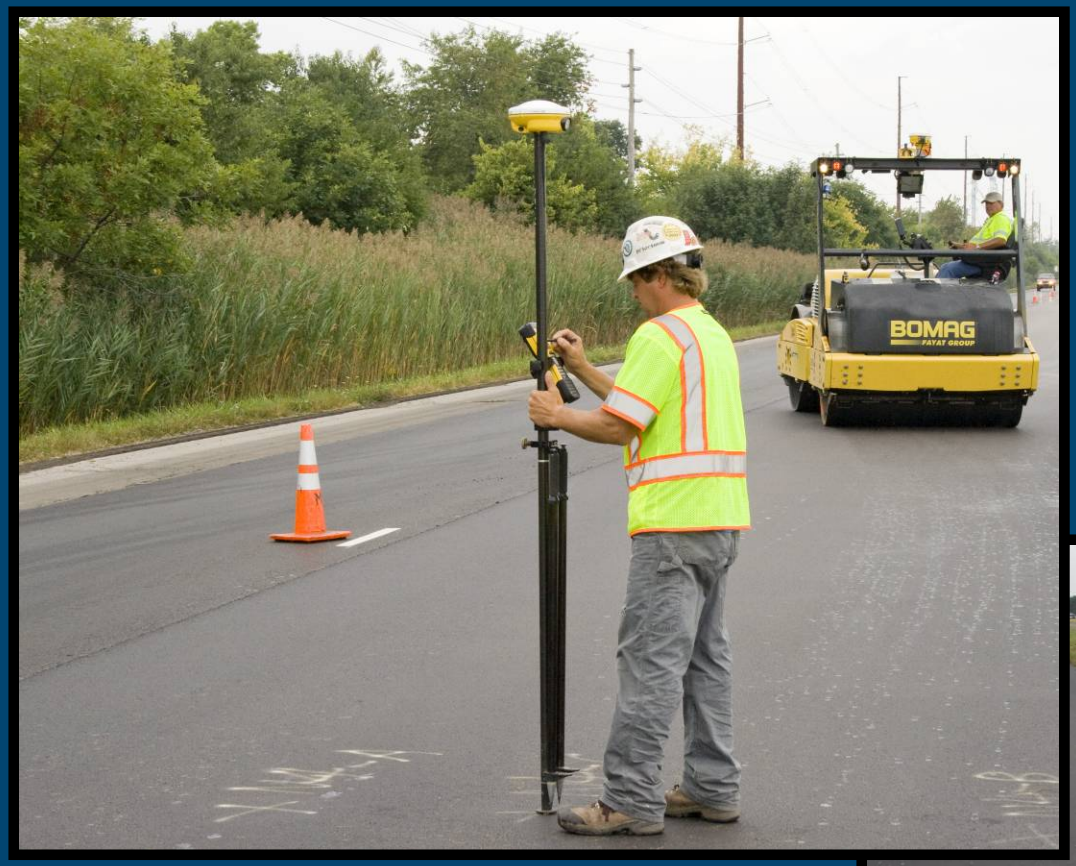
IC for Asphalt

W Layfayette IN - ICPF Site 2009

Mapping
HMA Layer

W Layfayette IN - ICPF Site 2009

W Layfayette IN - ICPF Site 2009



On Site QA Tests

Roller Compacted Concrete