Government of Nepal

Department of Roads

Quality, Research and Development Center,Patan

Workshop
on
“Bridge and Road Construction Issues”

पाँचौ : १४,१५,१६ फाल्गुन ,२०७६

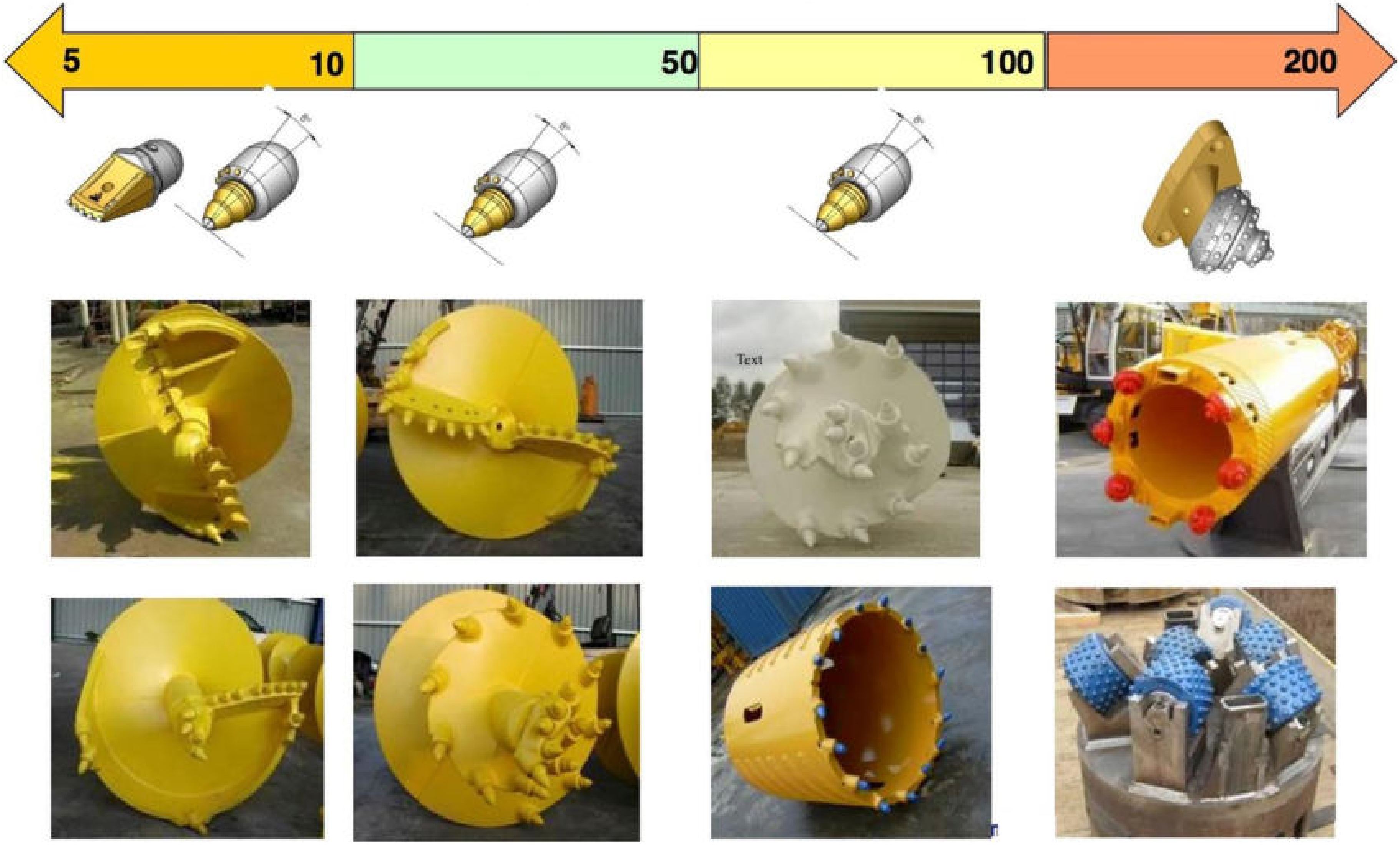
https://dor.gov.np/dorqrdc

Pile Construction Issues and Quality Control of PIT Test

Er. Prabhat Kumar Jha
Senior Divisional Engineer
9841360244
geoprabhat@gmail.com

https://techwingdor.blogspot.com/

Compressive strength MPa



0 20 40 60 80 100

Simple compressive strength (MPa)

COHESIONLESS SOIL

USCS (ASTM D-2487) Soil description						Drilling tools	
						BUCKET	AUGER
Coarse grain soil	Gravel > 50% of coarse fraction caught in screen no. 4	Clean gravel	GW	33°-45° 0 KPa	Well-graduated gravel and sandy gravel, little or no fine material	☑	☐
			GP	33°-45° 0 kPa	Well-graduated gravel and sandy gravel, little or no fine material	☑	☐
		Gravel with fine material	GM	30°-40° 0 KPa	Sandy and silty gravel, fine material >12%	☑	☐
			GC	30°-40° 0 KPa	Clayey gravel, fine material >12%	☑	☐
	Sand >=50% of coarse fraction passing through screen no. 4	Clean sand	SW	30°-40° 0 KPa	Well-graduated sand, from fine to coarse	☑	☐
			SP	30°-40° 0 KPa	Poorly graduated sand	☑	☐
		Sand with fine material	SM	28°-35° 0 KPa	Silty sand	☑	☑
			SC	28°-35° 0 KPa	Clayey sand	☑	☑
Terreni a grana fine	Silt and clay Liquid limit (LL)<50		ML	0-200 KPa	Inorganic silt, very fine sand, fine silty or clayey sand	☑	☑
			CL	0-300 KPa	Inorganic clay with medium-low plasticity, silty and sandy clay	☑	☑
			OL	0-200 KPa	Organic silt and low-plasticity organic silty clay	☑	☑
	Silt and clay Liquid limit (LL)<50		MH	0-20 KPa	High-plasticity silt	☑	☑
			CH	0-200 KPa	High-plasticity clay	☑	☑
			OH	0-10 KPa	Organic clay, organic silt	☑	☑
	Highly organic soil		Pt	0-10 KPa	Muskeg and other highly organic soils	☑	☑

Prefix:
G = Gravel **M** = Silt **O** = Organic
S = Sand **C** = Clay **H** = Clay, LL > 50%

Suffix:
W = Well-graduated **M** = Silty
P = Poorly graduated **L** = Clayey, LL < 50 %

Augers

SB augers are suitable for **loosening** water-bearing **cohesive** and **non-cohesive** soils, whilst SBF augers or progressive augers are suitable for **breaking** and **ripping medium-hard rock.**

The augers are available in a wide variety of configurations:

With flat teeth or round shank chisels
Wear protection on auger flight
Single or double start type
With or without pilot bit
With or without collar ring
Diameter range 520 mm – 2500 mm

Drilling buckets

KB drilling buckets are suitable for drilling in **water-bearing cohesive** and **non-cohesive** soils, whilst KBF augers are designed for **breaking** and **ripping dense soils** up to **medium-hard rock**. For emptying the bucket, the **hinged** revolving bottom gate can be opened automatically. A vent tube prevents the creation of a vacuum as the bucket is withdrawn from the borehole.

The drilling buckets are available in a wide variety of configurations:

With flat teeth or round shank chisels
Single or double start type
Different pilot bits
With or without collar ring
Diameter range 520 mm – 2500 mm

Core barrels

KR core barrels are deployed primarily when **encountering boulders, layers of gravel and cobbles, or for coring through rock shelves.**

The cutting ring of the core barrel can be equipped with different bits:

Tungsten carbide pins or weld-on teeth
AS weld-on blocks
Round shank chisels
In special cases also with roller bits
Diameter range 520 mm – 2500 mm

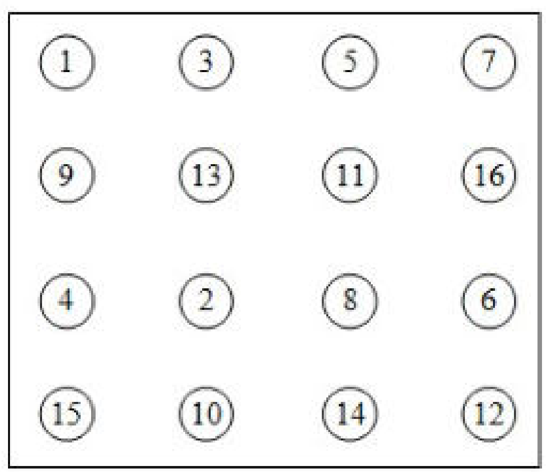
Belling bucket
In stable soil formations, the bearing capacity of bored piles can be increased significantly by enlarging the base area of each pile. Belling buckets with retractable cutter arms are used for this purpose.

The toothed cutter **arms** are **extended outwards** by the application with the Kelly bar of a vertical crowd force to the scissor mechanism inside the belling bucket.

Piling Common Procedures

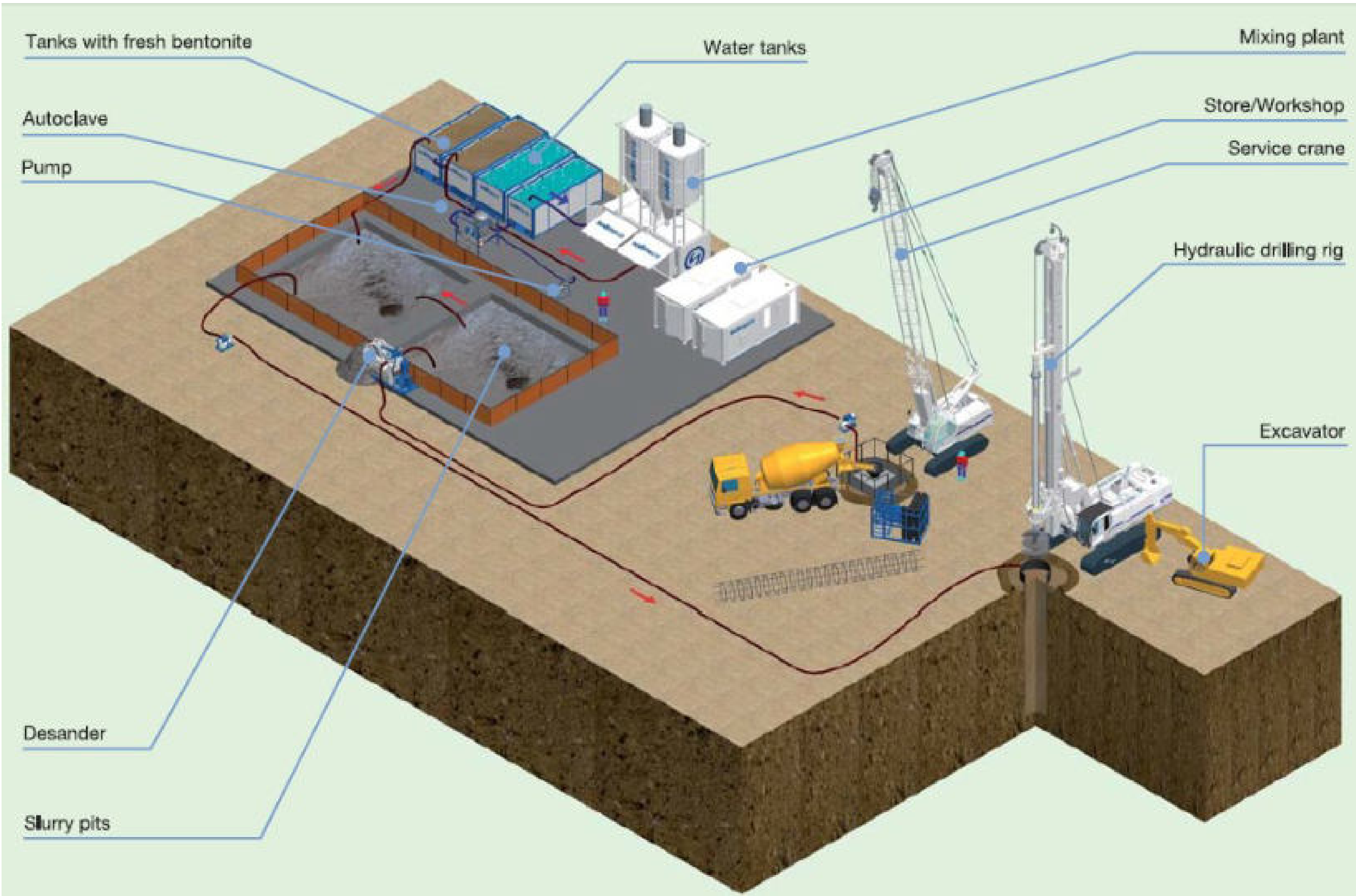
- Piling platform
- Setting Out
- Installation of Casing
- Supply Drilling Mud
- Boring
- Install the Reinforcement cage
- Install tremmie
- Start concrete
- Cut out tremmie as concrete progresses
- Remove casing

Boring and excavation for a pile shall not commence until 24 hours after completion of any pile within a radius of 6 meters centre to centre.

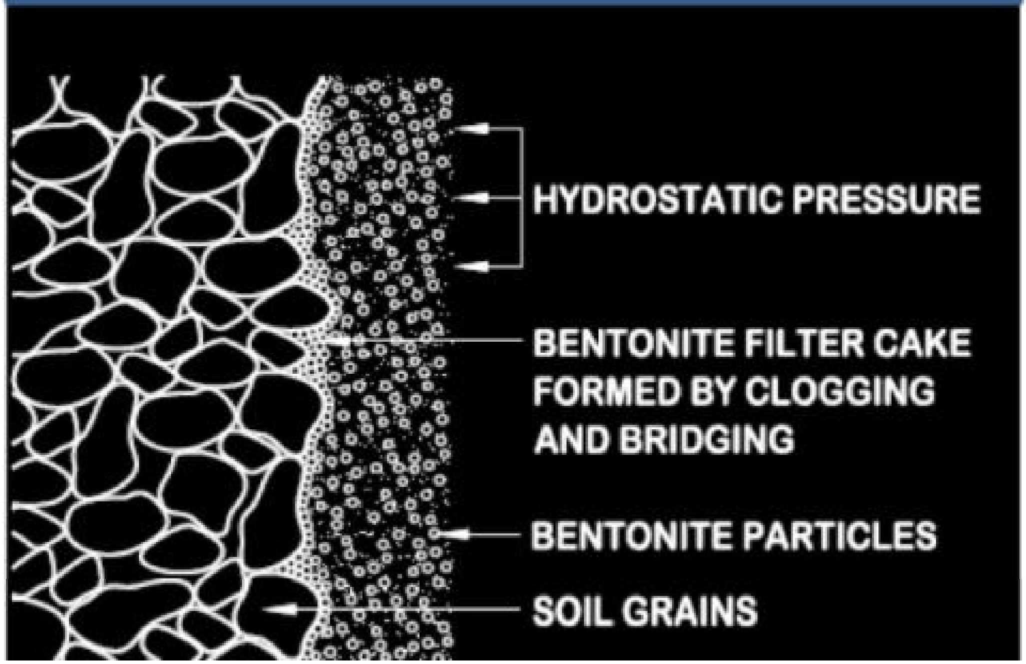


Suggested Piling Sequence for 1m dia bore pile of 4x4 configuration

Borehole Stabilization



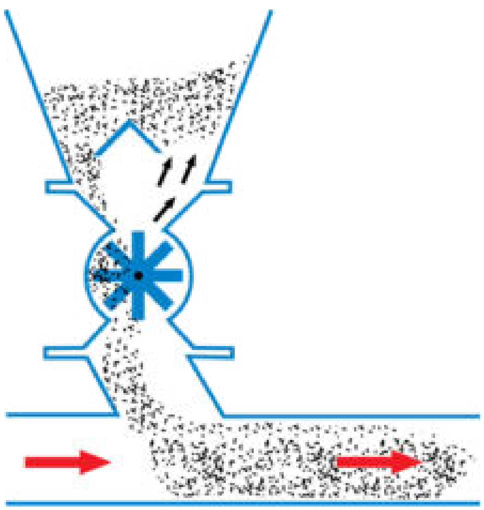
Bentonite Slurry



Bentonite : 30-70 kg per 1000 lit. water
Polymer : 0.5-3 Kg per 1000 lit. water

The slurry is normally stored for at least 12 hours before being used

The fluid level inside casing shall at all times be at least 2 meters higher than outside the casings.



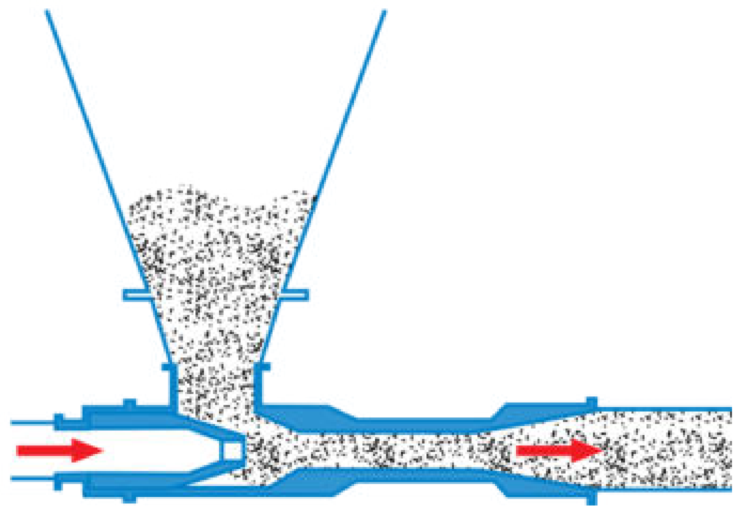


TABLE 1 : CHARACTERISTICS FOR BENTONITE SUSPENSIONS

Property	Units	Stages			Test equipment
		Fresh	**Ready for re-use**	**Before concreting**	
Density	g/ml	**< 1.10**	**< 1.25**	**< 1.15**	Mud balance
Marsh viscosity (946 ml)	sec	32 to 50	32 to 60	32 to 50	Marsh funnel
Fluid loss (30 min)	ml	< 30	< 50	n.a.	Filter press
pH		7 to 11	7 to 12	n.a.	pH meter
Sand content	%	**n.a.**	**n.a.**	**< 4**	Sand content set

Tests and Apparatus

Mud Balance
For Density Tests

Viscometer

pH test

SLURRY TESTING

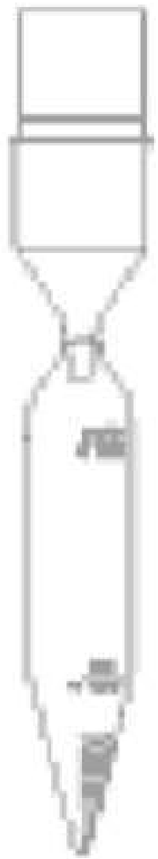


Figure 3—Sand Content Set

Steel Casing

- When permanent steel casing is shown on the Drawing, the **minimum thickness shall be 10 mm.**
- The minimum length shall be from **100 mm above the bottom of the pile cap to 5 meter under the river bed or into the firm strata.**
- Joints between casings shall be approved by the Engineer.

What are size of Casing and Bucket/Chisel

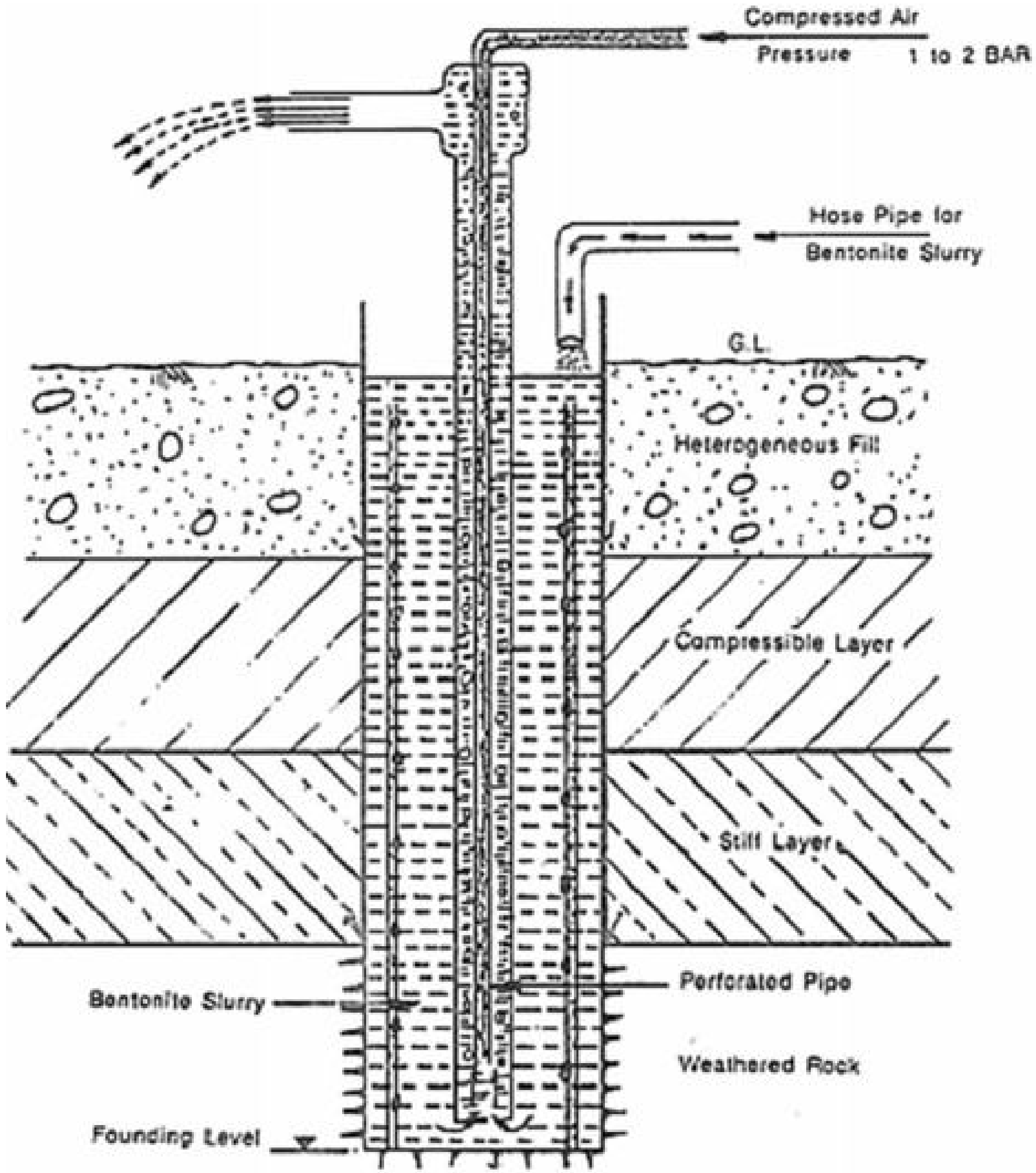
Aurhi Bridge : Under Construction

Design Dia. = 900mm

Casing = 920mm

Cutter head = 900mm

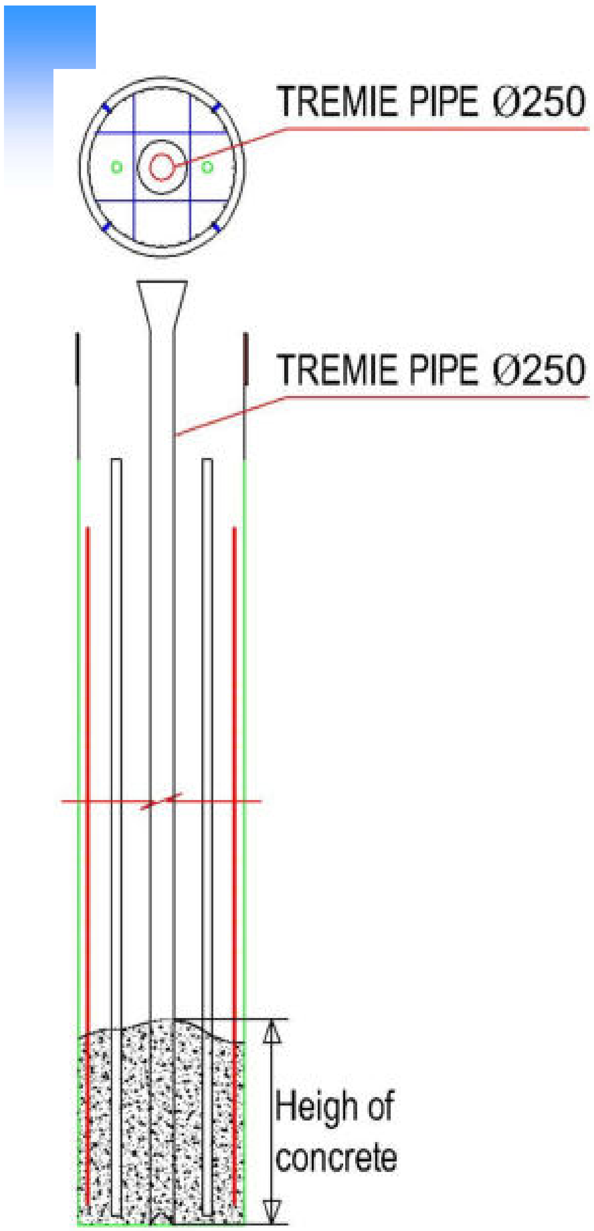
Tip Cleaning after Drilling , before concreting



Notes:-
1)Perforated pipe of 1.5 m length 40 mm. dia. should be kept 1.5m above tip level
2)Tremie pipe of 200 mm. dia. kept about 30cm. above tip level

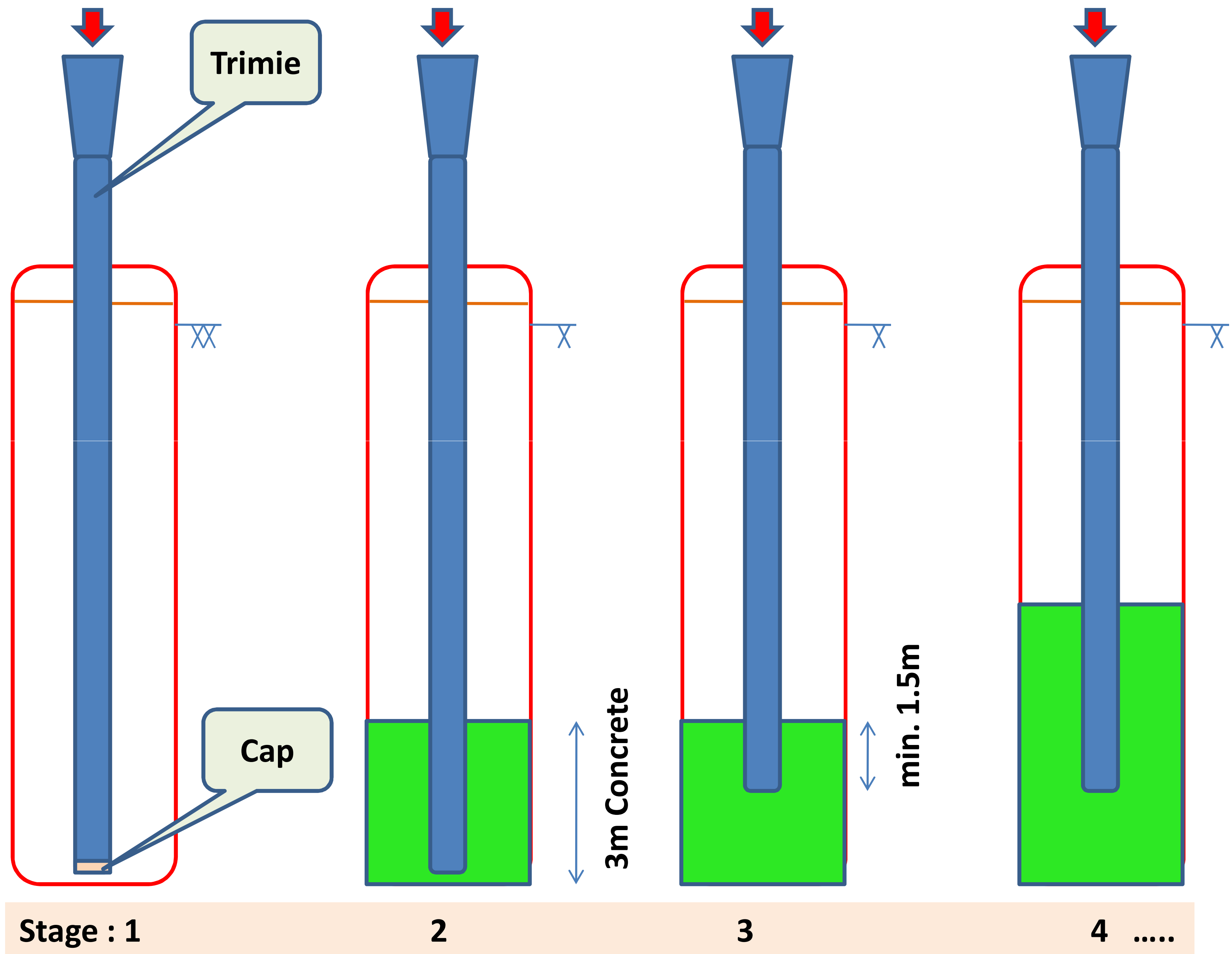
Reinforcement : Cover / Spacer / Splicing

Concreting by Trimie



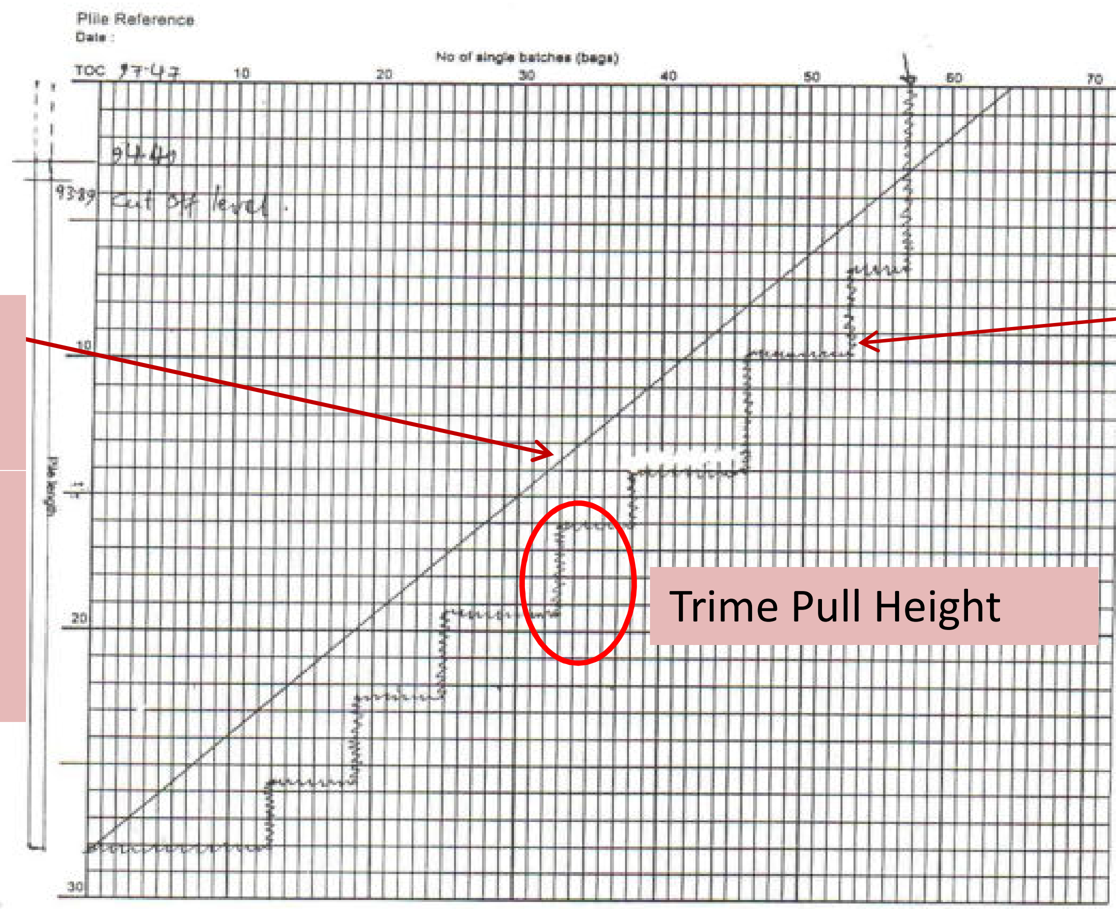
<u>The Contractor shall maintain a continuous record of the volume of concrete used and the level of the concrete in the pipe. Any deviations from the theoretical, or expected, volume/level relationship shall be immediately reported to the Engineer.</u>

The volume of concrete : not less than 105% of the nominal volume of the pile.


Trimie
Cap
3m Concrete
min. 1.5m
Stage : 1
2
3
4 .....

Tremie - Conc Vol - Pile depth Graph.

Pile no. 61 East (Judi)



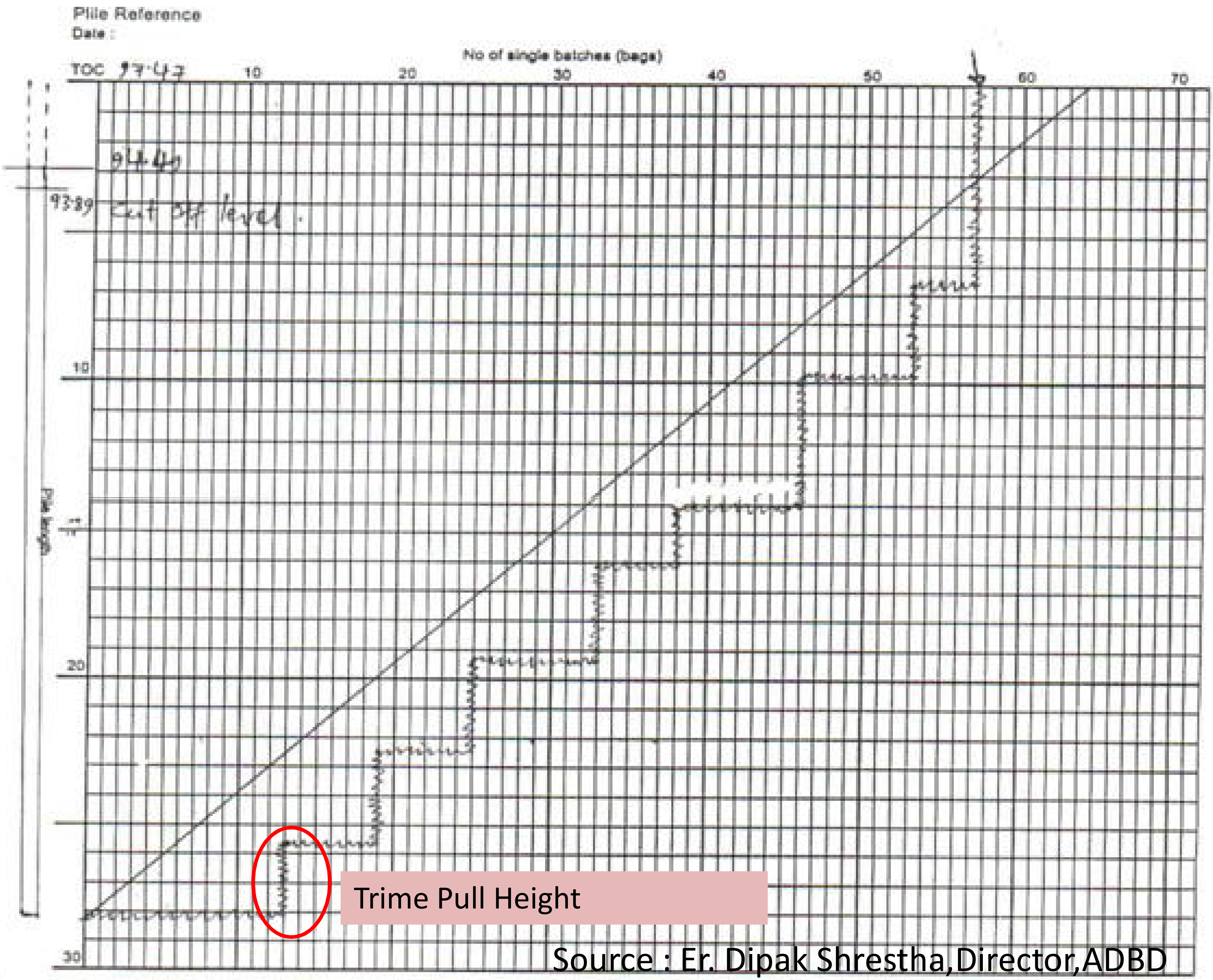
Bore length = 28.3 m.

Bore vol $= 28.3 \times \frac{\pi\, 0.6^2}{4} = 8\ m^3$

i.e. $8 \times \frac{400}{50} = 64$ bags

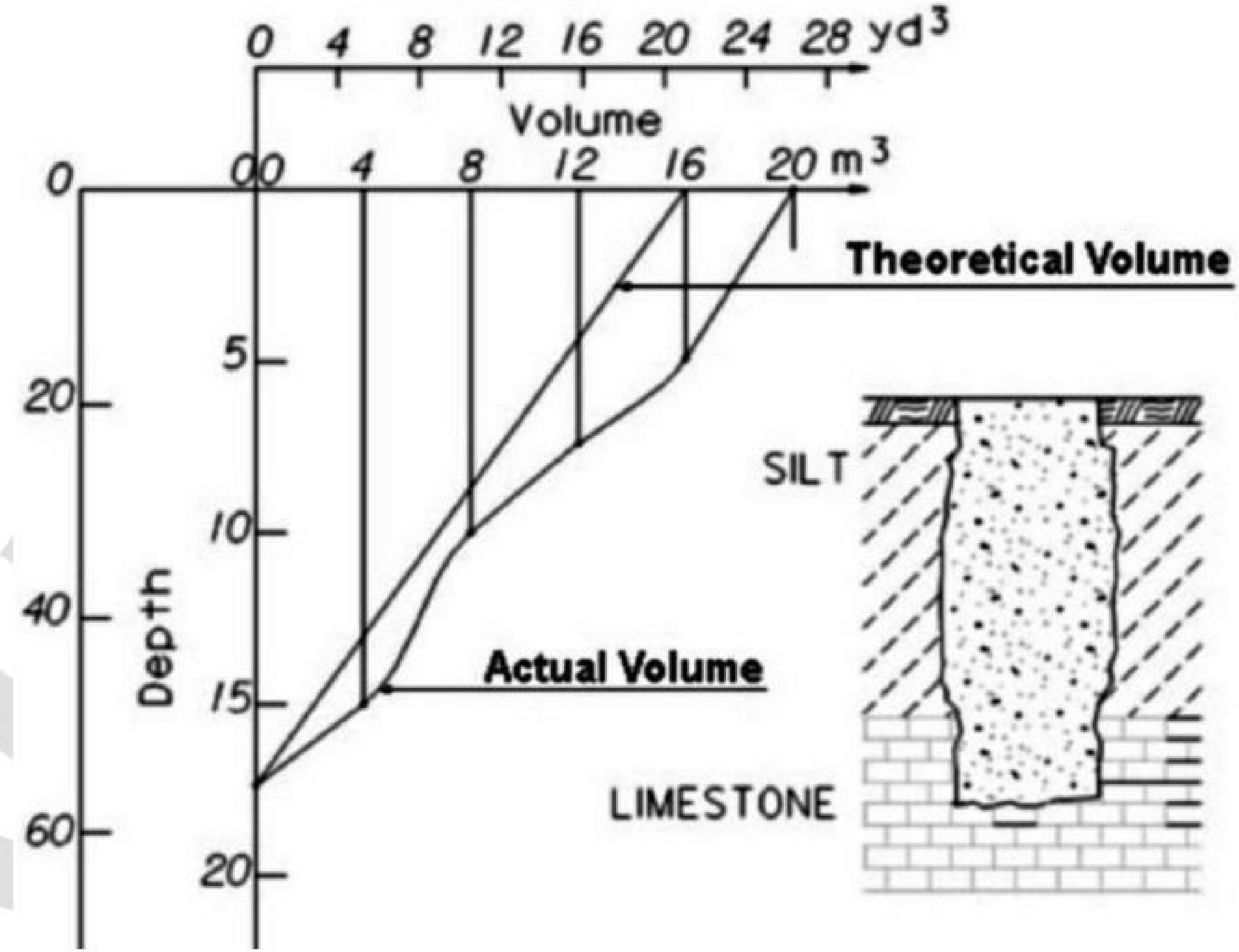
Bamboo dipping for top Conc = 2.98 meter.

Source : Er. Dipak Shrestha,Director,ADBD



Source : Er. Dipak Shrestha,Director,ADBD

FIG. 9 Concrete volume-depth plot for assessing drilled hole shape.



Anti-washout admixture

Anti-washout admixture (also, viscosity improving admixture) of concrete for underwater concreting is produced as a viscosity modifying admixture to enhance the rheological properties of cement paste. It mainly composed of microbial polysaccharides for example **gum or polysaccharide derivatives for instance hydroxyethyl cellulose and hydroxypropyl methyl cellulose.**

The slurry is normally stored for at least 12 hours before being used

The time between final excavation including bottom cleaning and the start of concreting shall be reduced as much as possible and **in any case shall not exceed 6 hours.**

Boring and excavation for a pile shall not commence until 24 hours after completion of any pile within a radius of 6 meters centre to centre.

Quality Assurance & Construction Controls *

(cited in Geotechnical Engineering Handbook, Vol 3 edited by Ulrich Smoltczyk, 2003)

- **Studies of foundation projects indicate that only 15% of damage or quality problems could not be anticipated & the remainder were avoidable. The same ratio is approximately valid for pile foundations. The main reasons for faulty quality are as follows:**

a). **40% errors in design & planning (designer's responsibility)-mainly due to inadequate & unreliable SI/GI.**

b). **40% poor workmanship (responsibility of Contractor & supervisor)**

c). **10% material deficiencies (responsibility of Contractor & supervisor)**

d). **10% other deficiencies (responsibility of Contractor & supervisor)**

Common defective construction for Bored piles?

No problem is a big problem. Why? *Important to be aware & understand the construction problems (mainly due to unexpected subsoil conditions)& principles involved. Effective mitigations?*

1. **Boring problems**: Old & low capacity of boring rigs &/or worn out or poor drill soil/rock augers/bucket that take >6hrs to complete boring. Contract/Spec/CP requirements? Contractor's contractual obligations? Consequences?
2. **Improper drilled shaft stabilization method & procedure** to take care the hole collapse problems in treacherous & collapsible strata have resulted in low f_{su} & integrity problems. CP/Spec requirements? Contractor's contractual obligations? Consequences?
3. **Inadequate or poor base cleaning method** has resulted in low f_{bu} and structural integrity problems. How to check? CP/Spec requirements? Contractor's contractual obligations?
4. **Reinforcement cage is not properly fabricated** resulting in excessive deformation & loosening of rebars, improper cover & localized small spacing (<100mm), etc. CP/Spec requirements? Contractor's contractual obligations? Consequences?
5. **Poor concreting technique** such as pulling temporary casing without adequate fresh concrete head, etc., may result in integrity problems. CP/Spec requirements? Contractor's contractual obligations? Consequences?

Frequency of Defective Bored Piles

- Davis and Dunn (1974) report **9.7% defective** out of a total **717 piles tested on five projects**

- Fleming et al (1985) found **1.5% defective out of a total 5,000 piles tested** and **1.9%** defective out of a further 4,550 piles tested.

- Ellway (1987) reports **4.2%** defective of a total **4,400** piles tested

Frequency of Defective Bored Piles

- Thasnanipan et al (1988) state **3.3%** defective of a total **8,689 piles** tested

- Low et al (2002) report **7% defective** within a population of **380 piles** tested and **1.5%** defective of a total 5000 piles tested.

- **Preiss and Shapiro (1981**) suggest that approximately **5 % to 10% of the piles on project could be defective.**

Frequency of Defective Bored Piles

NO REPORT TO DOR about the defective piles except

Bagmati Bridge Tinkune and One Bridge of Janakpur

????????????????????

<u>Supervision and monitoring</u>

Supervision

A suitably qualified and experienced person shall be in charge of the execution of the work

The person in charge(Resident Engineer/Site Engineer / Sub-Engineer) shall be responsible for :

- the conformity of the work with this Standard Specification / IRC/IS Code requirement and with any additional· specification and agreed working procedure;

- the **monitoring of pile construction and keeping of all necessary records; and to keep the Project/Division Chief/ Client's representative** and/or the designer **informed** of any variations or · deviations from the expected situation or condition of the site or any cases of non conformity

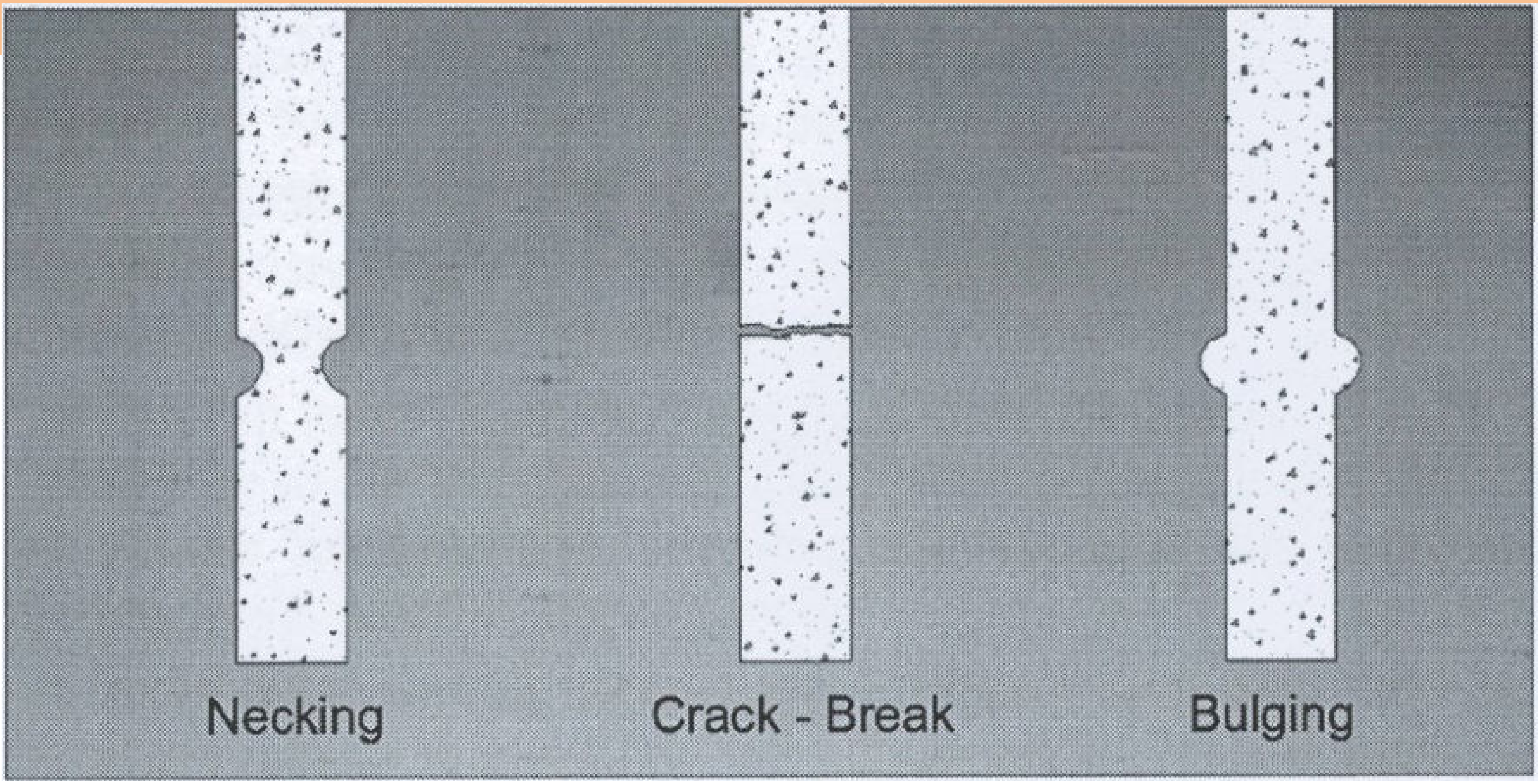
- *Pile capacity: Will the pile satisfactorily withstand a specified loading?*

- *Pile integrity: Is the pile of the correct dimensions and structural quality?*

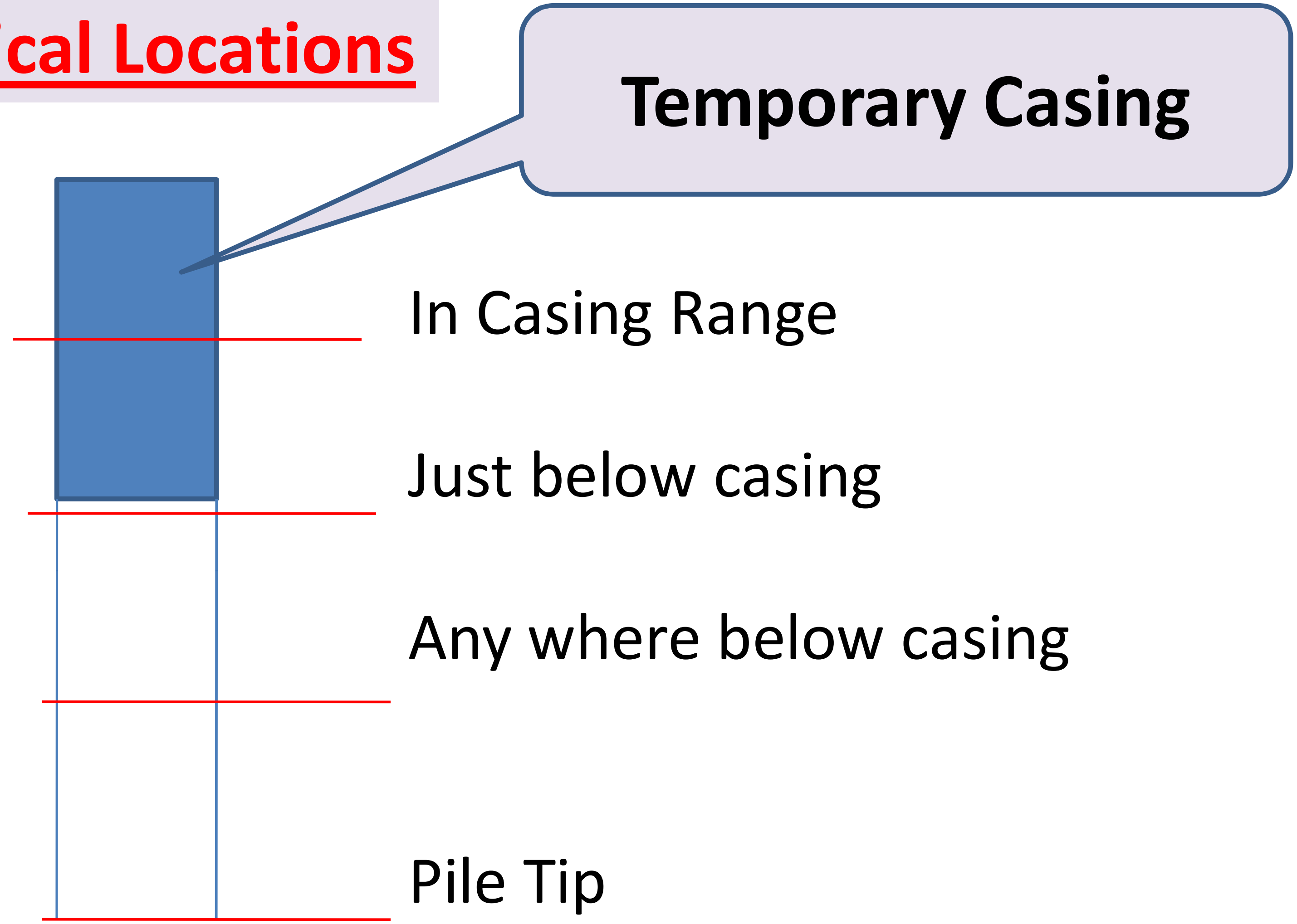
Integrity Problem

Pile Integrity refers to certain characteristics of deep foundations and piles such as:

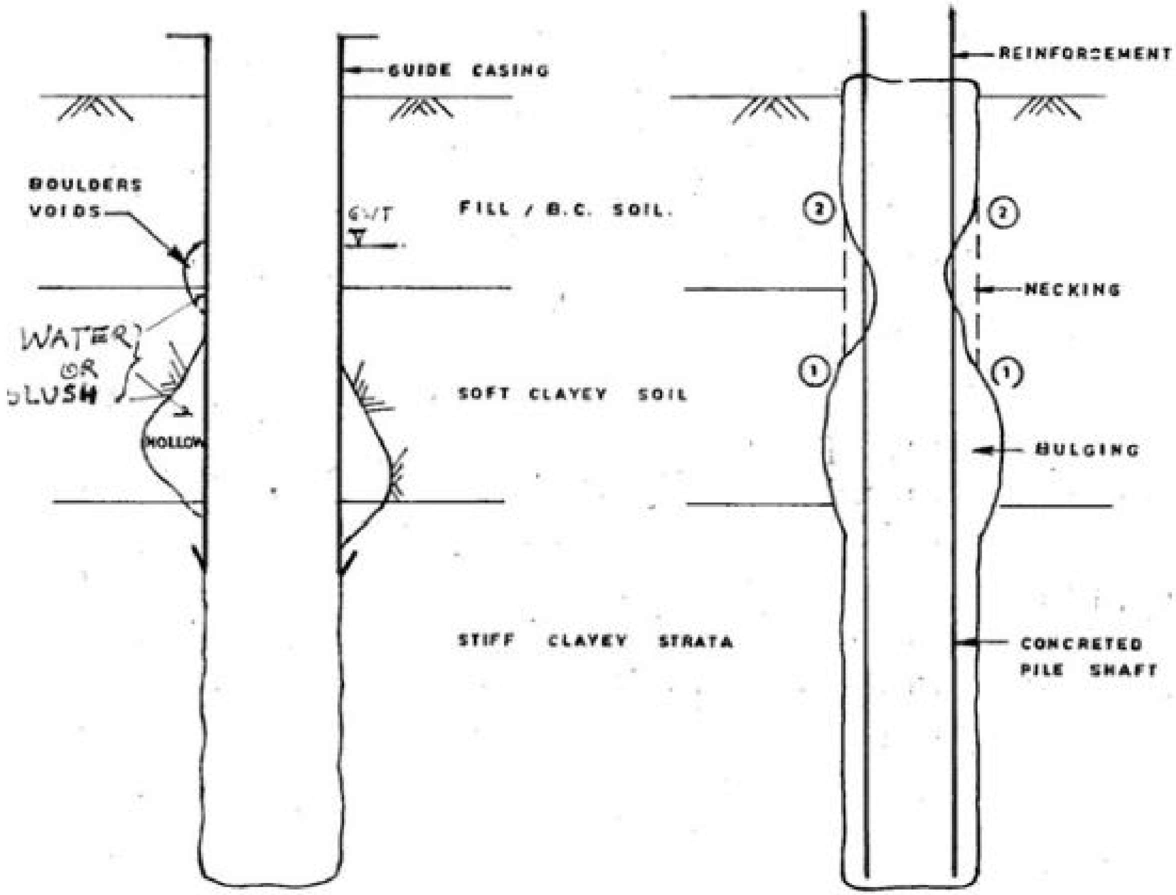
- **Physical Dimensions of Pile (Length or Cross-Section);**
- **Continuity of Pile (presence of Voids or Major Cracks); and**
- **Consistency of the Pile Material.**



Critical Locations

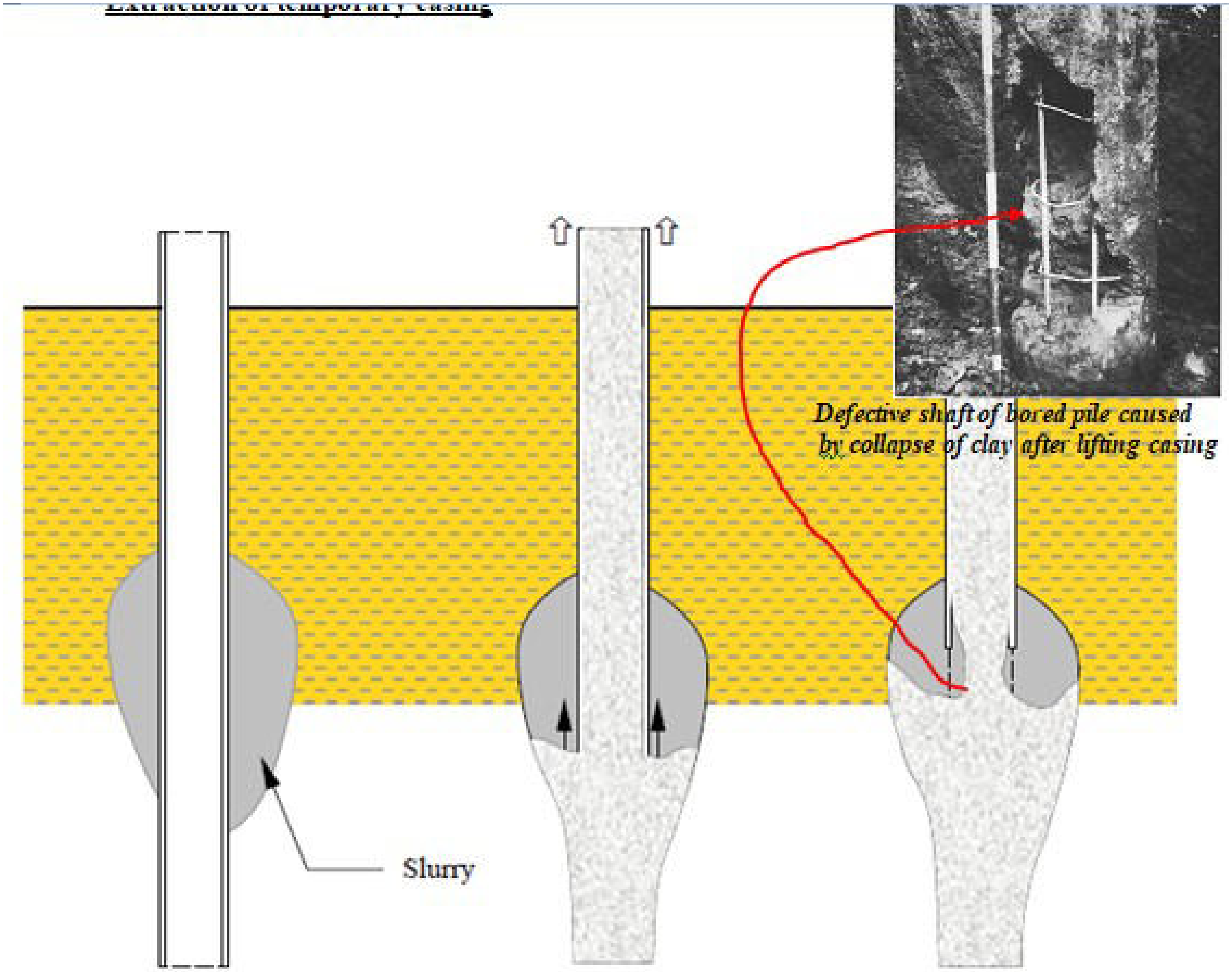


Necking Risk within Casing Length



PROBLEMS IN PILES IN FILL / BOULDERY STRATA.

__Extraction of temporary casing__



Defective shaft of bored pile caused by collapse of clay after lifting casing

(a) Slurry filled cavity formed outside steel casing

(b) Casting pile, casing is lifted and cavity under pressure

(c) Casing is lifted higher, concrete slumps into the slurry and contaminated slurry flows into pile

Defective shaft of bored pile caused by cement being washed out of unset concrete

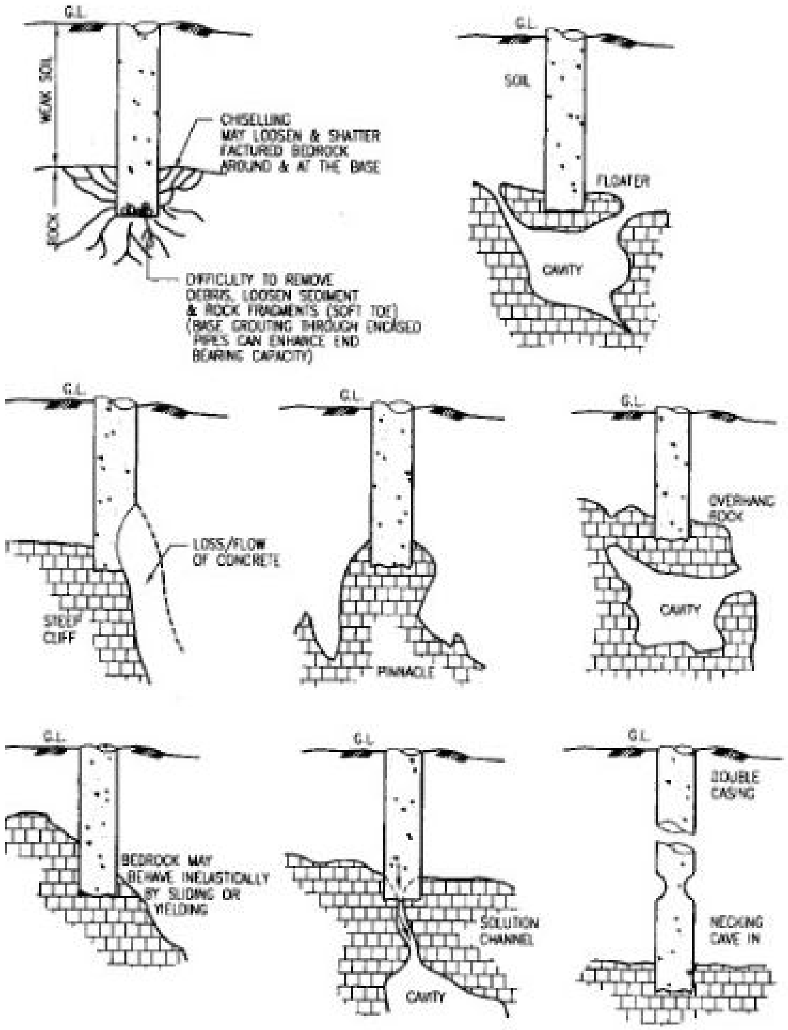
Soil Intrusion

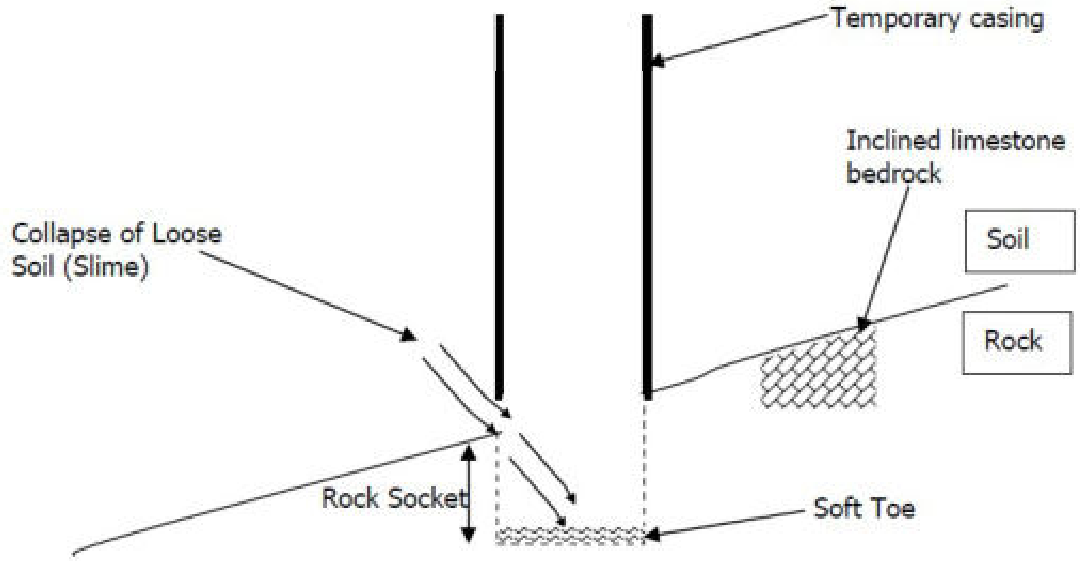
Coring results in a defective drilled shaft.

Mis-Aligned Reinforcement

Cracked Pile

Bleeding


G.L.
WEAK SOIL
CHISELLING
MAY LOOSEN & SHATTER
FACTURED BEDROCK
AROUND & AT THE BASE
ROCK
DIFFICULTY TO REMOVE
DEBRIS, LOOSEN SEDIMENT
& ROCK FRAGMENTS (SOFT TOE)
(BASE GROUTING THROUGH ENCASED
PIPES CAN ENHANCE END
BEARING CAPACITY)
G.L.
SOIL
FLOATER
CAVITY
G.L.
LOSS/FLOW
OF CONCRETE
STEEP
CLIFF
G.L.
PINNACLE
G.L.
OVERHANG
ROCK
CAVITY
G.L.
BEDROCK MAY
BEHAVE INELASTICALLY
BY SLIDING OR
YIELDING
G.L.
SOLUTION
CHANNEL
CAVITY
G.L.
DOUBLE
CASING
NECKING
CAVE IN


Temporary casing
Inclined limestone
bedrock
Soil
Rock
Collapse of Loose
Soil (Slime)
Rock Socket
Soft Toe

Pile Load Test :

Load tests on piles are conducted on completion of 28 days after casting of piles.

Two types of tests namely

initial and routine tests, for each type of loading viz. vertical, horizontal (lateral) pull out, are performed on piles.

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Load tests on piles are conducted on completion of 28 days after casting of piles.

Two types of tests namely

initial and routine tests, for each type of loading viz. vertical, horizontal (lateral) pull out, are performed on piles.

Initial Tests on piles:

This test is performed to confirm the design load calculations and to provide guidelines for setting up the limits of acceptance for routine tests.

It also gives an idea of the suitability of the piling system.

Initial Test on piles are to be carried out at one or more locations depending on the number of piles required.

Load applied for the initial (cyclic) load test is 2.5 times the safe carrying capacity of the pile. Loading for Initial Tests is conducted as per Appendix ‘A’ Clause 6.3of **IS-2911 Part IV**.

Routine Tests on piles:

Selection of piles for the Routine Test is done based on number of piles required subject to maximum of 0.5 % of total number of piles required.

The number of tests may be increased to 2% depending on the nature / type of structure.

Recommended : 1 pile on each foundation

The test load applied is 1.5 times the safe carrying capacity of the pile.

The Maintained load method as described in Clause 6.2 of **IS-2911 (Part IV) – 1985** shall be followed for loading for the Routine Tests.

This test will be performed for the following purposes:
a) To ensure the safe load capacity of piles
b) Detection of any unusual performance contrary to the findings of the Initial Test.

The tests shall be performed at the cut-off level only. A detailed report for the test result is prepared.

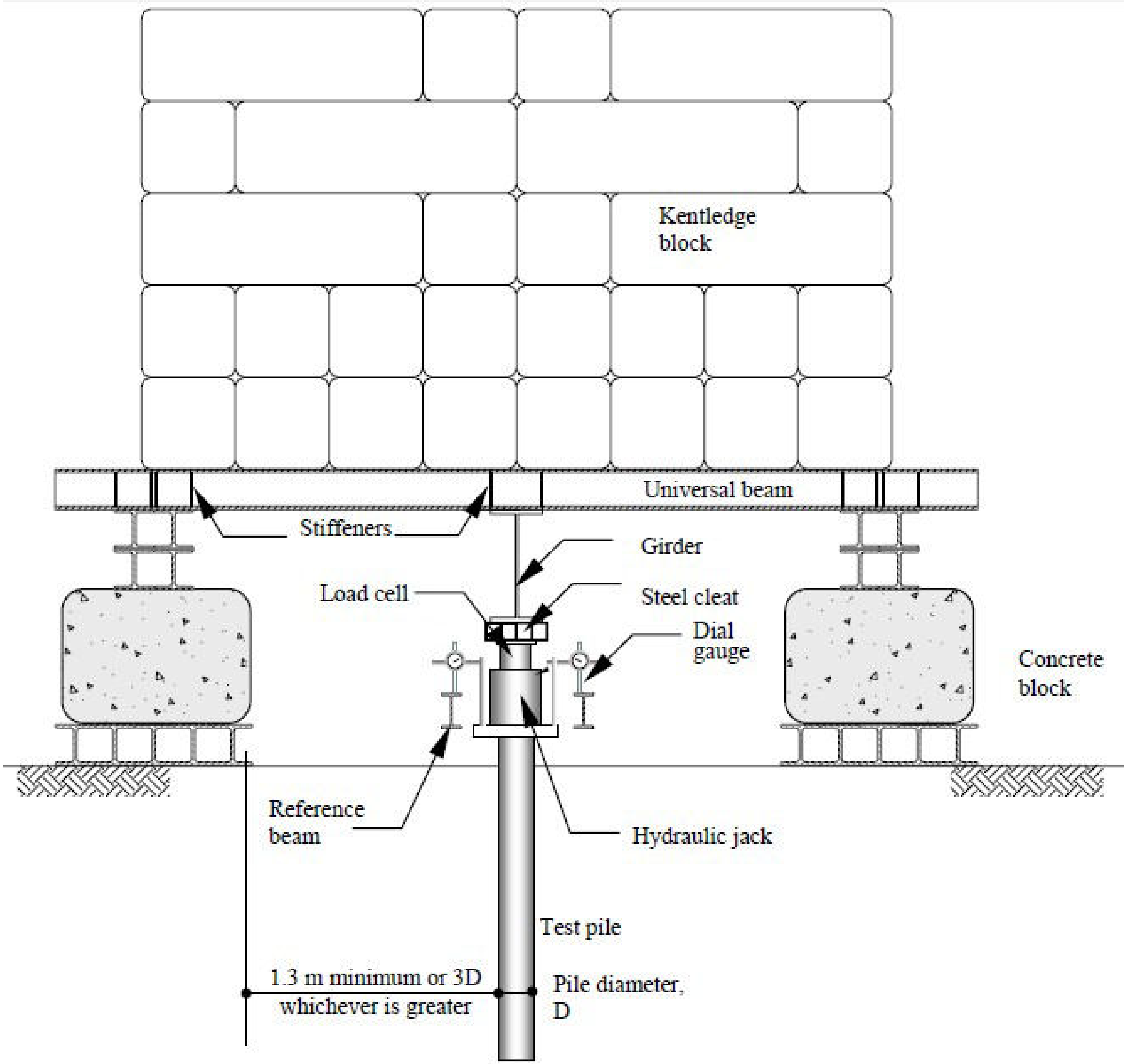
Vertical Load Tests on Piles

This test will be carried out as stipulated in IS-2911 (Part IV) 1995.

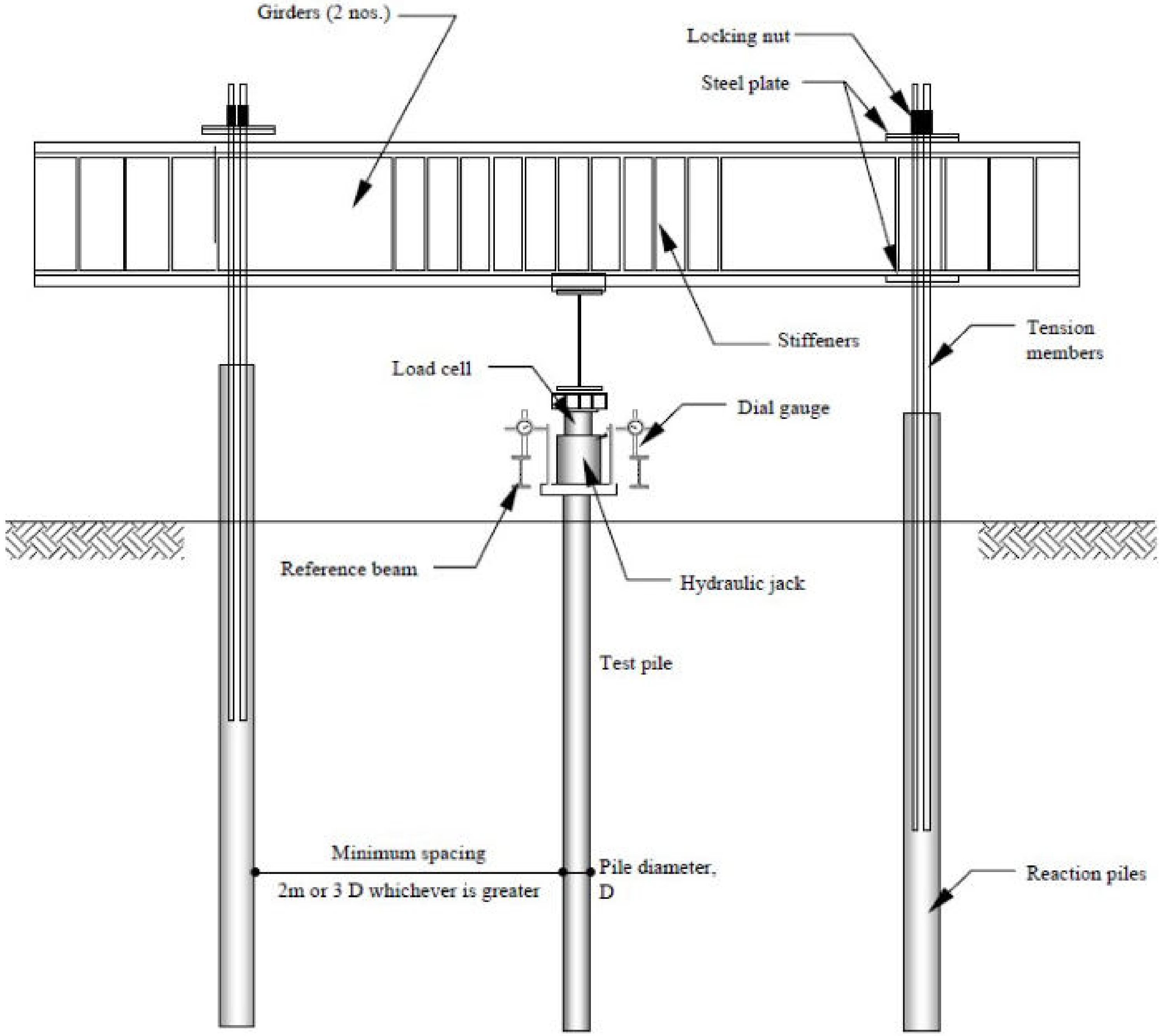
Fig: Vertical load test on piles

Pile Head – The pile head shall be chipped off till sound concrete is met wherever applicable. The reinforcement shall be cut and head levelled with Plaster of Paris. A bearing plate with a hole shall be placed on the head for the jack to rest.

Reaction- Kentledge shall be suitably designed to get the desired reaction on the piles. Anchor piles (if required) shall be placed at a centre to centre distance of 3 times the pile diameter subject to a minimum distance of 2 M.


Kentledge block
Universal beam
Stiffeners
Girder
Load cell
Steel cleat
Dial gauge
Concrete block
Reference beam
Hydraulic jack
Test pile
1.3 m minimum or 3D whichever is greater
Pile diameter, D


07/11/2005 15:03


Girders (2 nos.)
Locking nut
Steel plate
Stiffeners
Tension members
Load cell
Dial gauge
Reference beam
Hydraulic jack
Test pile
Minimum spacing
2m or 3 D whichever is greater
Pile diameter, D
Reaction piles


BURJ DUBAI
LOAD TEST 6000 TON
MIDDLE EAST


Settlement- 2 dial gauges for a single pile and 4 dial gauges for a group of piles with 0.01 mm sensitivity shall be used. They shall be positioned at equal distance around the piles on datum bars resting on immovable supports at a distance of 3D (min. of 1.5 m) where D is the diameter of pile or circumscribing circle for non-circular piles.

Application of load- It shall be applied as specified depending on the type of test (routine / initial). Each load shall be maintained till the rate of displacement of the pile top is either 0.1 mm in the first 30 minutes or 0.2 mm in the first one hour or 2 hours whichever occurs first. The next increment in the load shall be applied on achieving the aforesaid criterion.

The test load shall be maintained for 24 hours.

Preparation of Pile Head :

The pile head should be chipped off to natural horizontal plane till sound concrete is met.

The projection reinforcement should be cut off or bent suitable and the top finished smooth and level with plaster of Paris or similar material

Bearing plate: covering the pile dia.

फोन : ०१-५५२२८७७१

सडक विभाग
पुल महाशाखा

बबरमहल, काठमाण्डौ ।
हाल : चाकुपाट, ललितपुर ।

प.सं. ०७३/७४
चलानी नं. ६४६

मिति २०७४/०१/१५

विषय : Pile Capacity/ Functional Requirement बारे ।

श्री पूर्वाञ्चल क्षेत्रीय सडक निर्देशनालय, दमक, झापा

श्री मध्यमाञ्चल क्षेत्रीय सडक निर्देशनालय, बबरमहल, काठमाण्डौ ।

श्री पश्चिमाञ्चल क्षेत्रीय सडक निर्देशनालय, पोखरा ।

श्री मध्य-पश्चिमाञ्चल क्षेत्रीय सडक निर्देशनालय, वीरेन्द्रनगर, सुर्खेत ।

श्री सुदुर-पश्चिमाञ्चल क्षेत्रीय सडक निर्देशनालय, कुलपाते, डोटी ।

उपरोक्त विषयमा तहाँ निर्देशनालय अर्न्तगत डिभिजन सडक कार्यालय/योजना/आयोजनाद्धारा निर्माणधिन Pile Foundation का पुलहरुको Pile Capacity/Function Requirement उपर तपसिल बमोजिमको निर्णय कार्यान्वयन गर्ने/गराउन हुन निर्देशानुसार अनुरोध छ ।

तपसिल

१) No Scour Case मा Individuals Pile को Safe Load Capacity लाई आधार मानि Pile Load Test गर्न/ गराउने ।

२) Pile Intetrity Test अनिवार्य रुपमा गर्न/गराउने ।

(प्रभात कुमार झा)
सि.डि.ई.

प.सं. ०७४/७५
चलानी नं. ८६१

मिति २०७५/०२/११

विषय : Pile Integrity Test Accpetance Criteria बारे ।

श्री सबै क्षेत्रीय निर्देशकहरु

श्री सबै आयोजना निर्देशकहरु

उपरोक्त विषयमा यस महाशाखाको च.नं. ९५५, मिति २०७५/२/७ को पत्रद्वारा, Cast in Situ Bored Pile को निर्माण गर्दा, अनिवार्य रुपमा Specification मा भएका प्रावधानहरु सहित १३ बुँदे प्रावधानहरु अवलम्बन गर्न/गराउन अनुरोध भएकोमा, Pile Integrity Test गर्दा, Profile Analysis तथा Beta Analysis गरि, मिति २०७५/२/०९ को विभागिय निर्णयानुसार तपसिल बमोजिम Acceptance Criteria समेत अवलम्बन गर्न/गराउन हुन निर्देशानुसार अनुरोध छ।

तपसिल

- *If difference in Costruct Area and Minimum Profile (X-Section Area) % < 10% : OK*
- *If difference in Construct Area and Minimum Profile (X-Section Area) % > 10-25% : Serious Defect, details to be verified.*
- *If difference in Construct Area and Minimum Profile (X-Section Area) % > 25% : Rejection of pile. Though X-Section of entire pile is ok.*
- *If Impendence Change % < 10% : OK*
- *If Impendence Change % > 10-5% : Serious Defect, Details to be verified.*
- *If Impendence Change % > 25% Rejectin of Pile.*

चलानी नं. ६५५

मिति २०७५/०२/०७

विषय : जानकारी सम्बन्धमा ।

श्री सबै क्षेत्रीय निर्देशकहरु

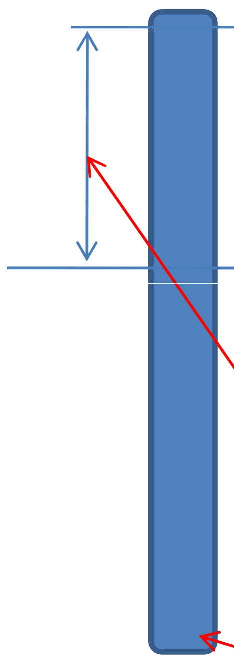
श्री सबै आयोजना निर्देशकहरु

उपरोक्त विषयमा ईन्जिनियरिङ्ग अध्ययन संस्थान पुल्चोकबाट गत वर्षात्मा क्षतिग्रस्त भएको मध्य-पश्चिम क्षेत्रको एउटा पुलको Pile मा Core Drill गरी हेर्दा, कुनै Pile मा ३.२ मी. भन्दा मुनी कंक्रीट नै नभएको र भएको कंक्रीटको सिमेन्ट पानीले पखालिएर Cement coated gravel को अवस्थामा देखियो । तसर्थ Cast in situ Bored Pile को निर्माण गर्दा अनिवार्य रुपमा Specification भएका प्रावधानहरु सहित तपसीलका प्रावधानहरु अवलम्बन गर्न/गराउनु हुन अनुरोध गरिन्छ ।

निम्न

१) Soil type, Design भन्दा फरक भए, यस महाशाखामा प्रमाण सहित जानकारी गराउन हुन ।
२) Piling Sequence, Specification अनुसार गराउन हुन ।
३) Pile को Layout accurate तरिकाले गर्नु हुन ।
४) Bentonite Slurry को Property Test, प्रयोग पूर्व तथा Concerting पूर्व अनिवार्य गराउन हुन ।
५) Pile को Concreting गर्दा उपयुक्त तरिकाले Tremie Pipe को प्रयोग गराउन हुन ।
६) न्यूनतम Maximum Scour Level सम्म Temporary Casing प्रयोग गर्नुहुन ।
७) Drill depth पुगे पश्चात, Concreting पूर्व Pile Bottom, उपयुक्त प्रविधिद्धारा सफा गराउन हुन ।
८) Temporary Casing Extraction गर्दा, न्यूनतम 2m concrete head above the pile top level maintain गराउन हुन ।
९) Pile Reinforcement Splice गर्दा न्यूनतम 2 Bull dog grips per bar at min. 4 locations गराउन हुन ।
१०) 150mm को अनिवार्य प्र्याप्त Cover Block प्रयोग गराउन हुन ।
११) Pile को Concrete Production गर्दा अनिवार्य रुपमा Anti-washout admixture प्रयोग गराउनु हुन ।
१२) शतप्रतिशत Pile को Pile Integrity Test गराउन, field data बाट थप Pile Profile Analysis तथा Beta-Analysis गर्नुहुन । Profile analysis/beta analysis नगरिएको Pile को हकमा, न्यूनतम १ Core Drill गरि, सो को Result अनुसार आवश्यक कारबाही अगाडि बढाउन हुन ।
१३) एउटा Foundation मा न्यूनतम एक Pile Load Test (Considering No scour Case) गराउन हुन ।

What mistake ?



Pile Capacity Test for No Scour Case

Pile Safe Capacity for **MSL**

Additional Shaft Resistance considered

Additional End Bearing Capacity due to overburden

Overestimation of pile capacity by pile load test

B-1 PILES IN GRANULAR SOILS

The ultimate load capacity (Q_u) of piles, in kN, in granular soils is given by the following formula:

$$Q_u = A_p\left(\tfrac{1}{2} D \gamma N_\gamma + P_D N_q\right) + \sum_{i=1}^{n} K_i P_{Di} \tan \delta_i A_{si} \quad \dots (1)$$

The first term gives end-bearing resistance and the second term gives skin friction resistance.

where

A_p = cross-sectional area of pile tip, in m²;

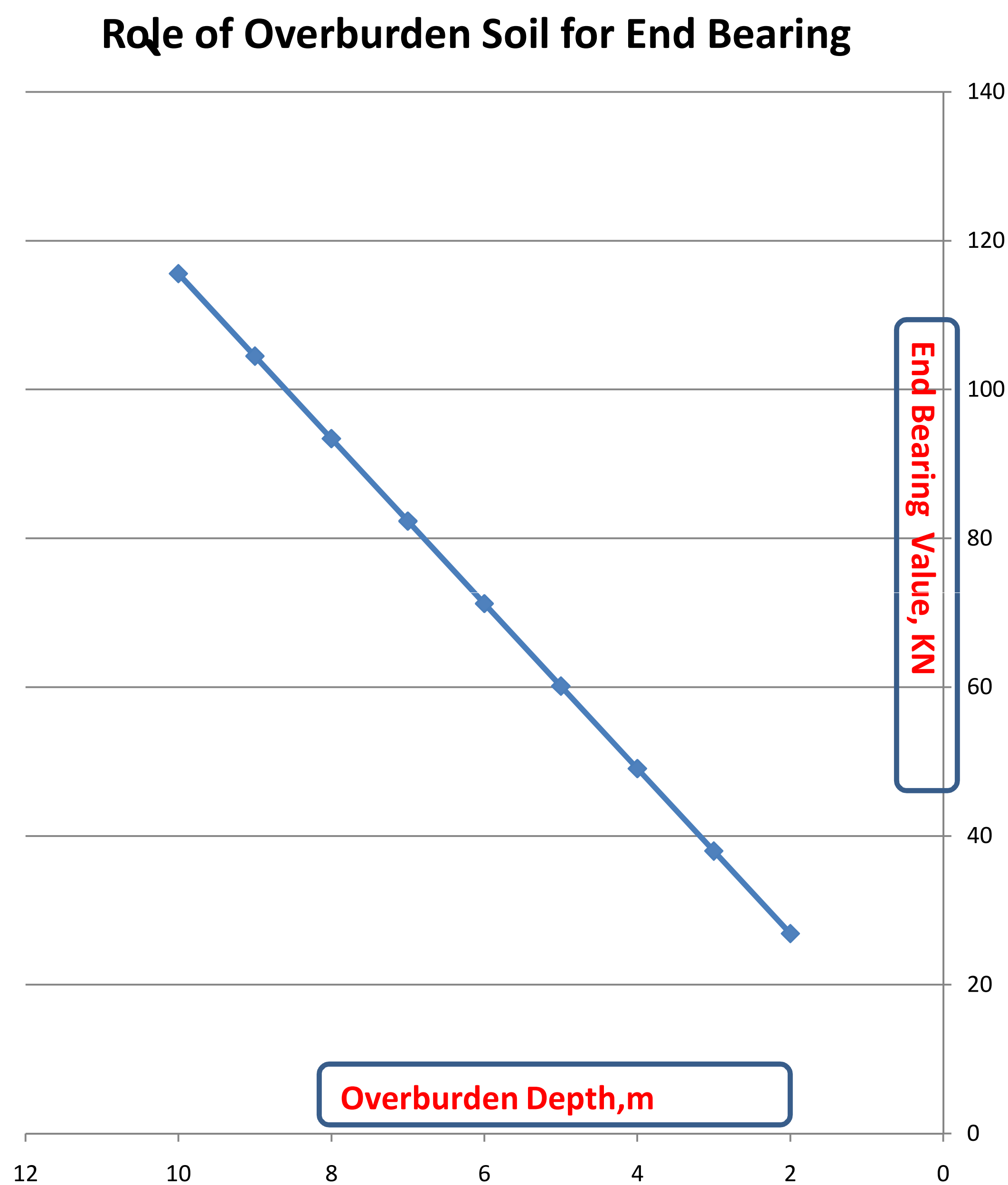
D = diameter of pile shaft, in m;

γ = effective unit weight of the soil at pile tip, in kN/m³;

N_γ and N_q = bearing capacity factors depending upon the angle of internal friction, ϕ at pile tip;

P_D = effective overburden pressure at pile tip, in kN/m² (*see* Note 5);

$\sum_{i=1}^{n}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction;



Total Length of Pile	14.500m				
Pile Length below the MSL	9.843m				
N_c	9			Nq	40
Adhesion factor, α					

Fig. 1 Bearing Capacity Factor, N_q for Bored Piles

Layers	Length of Pile	Soil	SPT Corrected	Cohesion from Lab	Angle of friction	Area of Pile Shaft	Area of Pile Base	Ultimate load of Single Pile	Area of Pile Group Shaft	Area of Pile Group Base	Ultimate load in group action
At MSL		Cohesionless	50		39.3						
Next layer below	2.00m	Cohesionless	50		38.3	7.540		50.15	96.000		564.13
Next layer below	2.00m	Cohesionless	50		37.4	7.540		75.58	96.000		850.33
Next layer below	2.00m	Cohesionless	50		36.6	7.540		75.71	96.000		851.73
Next layer below	2.00m	Cohesionless	50		35.9	7.540		101.20	96.000		1138.54
At Base of Pile	1.84m	Cohesionless	50		35.3	6.948	1.131	3675.44	88.464	131.04	41348.72
							Ultimate load capacity of single pile, KN	3978.08			
							Ultimate load for Individual Pile failure of Group, KN	**59671.3**			**44753.5**
							Ultimate load for Group, KN		44753		
							Safe Load , KN		17901		FOS = 2.5
							Single Pile Safe Load , KN (3x5)		1211		FOS = 2.5
							Test Load		1817		

Total Length of Pile	14.500m				
Pile Length below the MSL	14.500m				
N_c	9			Nq	40
Adhesion factor, α					

Fig. 1 Bearing Capacity Factor, N_q for Bored Piles

Layers	Length of Pile	Soil	SPT Corrected	Cohesion from Lab	Angle of friction	Area of Pile Shaft	Area of Pile Base	Ultimate load of Single Pile	Area of Pile Group Shaft	Area of Pile Group Base	Ultimate load in group action
At MSL		Cohesionless	50		42.6						
Next layer below	2.00m	Cohesionless	50		41.2	7.540		48.96	96.000		550.75
Next layer below	2.00m	Cohesionless	50		39.7	7.540		74.38	96.000		836.75
Next layer below	2.00m	Cohesionless	50		38.6	7.540		74.72	96.000		840.64
Next layer below	2.00m	Cohesionless	50		37.6	7.540		100.37	96.000		1129.13
At Base of Pile	6.50m	Cohesionless	50		35.3	24.504	1.131	6029.15	312.000	131.04	67827.98
							Ultimate load capacity of single pile, KN	6327.58			
							Ultimate load for Individual Pile failure of Group, KN	**94913.7**			**71185.2**
							Ultimate load for Group, KN		71185		
							Safe Load , KN		28474		FOS = 2.5
							Single Pile Safe Load , KN (3x5)		1927		FOS = 2.5
							Test Load		2890		

Safe Load on single pile: least of

a) 75% of Load causing 12mm settlement

b) 50% of Load causing settlement equivalent to 10% of Pile Dia.

c) 1.5 times the working load without causing 12mm settlement.

20% load increment in every 30 min.
20% load decrement in every 30 min.
Normally takes 36 hour for complete test

Design Load	Test Load
80 ton	**120 ton**

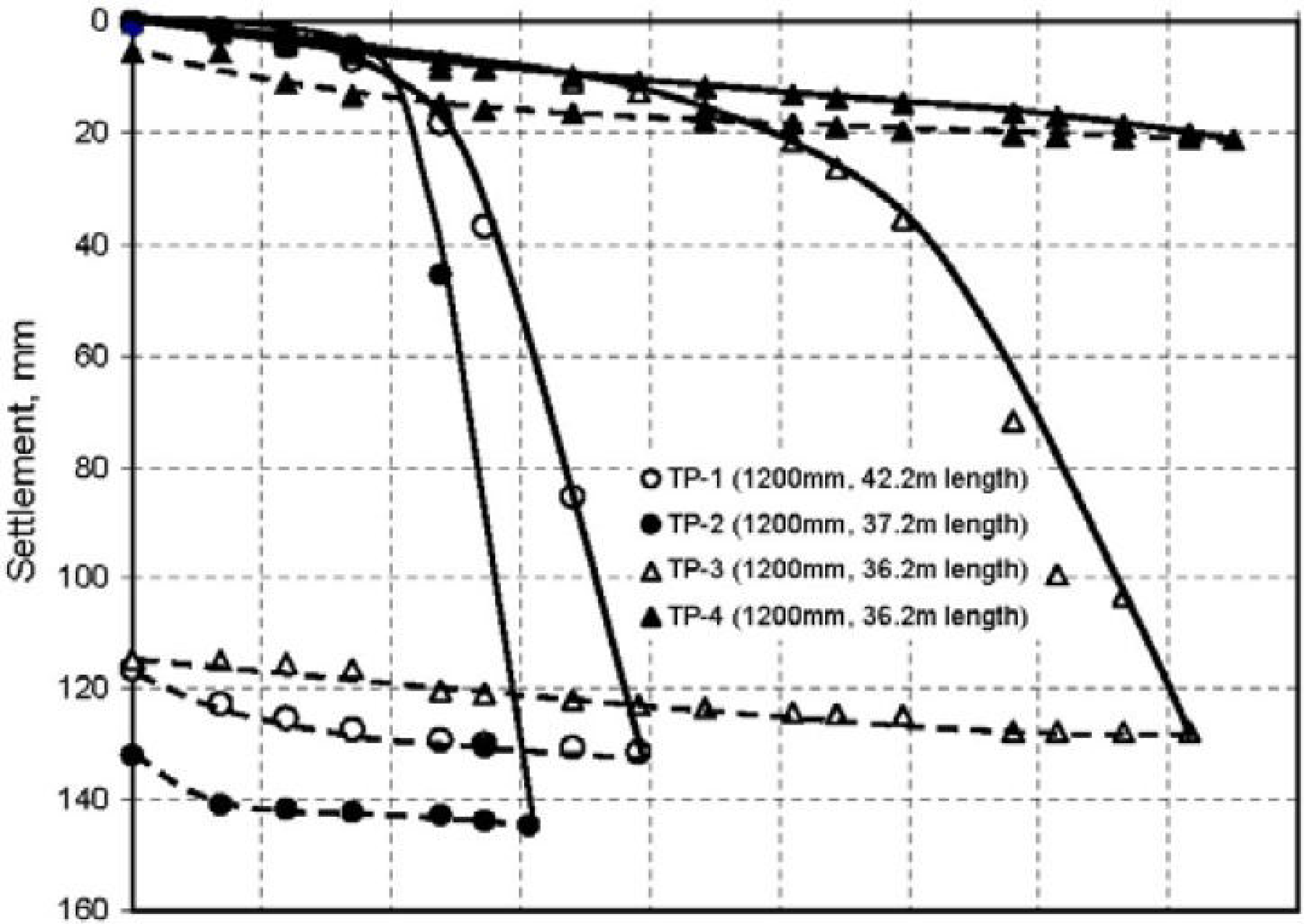
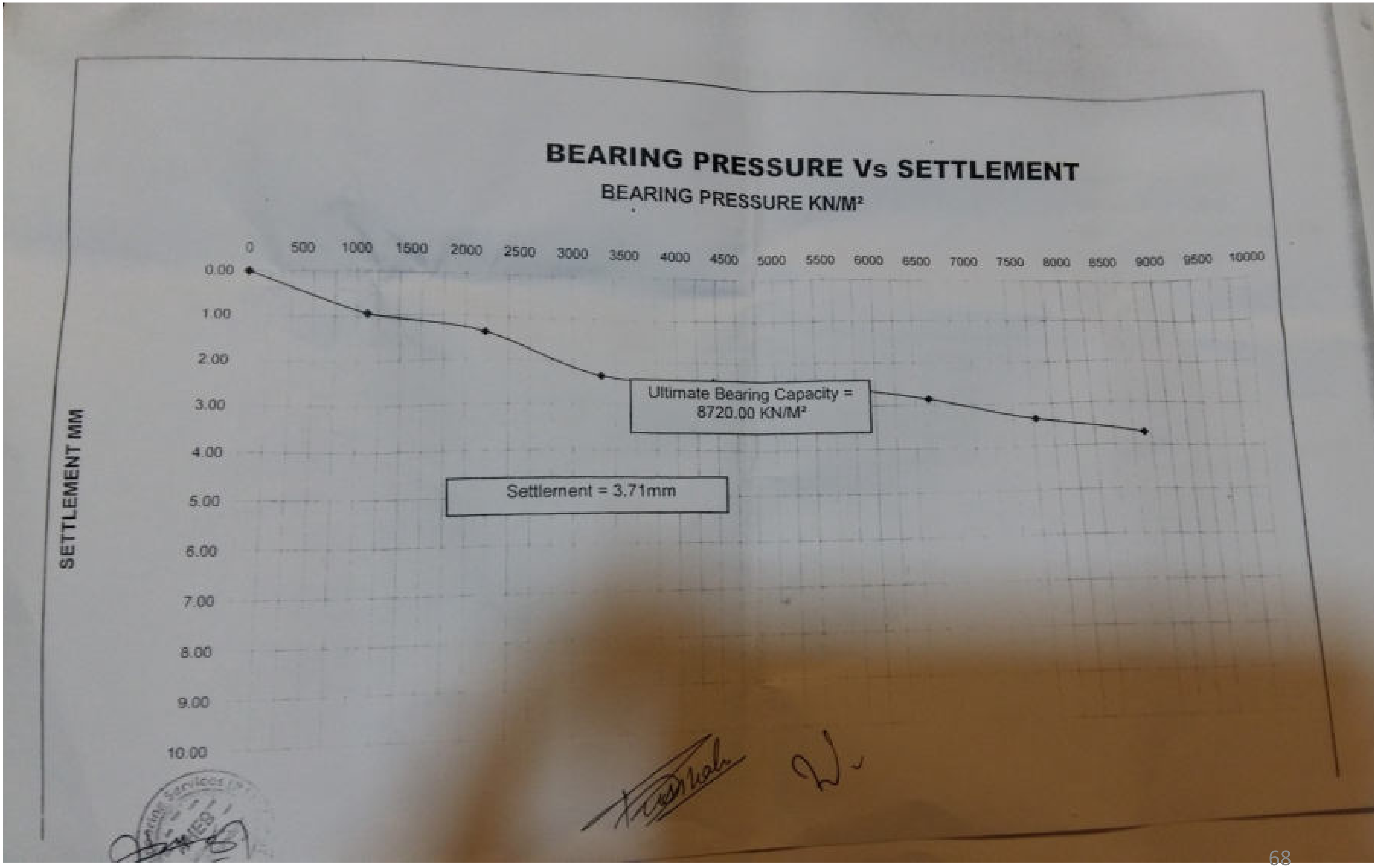


Fig. 3: Load-settlement Curves – 1200 mm diameter piles

Settlement: 1 division =0.01 mm

Deformation Measured Div

Avg. Dial Reading	Settlement (mm)	Dial gauge No. 1 5min	Dial gauge No. 2 5min	Avg. Dial Reading	Settlement (mm)	Dial gauge No. 1 10 min	Dial gauge No. 2 10 min	Avg. Dial Reading	Settlement (mm)	Dial gauge No. 1 15 min	Dial gauge No. 2 15 min	Avg. Dial Reading	Settlement (mm)
0	0	0	0	0	0	0	0	0	0	0	0	0	0
49.50	0.5	49	51	50.00	0.5	49	51	50.00	0.5	49	51	50.00	0.50
76.00	0.76	79	75	77.00	0.77	80	75	77.50	0.78	80	75	77.50	0.78
127.50	1.28	129	135	132.00	1.32	130	136	133.00	1.33	130	136	133.00	1.33
207.50	2.08	215	217	216.00	2.16	217	219	218.00	2.18	218	219	218.50	2.19
323.00	3.23	332	329	330.50	3.31	335	332	333.50	3.34	335	332	333.50	3.34
547.00	5.47	515	585	550.00	5.5	516	587	551.50	5.52	516	587	551.50	5.52
631.50	6.32	617	648	632.50	6.33	618	650	634.00	6.34	618	650	634.00	6.34
797.50	7.98	787	813	800.00	8	788	813	800.50	8.01	789	813	801.00	8.01
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	910.00	9.1	898	922	910.00	9.10


BEARING PRESSURE Vs SETTLEMENT
BEARING PRESSURE KN/M²
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
SETTLEMENT MM
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
Ultimate Bearing Capacity =
8720.00 KN/M²
Settlement = 3.71mm

LAB UNIT

Date : 2074/02/16

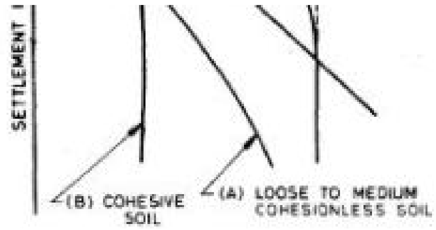
PILE LOAD TEST RESULT SHEET

Project: Construction of Prestressed RCC Bridge Over Dimha Khola at Rampur Birta-5
Client Department of Road, Division Road Office,Lahan
Contract No. DROLHN/337157-4/072/073-008
Contractor: M/S Sunaula Khimti -Bikas JV
Location: Rampur -5,Birta,Sirha
Test Bank: Right Side Abutment
Test Pile No.: C3

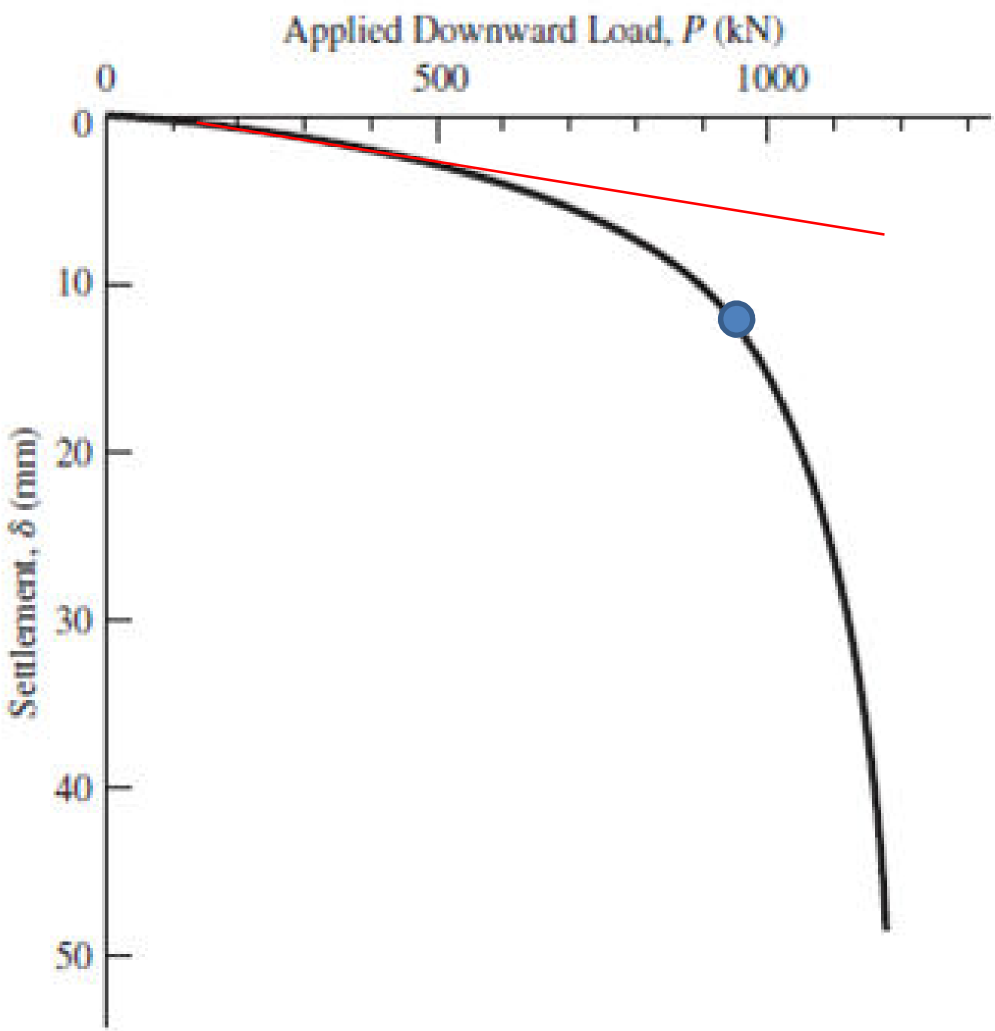
Area of Plate :0.09 m^2
Plate length : 0.30 m
Settlement ; 1 division =0 .01 mm
Dia of Pile :800 mm
Depth of Pile : 20 m
No. of Pile : 16

SN	Load Ton	Load KN/M²	Information Measurement dir										Average Dial Reading in mm	Average Settlement mm	Remarks
			Dial Gauge No.1	Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2			
			1 min	1 min	4 min	4 min	10 min	10 min	15 min	15 min	30min	30 min			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	Dial gauge refixed
1	10	1090.00	102	78	103	79	105	79	106	80	107	81	92	0.92	
2	20	2180.00	110	160	111	162	111	163	112	164	112	166	137	1.37	
3	30	3270.00	210	252	211	254	212	256	213	258	215	260	234	2.34	
4	40	4360.00	225	261	226	262	227	262	228	263	230	264	245	2.45	
5	50	5450.00	240	266	241	267	242	268	244	270	248	271	256	2.56	
6	60	6540.00	268	295	269	295	272	297	276	299	280	305	286	2.86	
7	70	7630.00	315	348	316	349	317	352	318	355	320	358	335	3.35	
8	80	8720.00	348	385	350	387	352	389	355	390	358	392	371	3.71	

Tested & Checked By



ient loading practice :

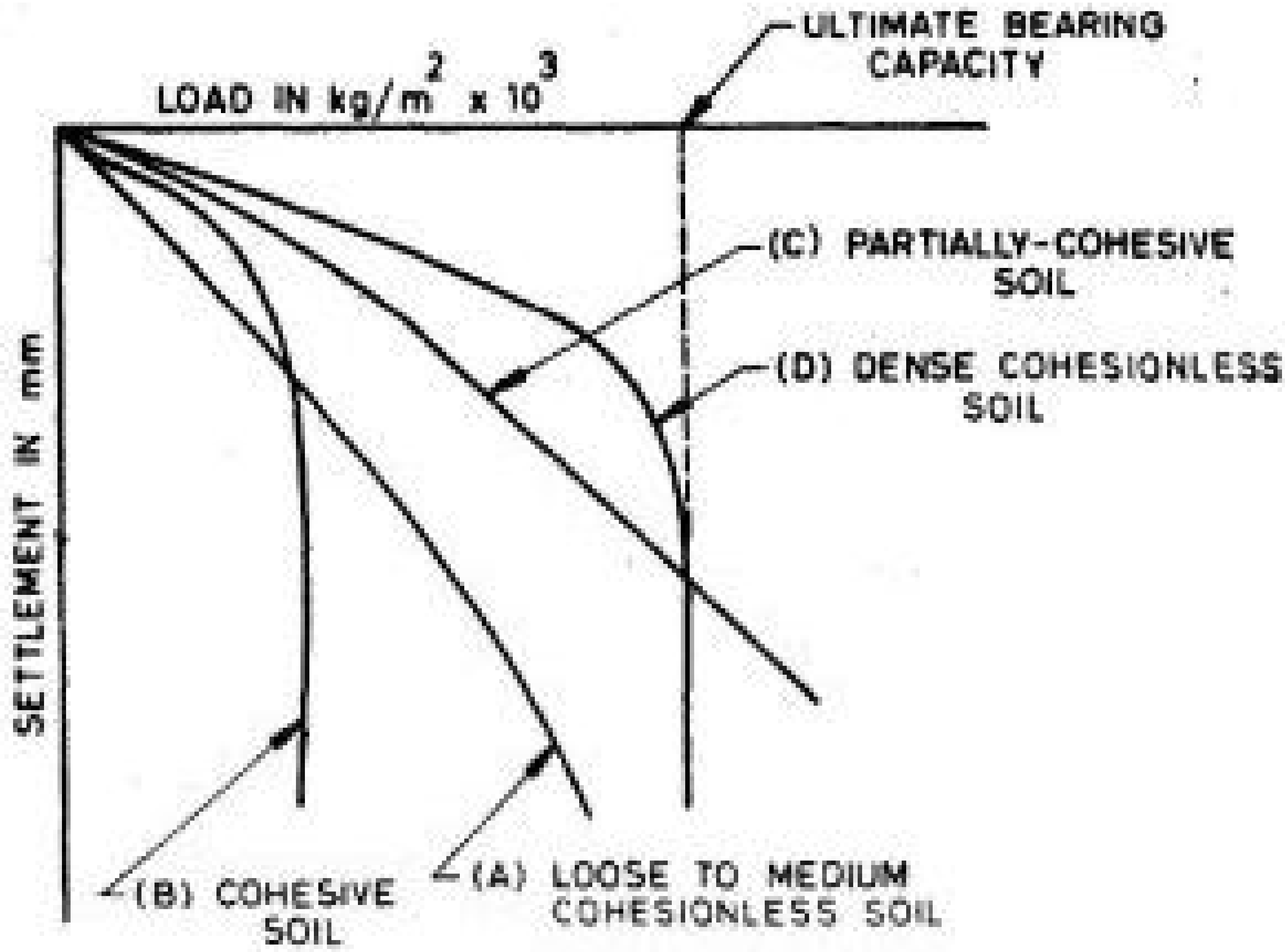


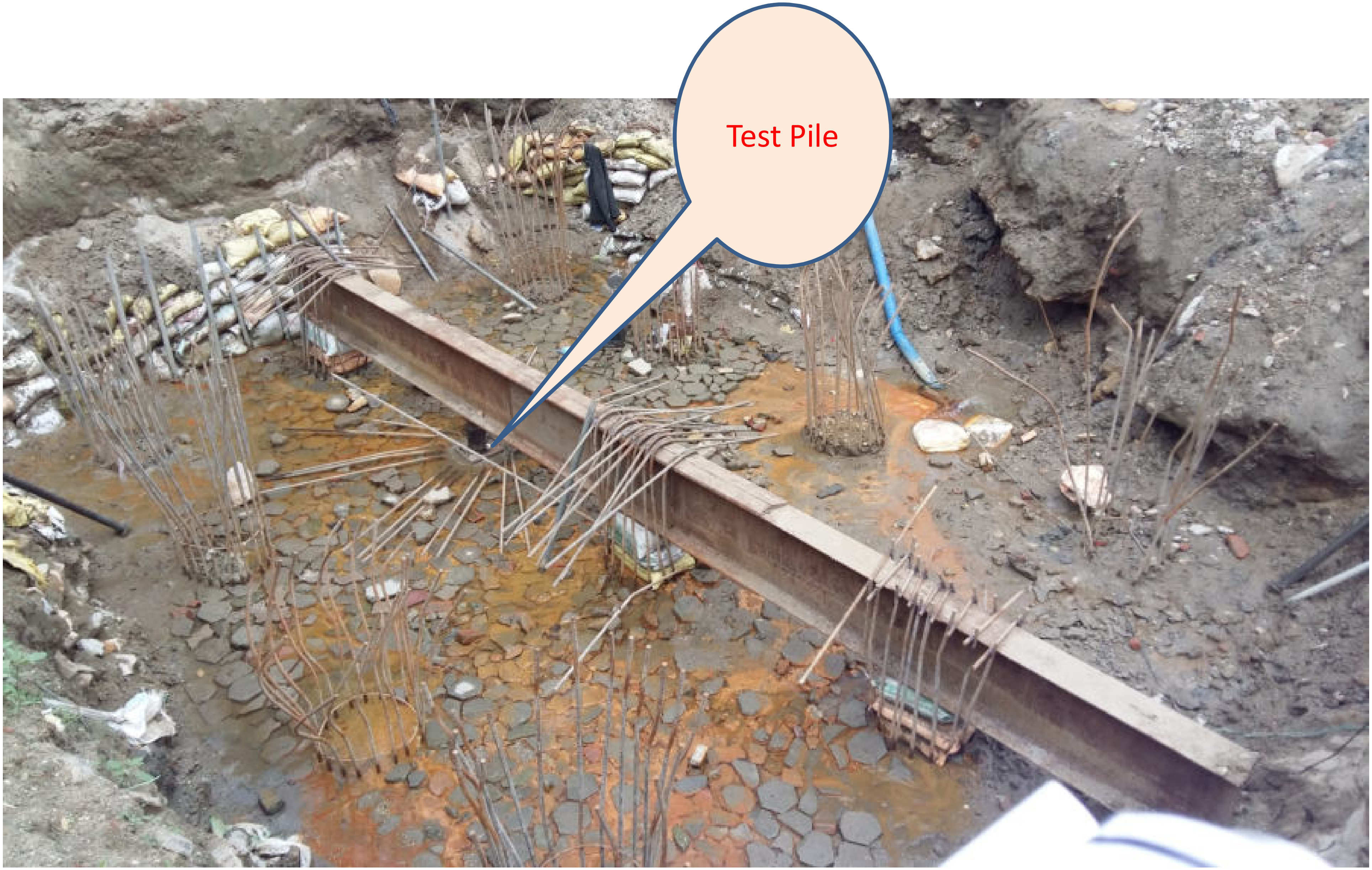
NO Linear relation between Load-Displacement

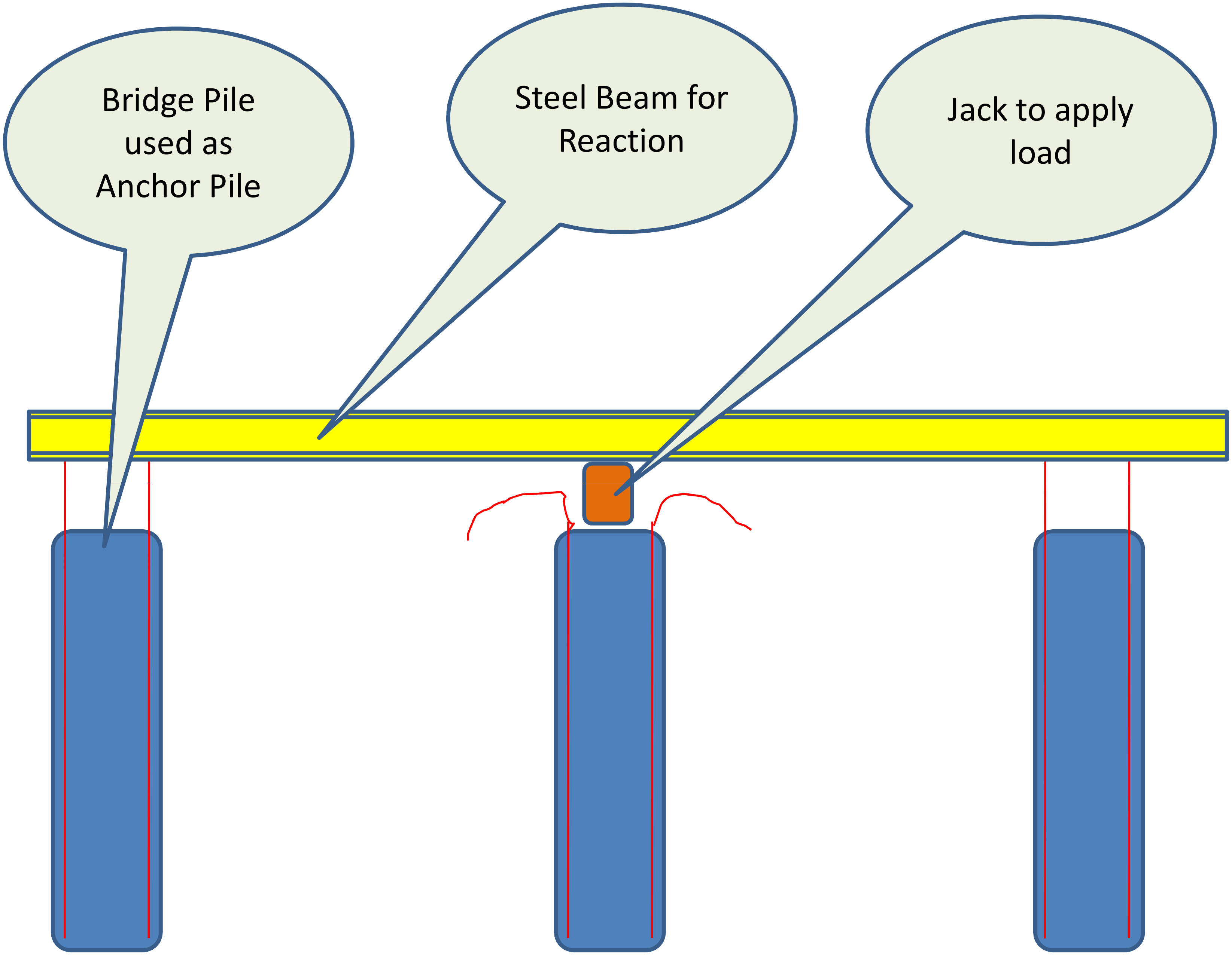
In this case :
Upto 50 ton, Settlement = 3mm

After 95 ton, Settlement >12mm

But from linear assumption, for 95 ton : only 5.7 mm : Blunder


ULTIMATE BEARING CAPACITY
LOAD IN kg/m2 x 10 3
SETTLEMENT IN mm
(C) PARTIALLY-COHESIVE SOIL
(D) DENSE COHESIONLESS SOIL
(B) COHESIVE SOIL
(A) LOOSE TO MEDIUM COHESIONLESS SOIL


Test Pile


Bridge Pile used as Anchor Pile
Steel Beam for Reaction
Jack to apply load

To be checked before any pile test :

1. Sure about Test load for No-Scour Case

2. Check the Steel Beam Capacity for Test Load

3. Check for bearing plate size needed according to Pile Dia.

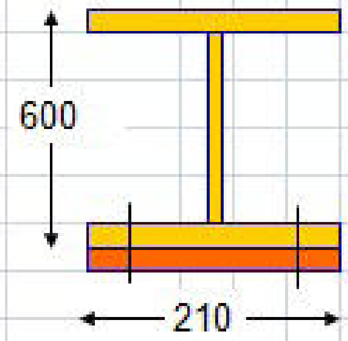
4. Check for Required thickness of Bearing Plate

5. Check the Dial gauges are calibrated or not

6. Check the Hydraulic Jack Load transferring pipe capacity

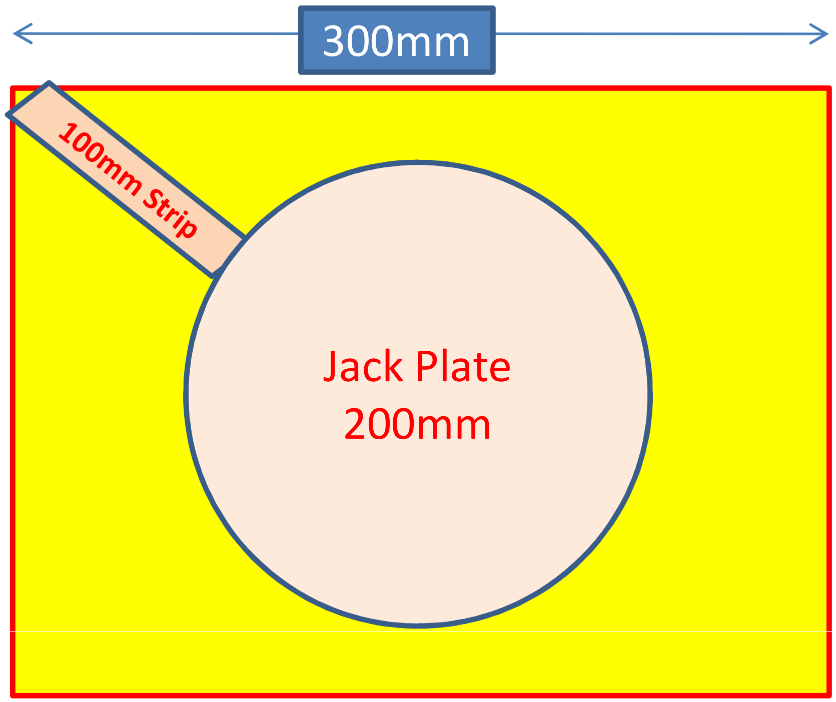
Point Load	800	KN
Design BM	**480.00**	**KNm**
Stringer : Rolled Section ISMB 600		
Zxx	3.06E+06	mm3
Ixx	9.18E+08	mm4
tw	12	mm
tf	20.8	mm
bf	210	mm
h	600	mm
h2	45.15	mm
Wt./m	122.6	Kg/m
Required Zxx	**3.10E+06**	**mm3**

Extra Plate Needed



While Pile load test : must check the testing company has anchor beam of sufficient capacity


Faulty Base Plate



For Test Load =1500KN

Base Pressure at Base Plate = 1500*1000/(300*300) = 16.67 N/mm^2

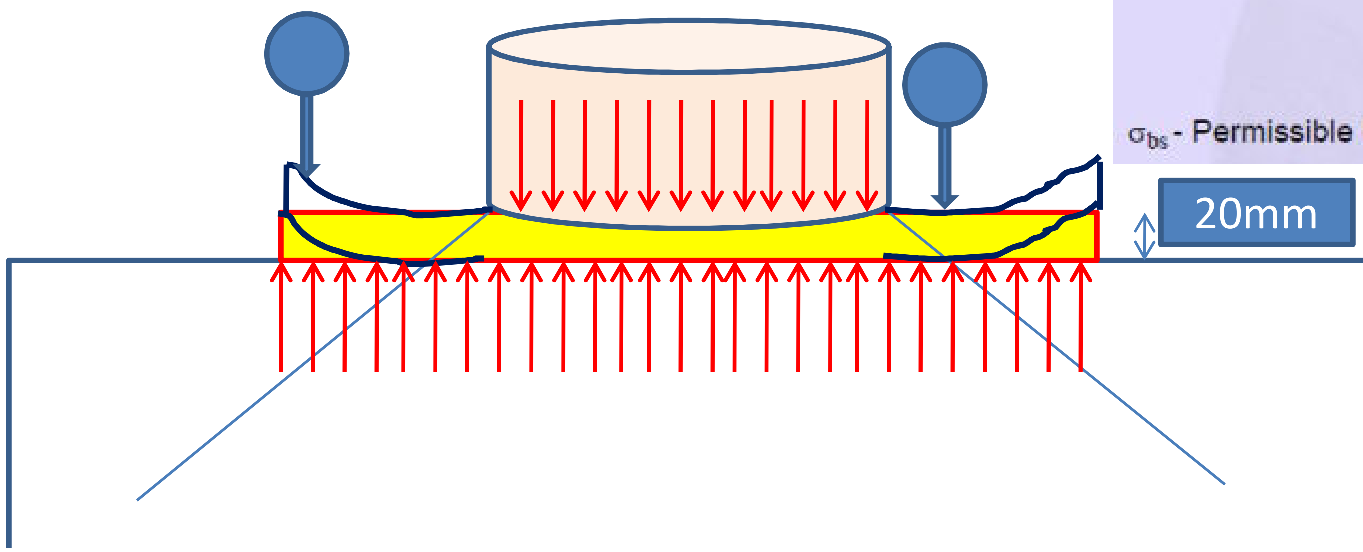
Strip Length = 100mm
Strip Width,B = 25mm

BM to Strip = 16.67*25*100^2/2
= **2.08 KNm**

t req. = sqrt (6 * 2.08 * 10^6/ (25*155)) = **56.75 mm**
but
used = 20mm

$$t_x = \sqrt{\frac{6M}{B\sigma_{bs}}}$$

σ_{bs} - Permissible bending steal of the plate



Date : 2074/01/12

PILE LOAD TEST RESULT SHEET

a Khola at Rampur Birta-5

Area of Plate :0.09 m²
Plate length : 0.30 m
Settlement ; 1 division =0 .01 mm
Dia of Pile :800 mm
Depth of Pile : 20 m → 16 m
No. of Pile : 16

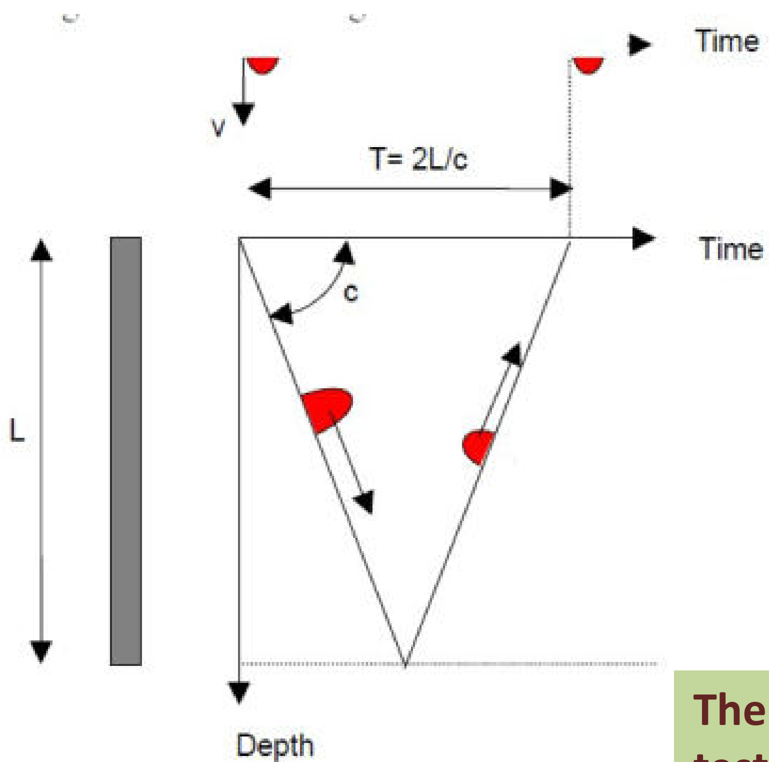
Diformation Measurement div									
Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2	Dial Gauge No.1	Dial Gauge No.2	Average Dial Reading ivisions	Average Settlement mm	Remarks
4 min	10 min	10 min	15 min	15 min	30min	30 min			
0	0	0	0	0	0	0	0	0.00	Dial gauge refixed
2	1	3	1	4	1	4	2	0.02	
7	22	8	25	10	29	13	16	0.16	
13	41	13	42	13	42	13	27	0:27	
23	54	24	56	25	57	25	39	0.39	
32	74	33	76	34	77	35	53	0.53	
43	93	46	95	47	99	50	69	0.69	
60	120	82	124	64	124	64	93	0.93	


Improper Cover

Pile Integrity Test # ASTM D5882

Low Strain *Pile Integrity Testing* is a quick and cost effective method to evaluate the shaft integrity of concrete piles. The testing is able to provide information on:

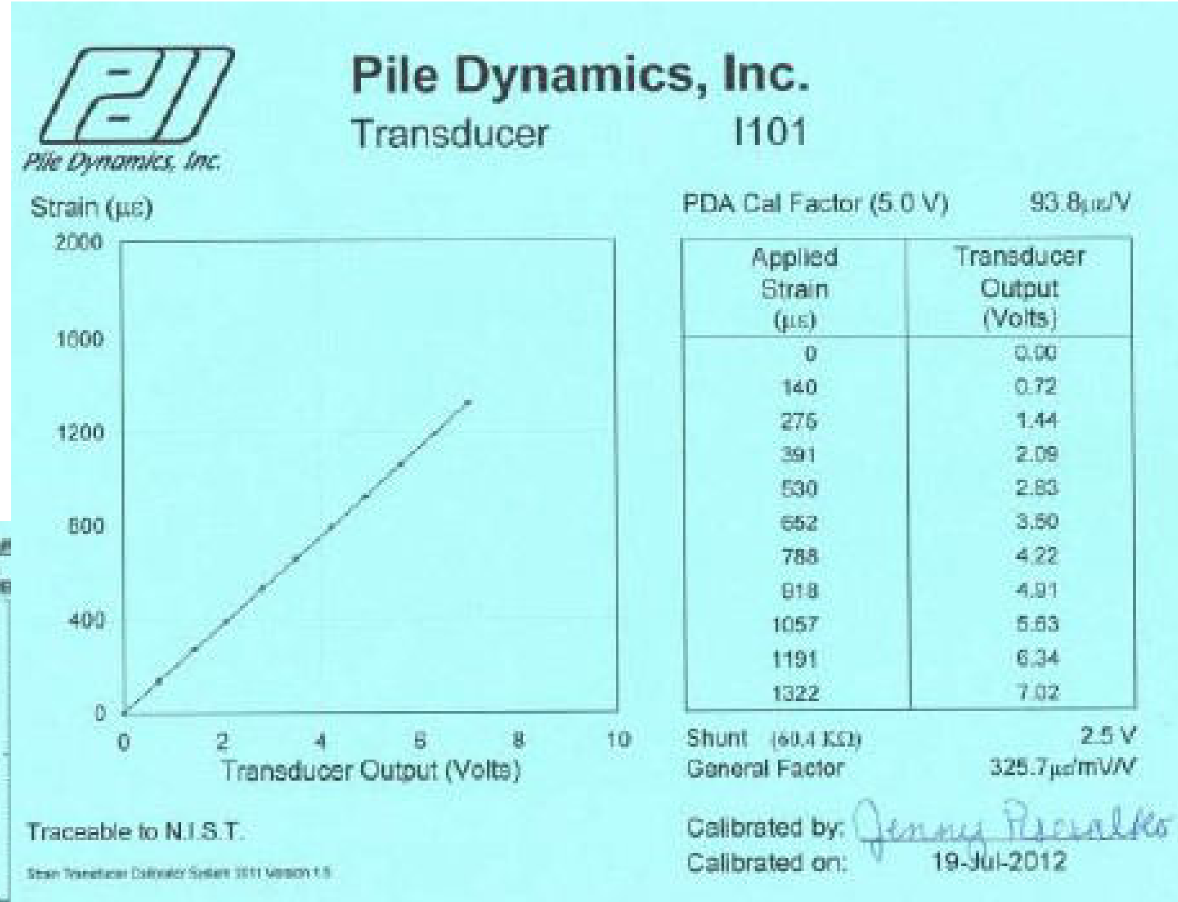
a.) pile continuity
b.) consistency of material
c.) location of defect
d.) degree of defect



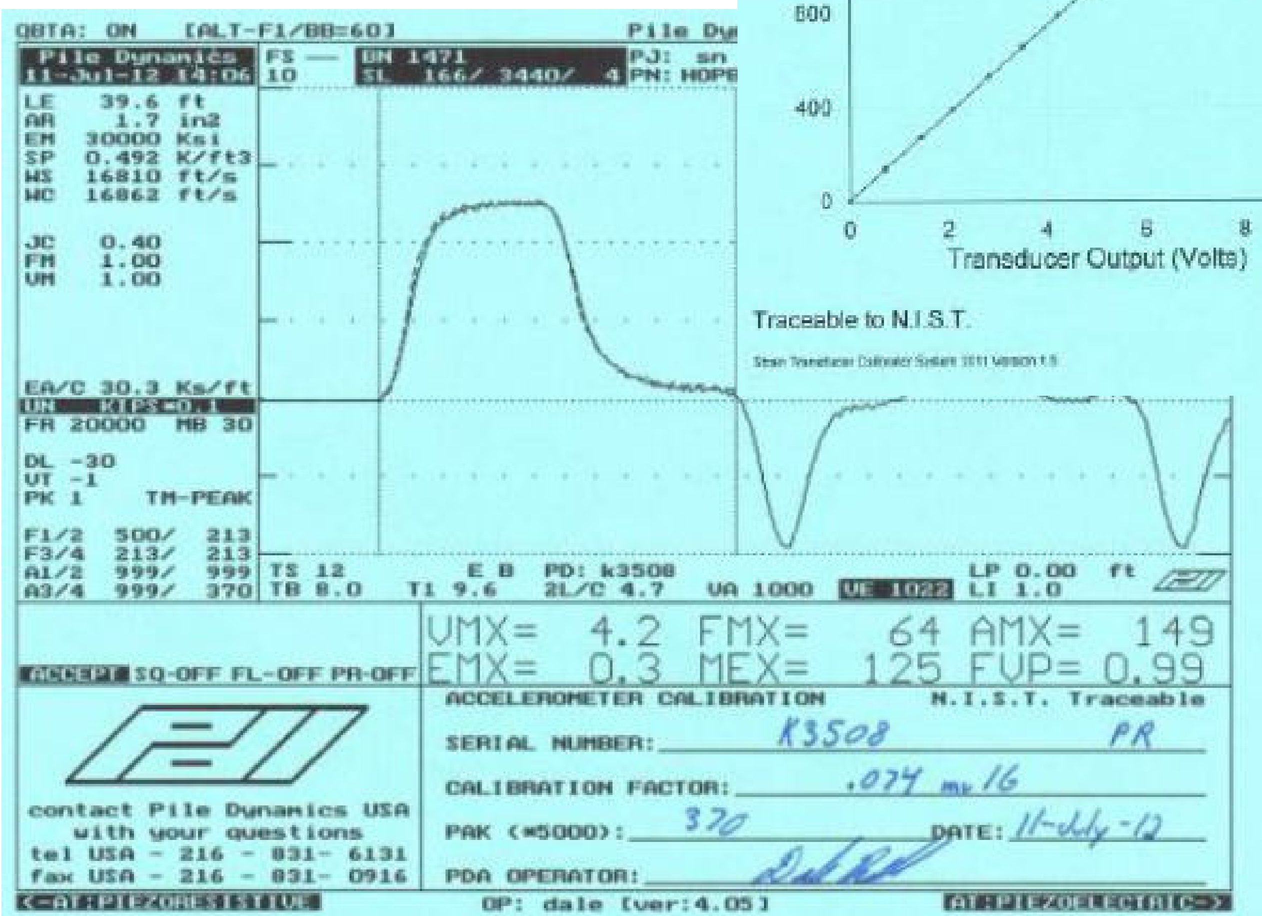
The cast in situ piles should not normally be tested before 14 days of casting.

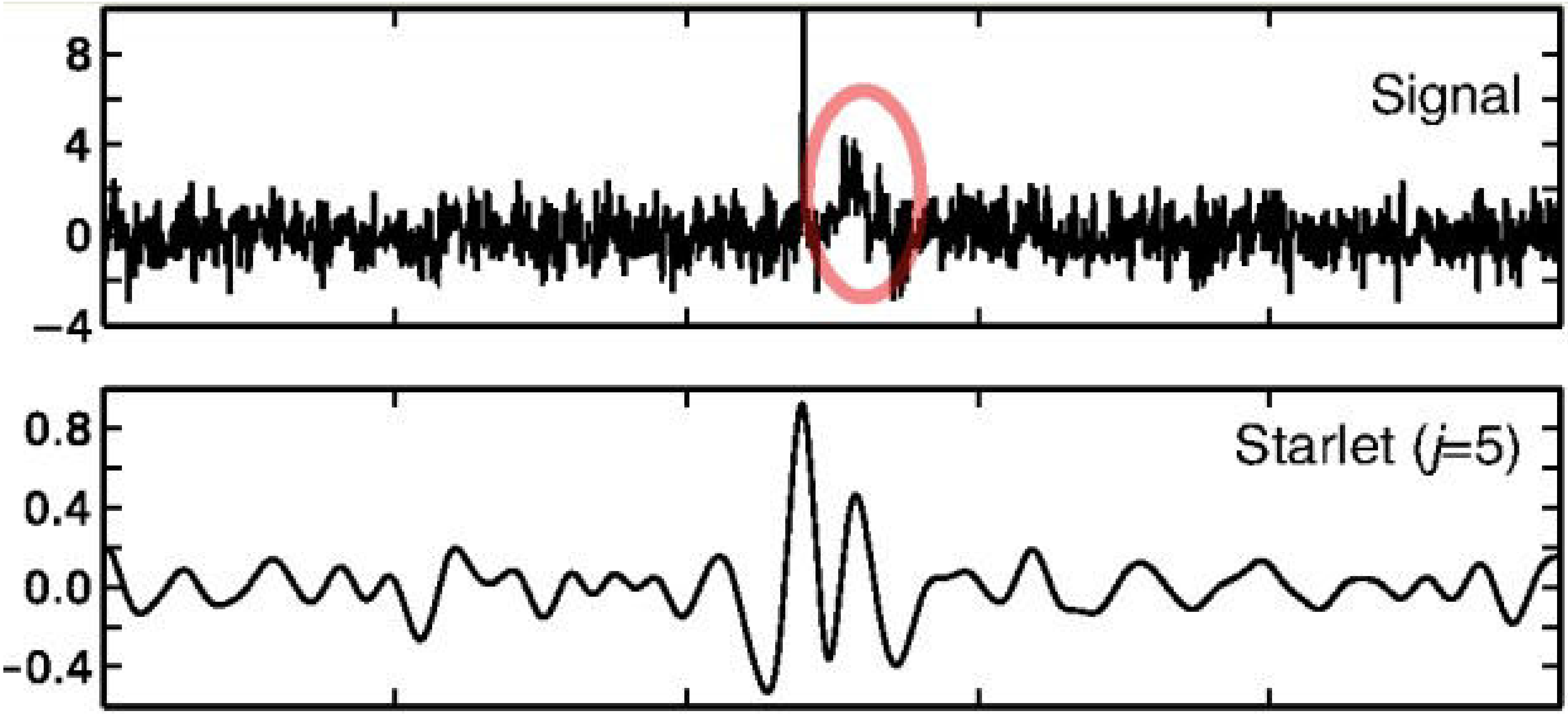
L/D ratio of 30 was designated as the maximum for PIT tests

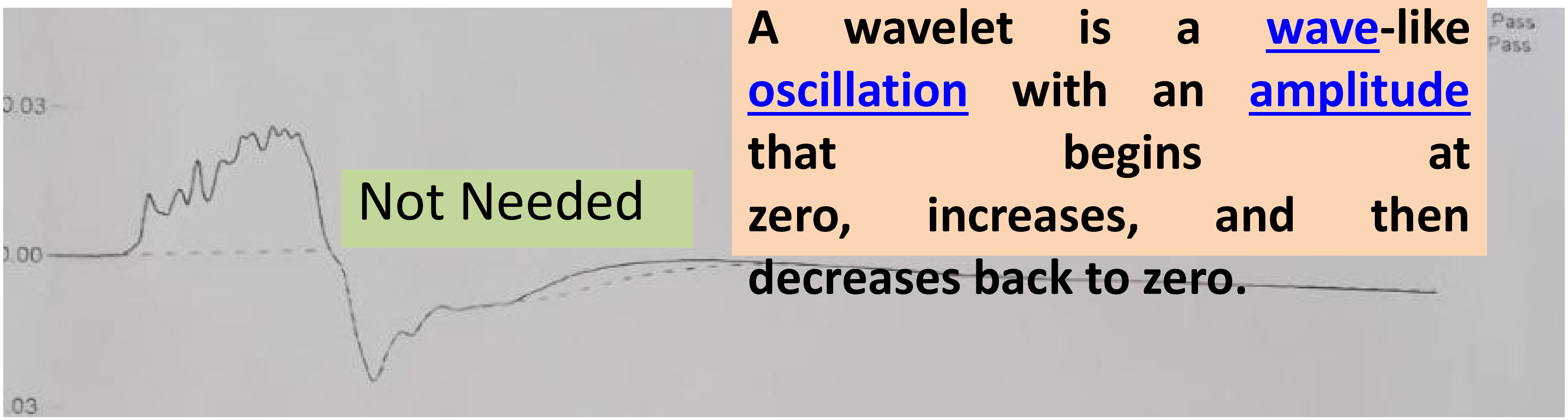
Calibration



Applied Strain (µε)	Transducer Output (Volts)
0	0.00
140	0.72
275	1.44
391	2.09
530	2.83
652	3.50
788	4.22
918	4.91
1057	5.63
1191	6.34
1322	7.02

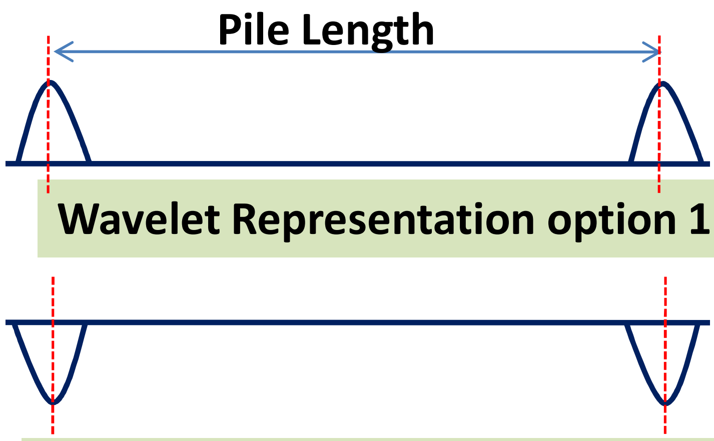






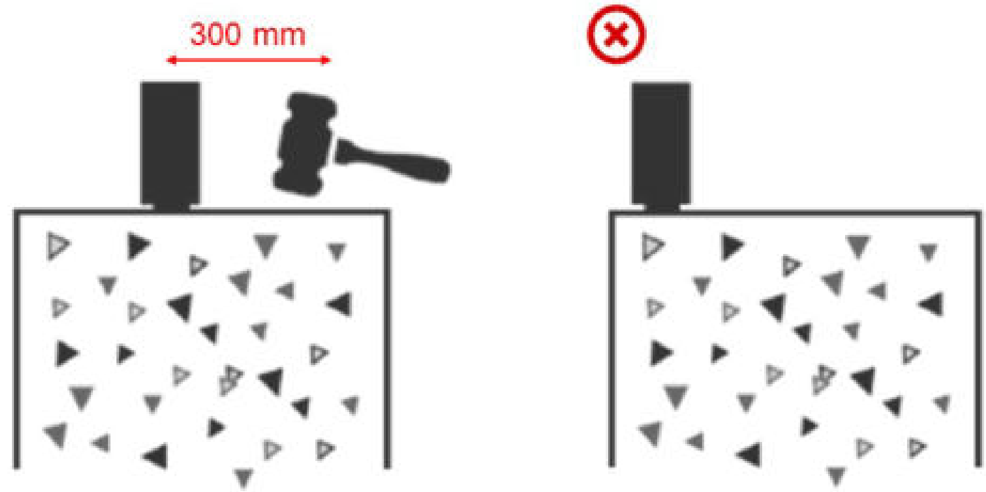
Not Needed

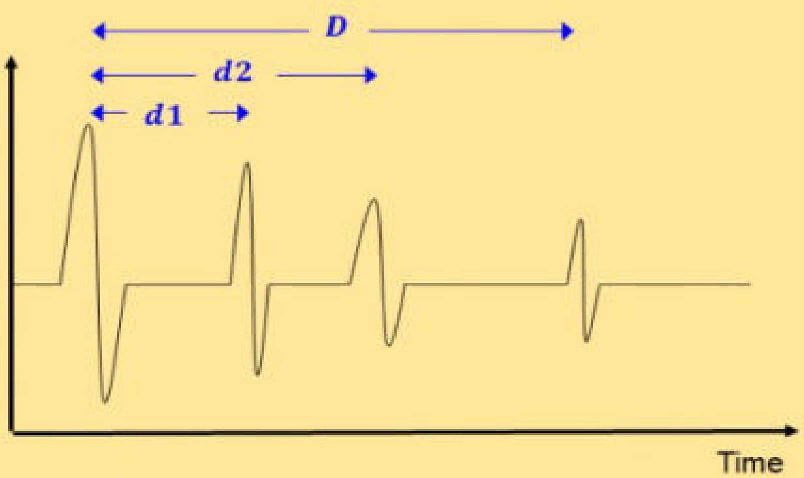
A wavelet is a wave-like oscillation with an amplitude that begins at zero, increases, and then decreases back to zero.



Wavelet Representation option 1

Wavelet Representation option 2

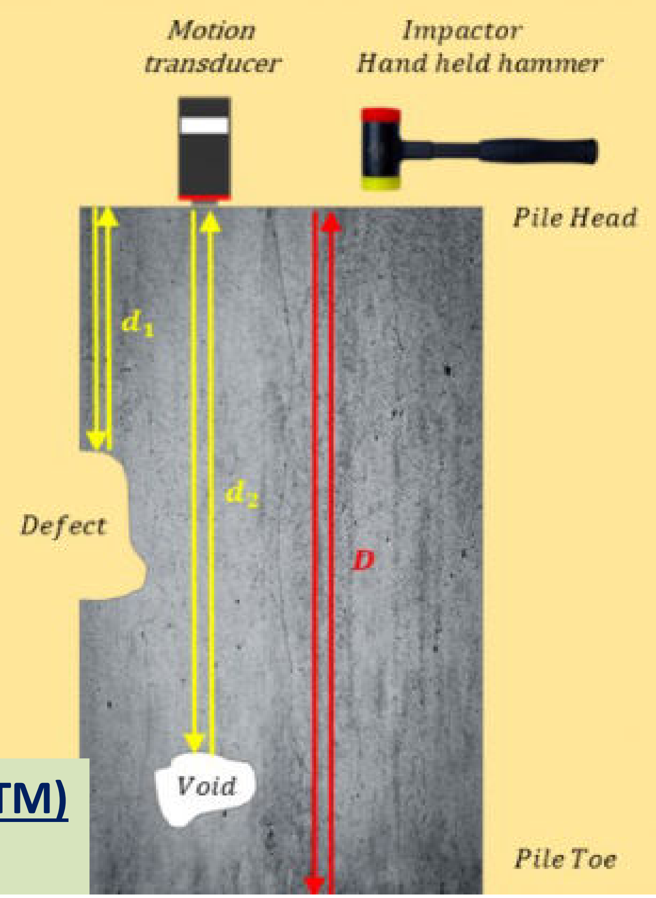




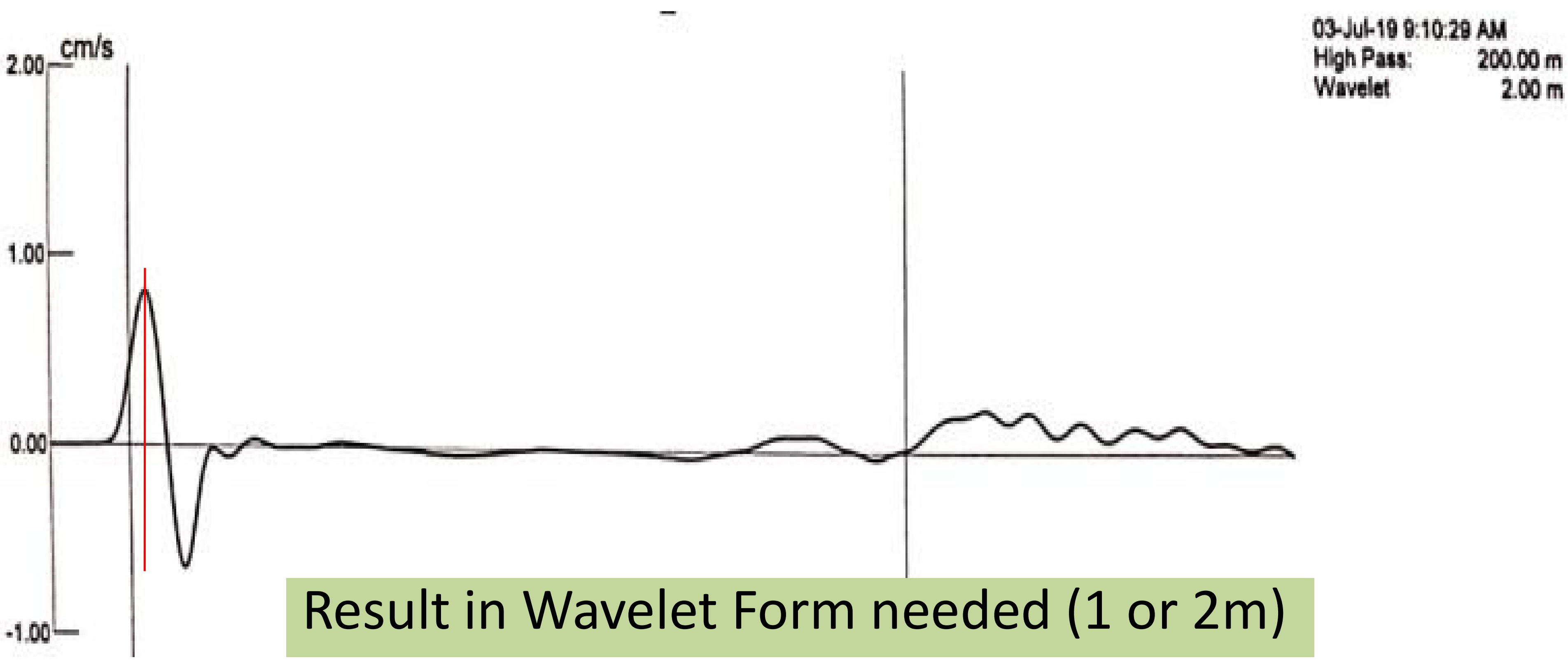
$$d_1 = \frac{1}{2}V.t_1$$

$$d_2 = \frac{1}{2}V.t_2$$

$$D = \frac{1}{2}V.T$$



Continuous wavelet transform method (WTM)
for signal processing technique



Result in Wavelet Form needed (1 or 2m)

- Generally, all piles should be tested with three different sized hammers.
- **Heavier hammers provide better results for long piles.**
- Lighter hammers provide better resolution, particularly near the pile top. If the piles have diameters **greater than 1 m (36 inches**), the recommended hammer masses are **1.5 kg, 3.5 kg, and 6 kg** (3 lbs., 8 lbs., and 14 lbs.).
- The recommended hammer masses for smaller size piles are **0.5 kg, 1.5 kg, and 3.5 kg** (1 lb., 3 lbs. and 8 lbs.).

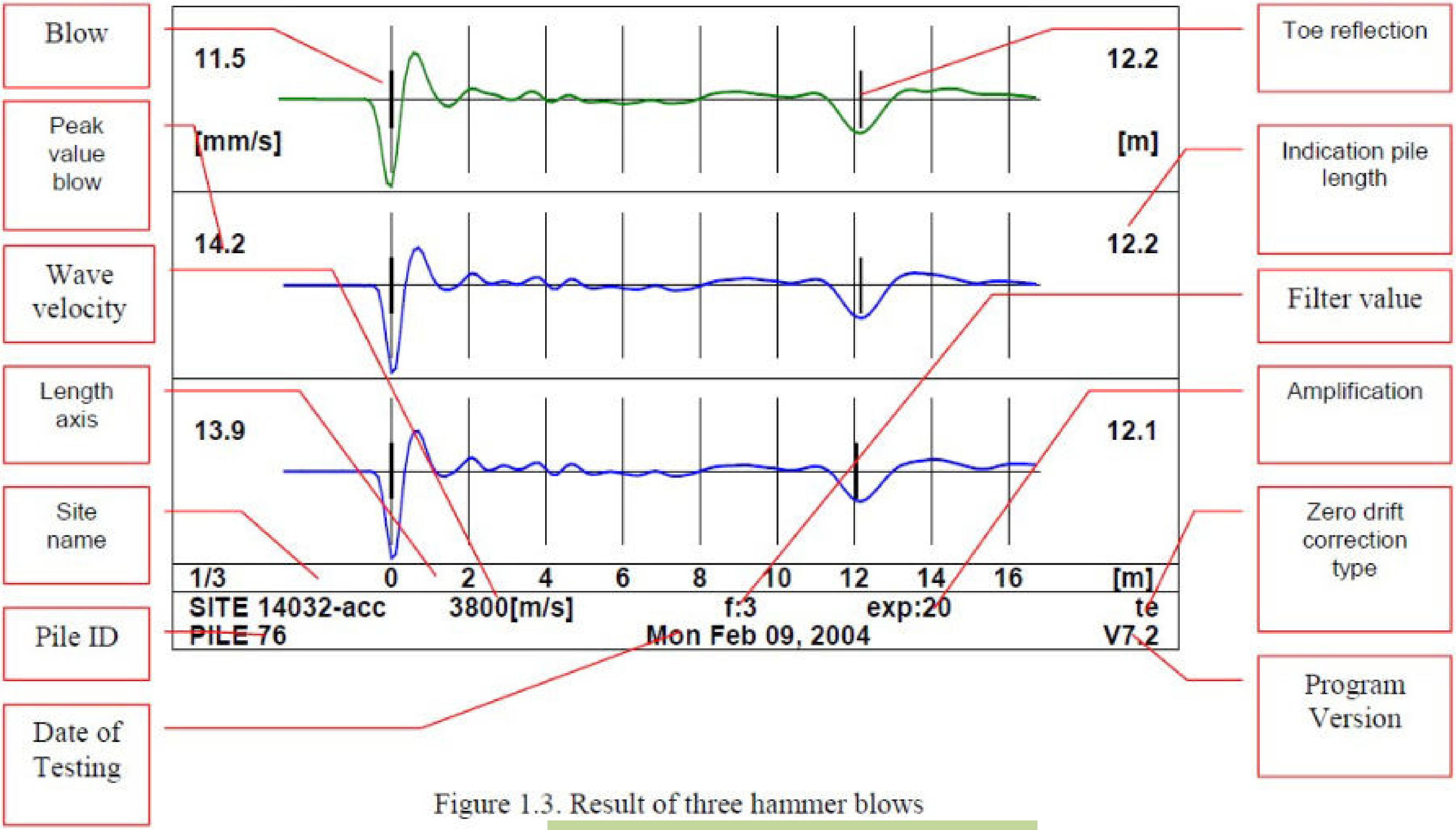
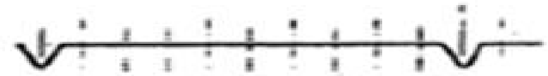
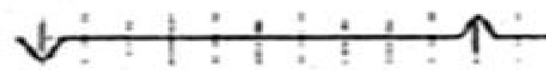
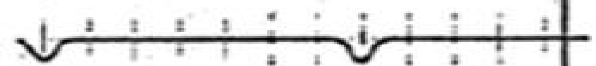
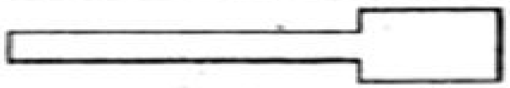
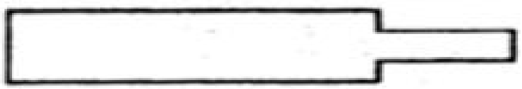
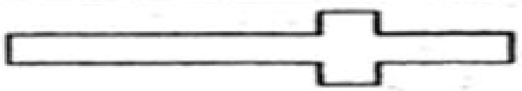
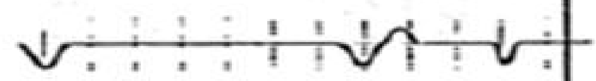
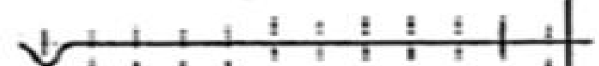
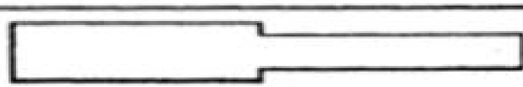
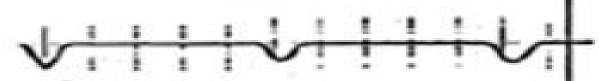
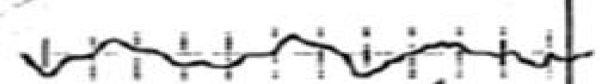


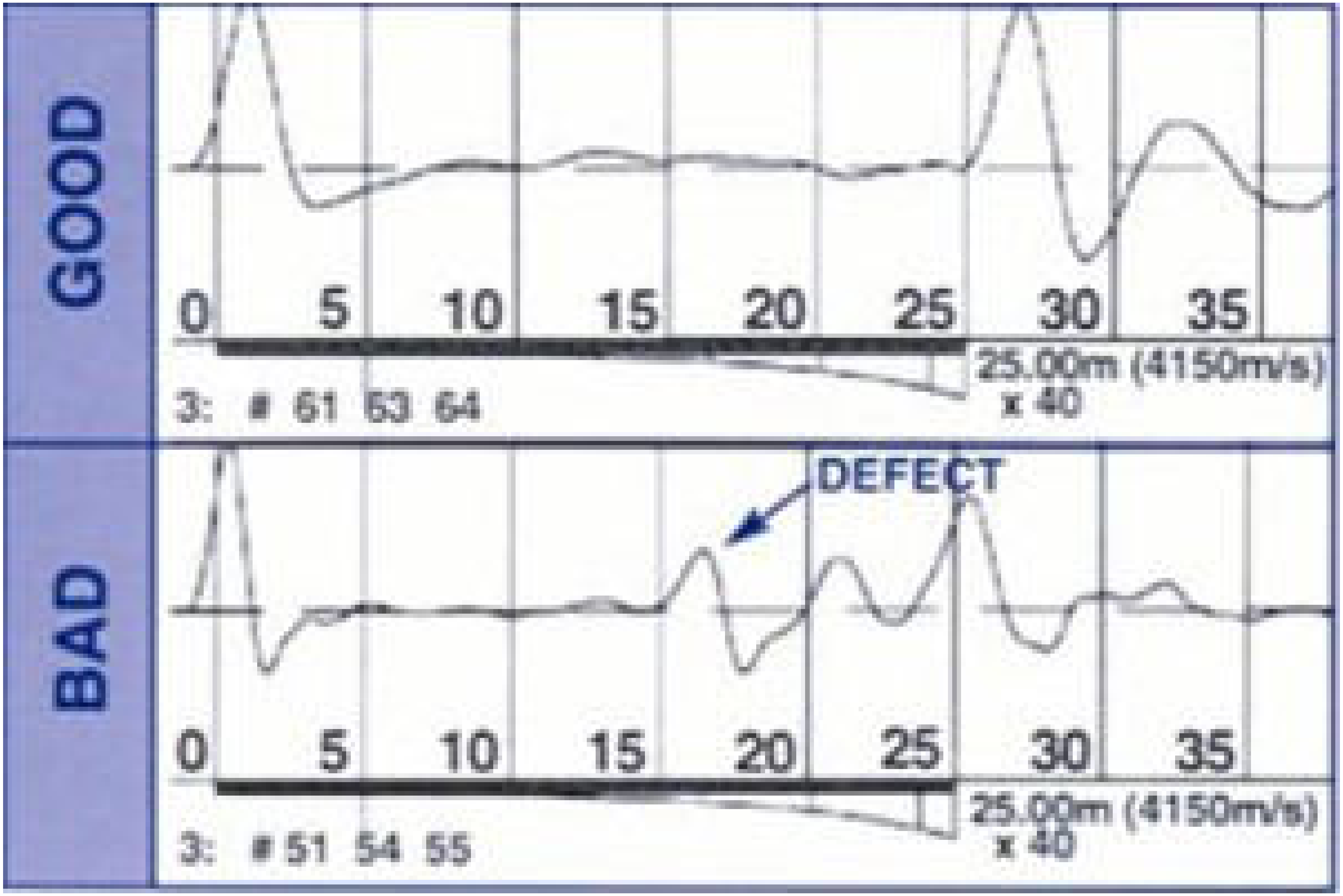
Figure 1.3. Result of three hammer blows

Wave Velocity
Magnification Delay
Magnification
Filter

TABLE 1: TYPICAL REFLECTOGRAMS

PILE PROFILE	DESCRIPTION	REFLECTOGRAM
	Straight pile, free end, length as expected	
	Straight pile, fixed end, length as expected	
	Straight pile, free end, shorter than expected	
	Increased impedance	
	Decreased impedance	
	Locally increased impedance	
	Locally decreased impedance	
	High L/D ratio and/or high skin friction -no toe reflection	
	Multiple reflections from mid-length discontinuity - toe reflection indiscernible	
	Irregular profile - irregular reflectogram	

Note: In the reflectogram, the direction below the axis is positive (compressive).


GOOD
0 5 10 15 20 25 30 35
25.00m (4150m/s)
x 40
3: # 61 63 64
BAD
DEFECT
0 5 10 15 20 25 30 35
25.00m (4150m/s)
x 40
3: # 51 54 55

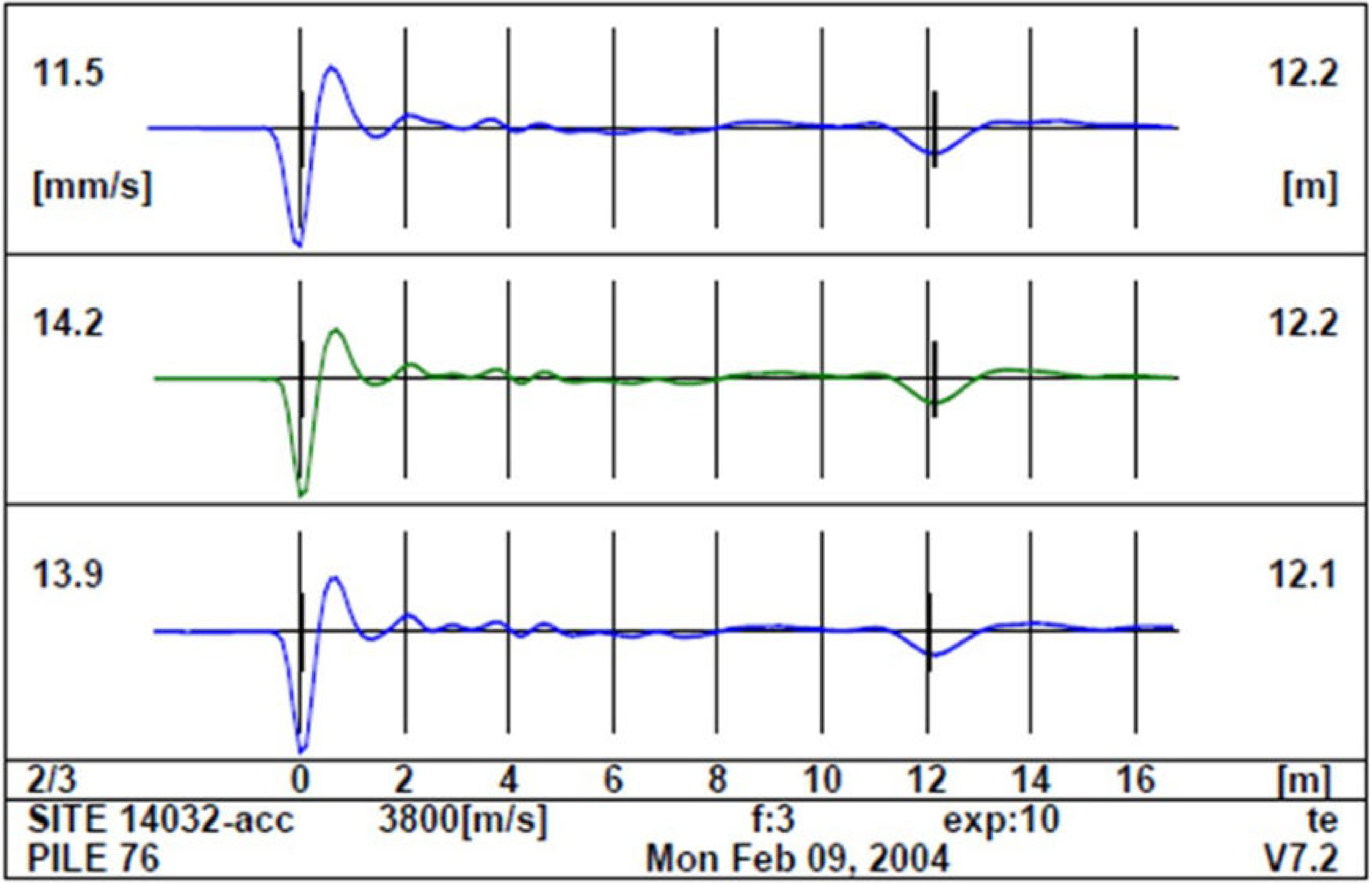


Figure 6.1. Class 1. Pile good, length OK,

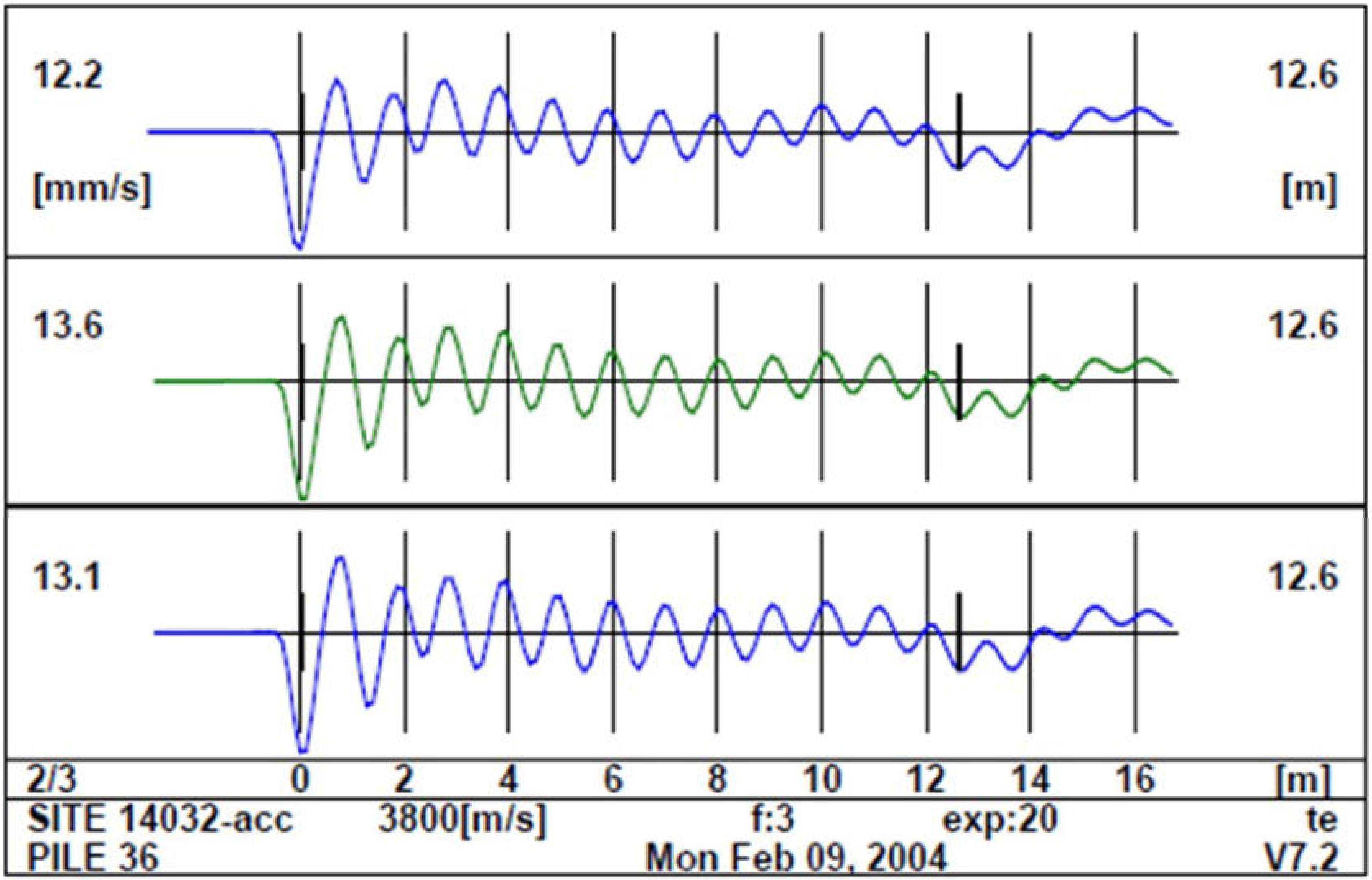


Figure 6.2 Pile head problem, Class 2
Possible reason, crack, necking, low material quality.

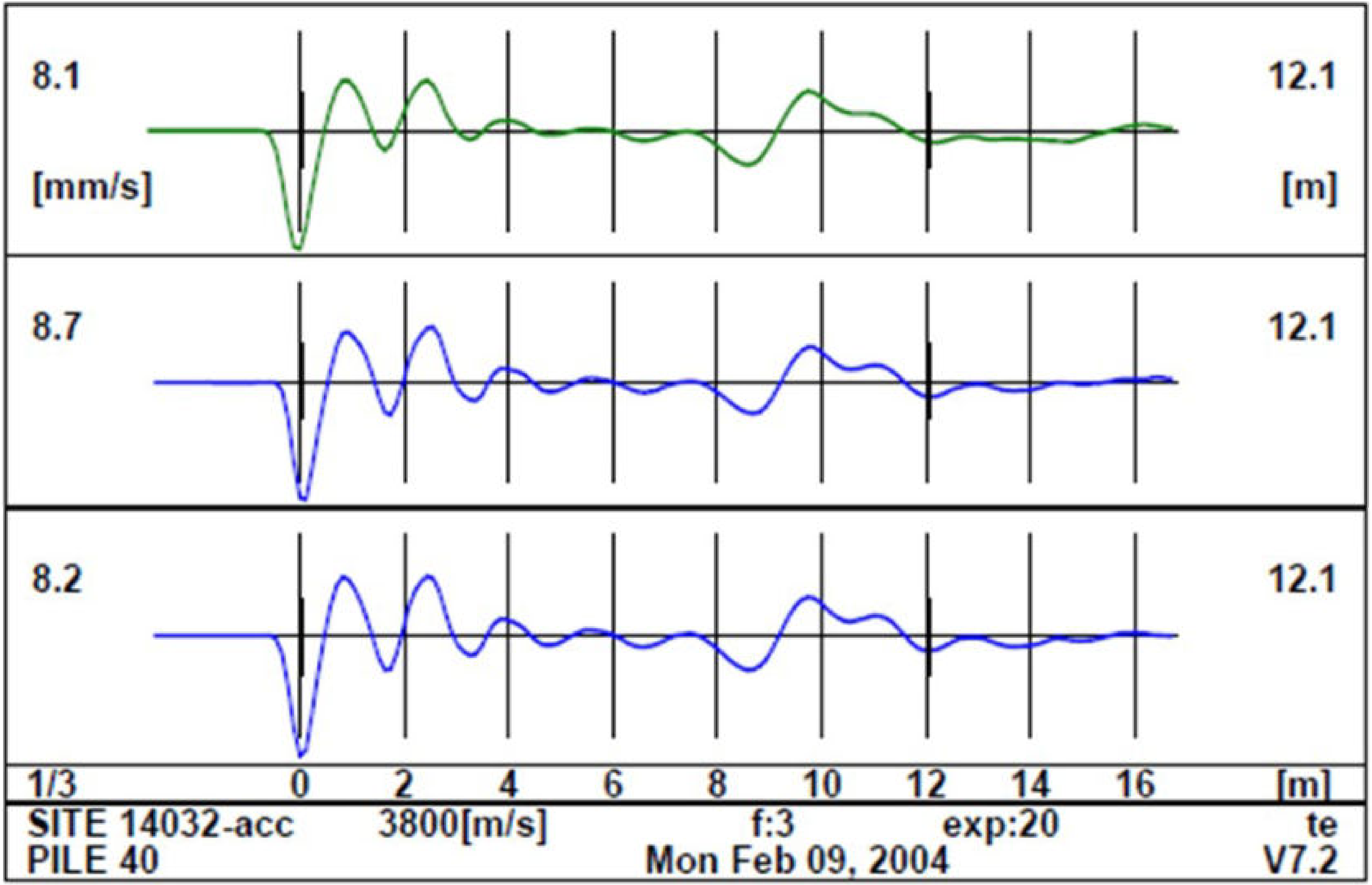


Figure 6.3. Class 3. Reflection from discontinuity at 1.5 m from the pile head. Possible cause, crack, necking, low material quality.

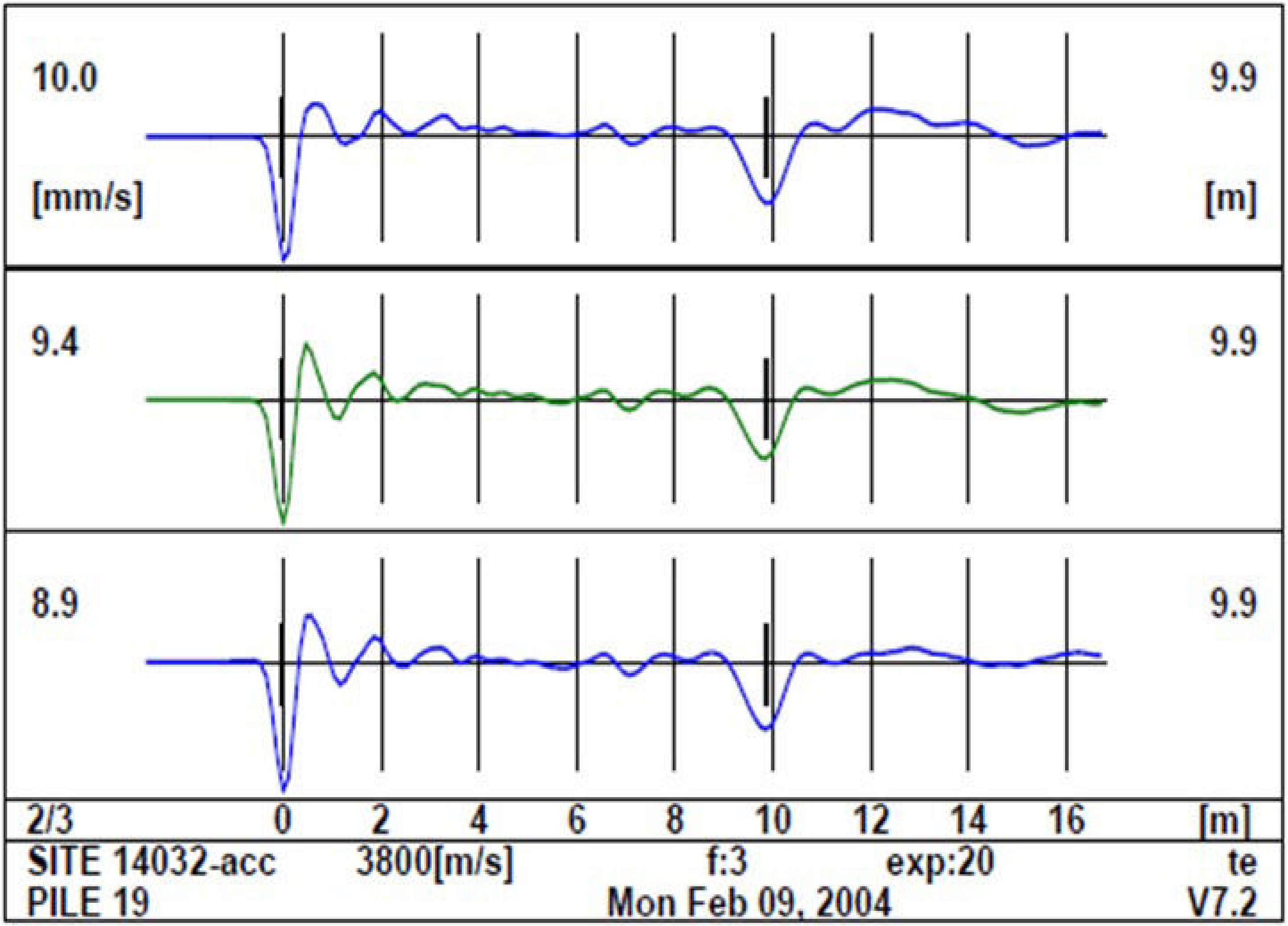


Figure 6.4. Class 4. Pile too short, reflection at 10m, should be 12m
Possible cause: made too short, broken, heavily cracked or serious necking at 10 from the top.

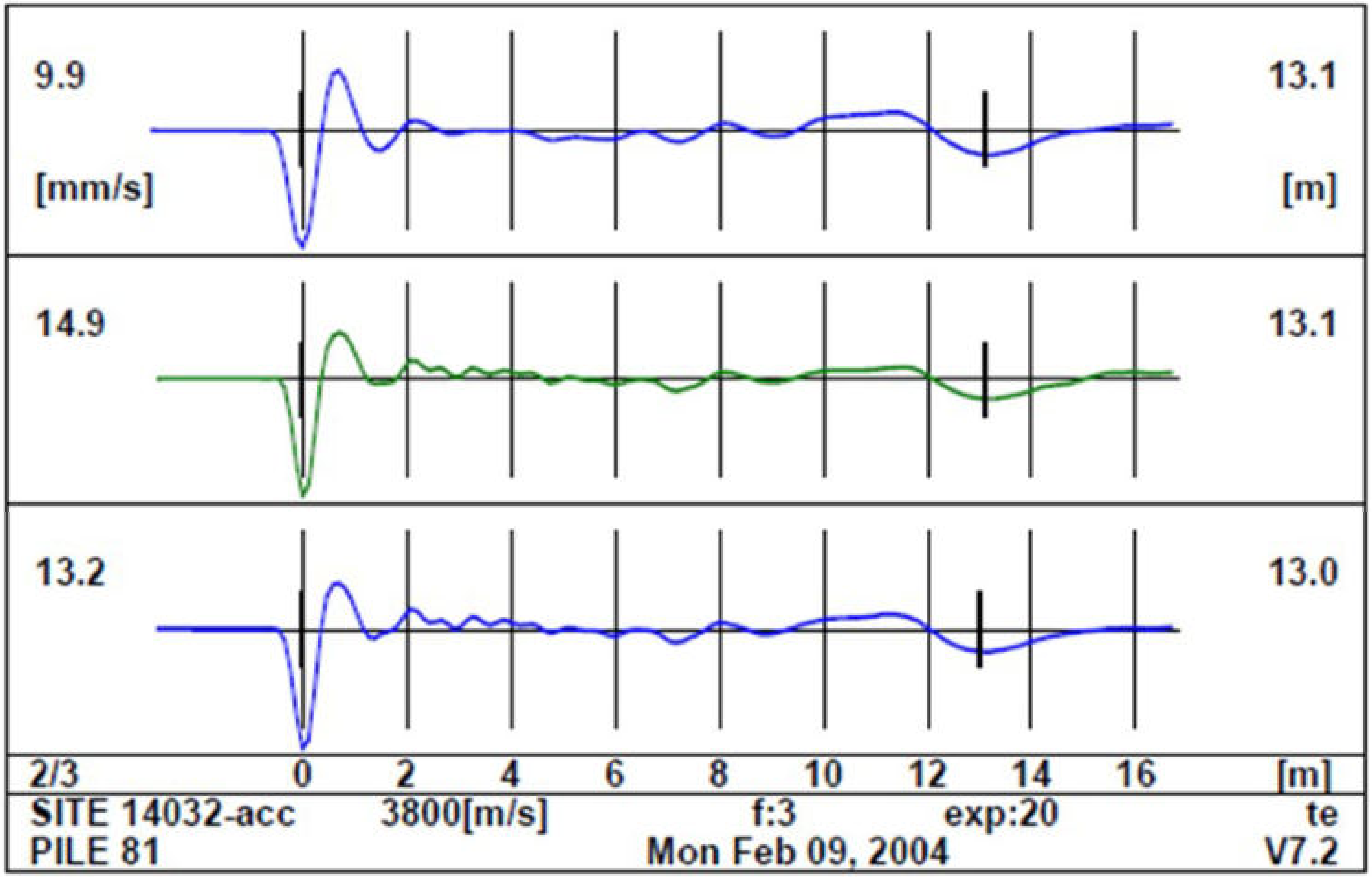


Figure 6.5. Class 5. Toe reflection too late.
Possible cause: Pile made too long, lower material quality, pile younger than other piles,

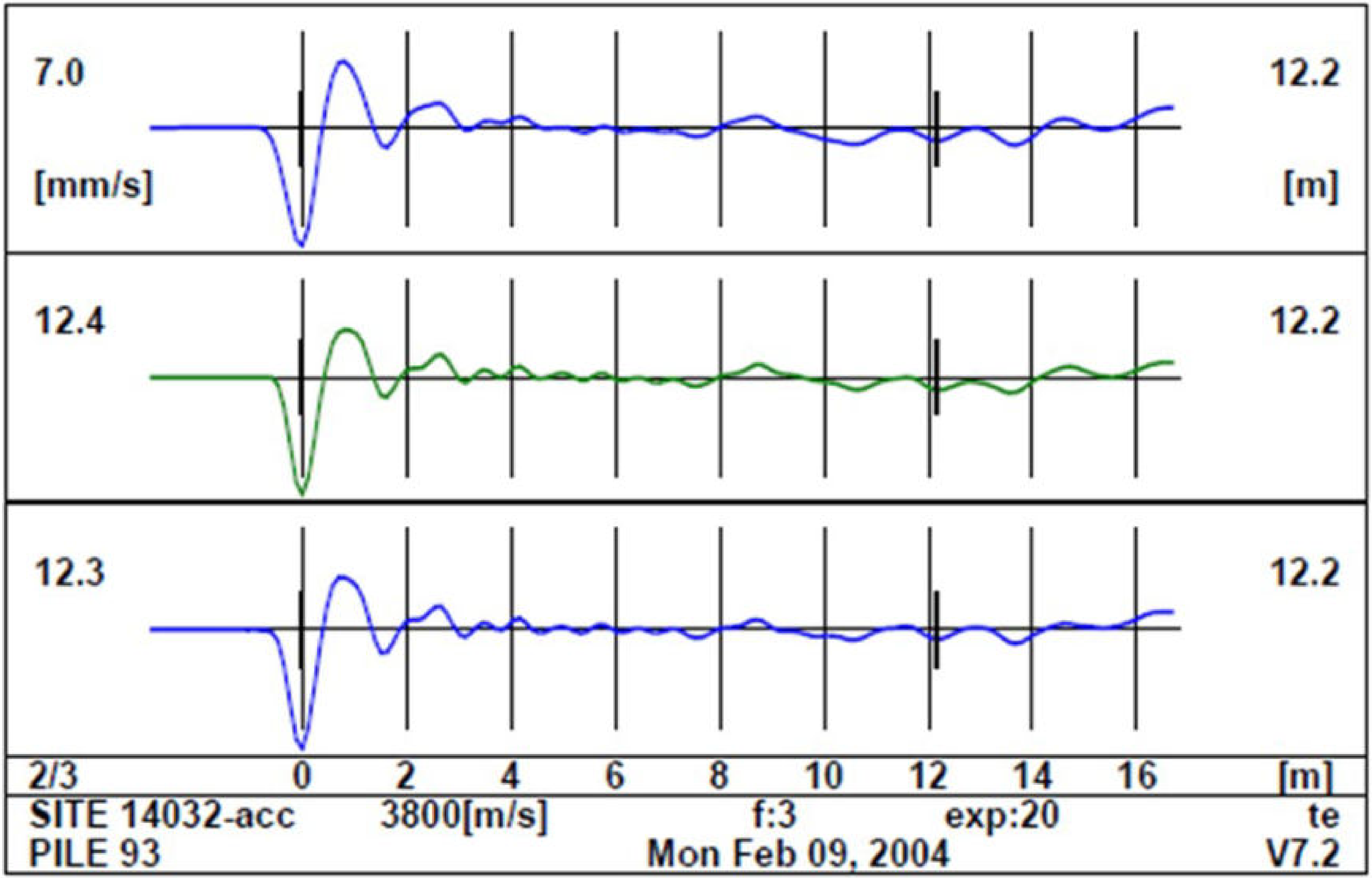


Figure 6.6. Class 6. No clear toe reflection

Possible cause, large friction, deviating material properties at pile toe

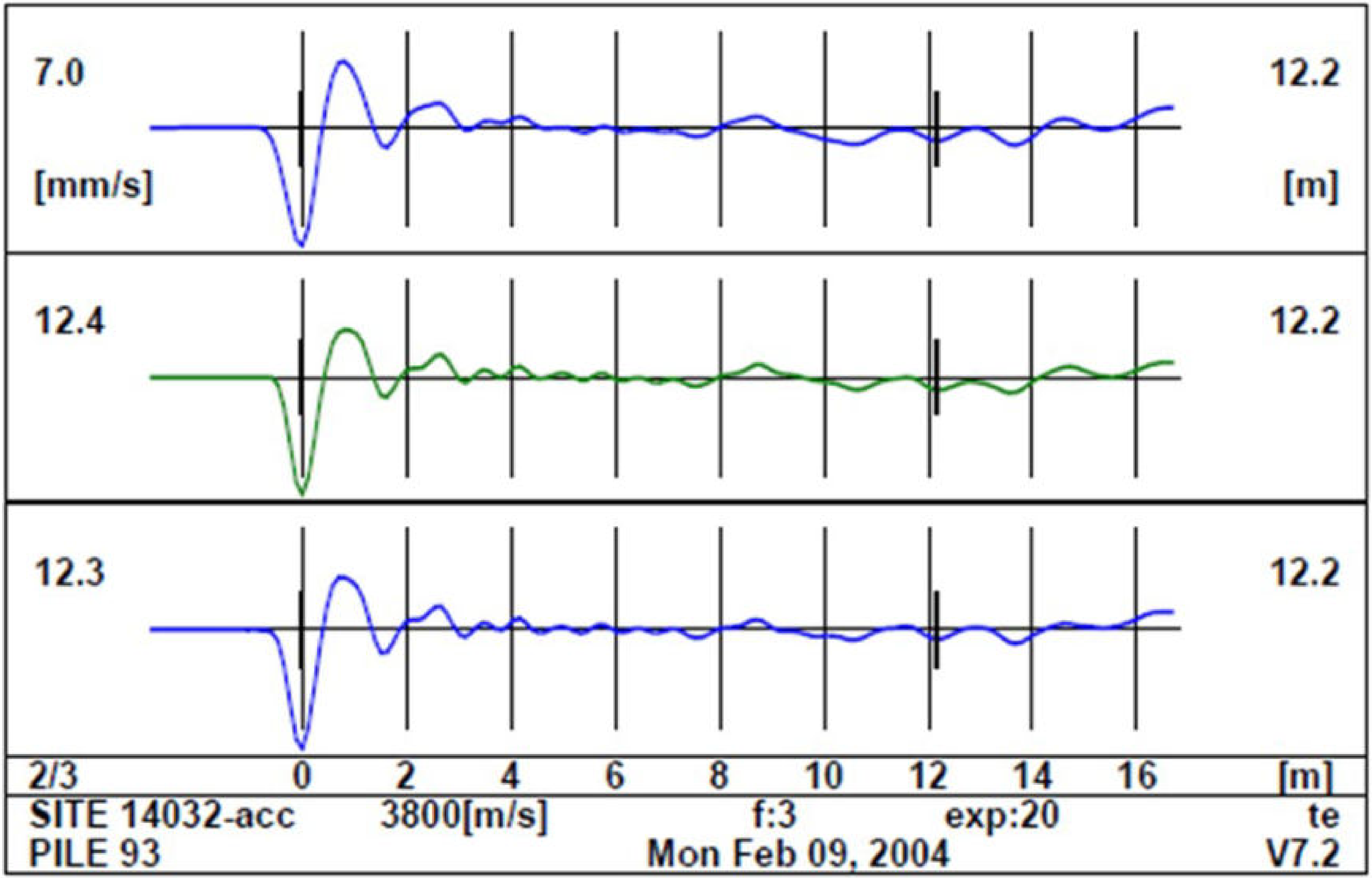


Figure 6.6. Class 6. No clear toe reflection
Possible cause, large friction, deviating material properties at pile toe

A) Magnification Delay (MD)

Energy loss due to soil resistance, pile non-uniformities and / or pile maetrial damping reduce reflections from lower pile portion.

As a compensation for this signal reduction as amplification, exponentially increase with time, is applied : MD.

A) Magnification Delay (MD)

The MD defines the time when exponential magnification of the signal with time should be applied to the pile. **The default value of 20% of the total pile length works well in most situations.**

This should only be modified when the free standing length of the pile is more than 20% of its total length.

This situation might occur only for marine piles.

The change in **<u>MD value beyond 20% of pile length is a most common abuse of data</u>**.

defect diminishes and the defective pile incorrectly appears acceptable due to the inappropriate change in MD value.

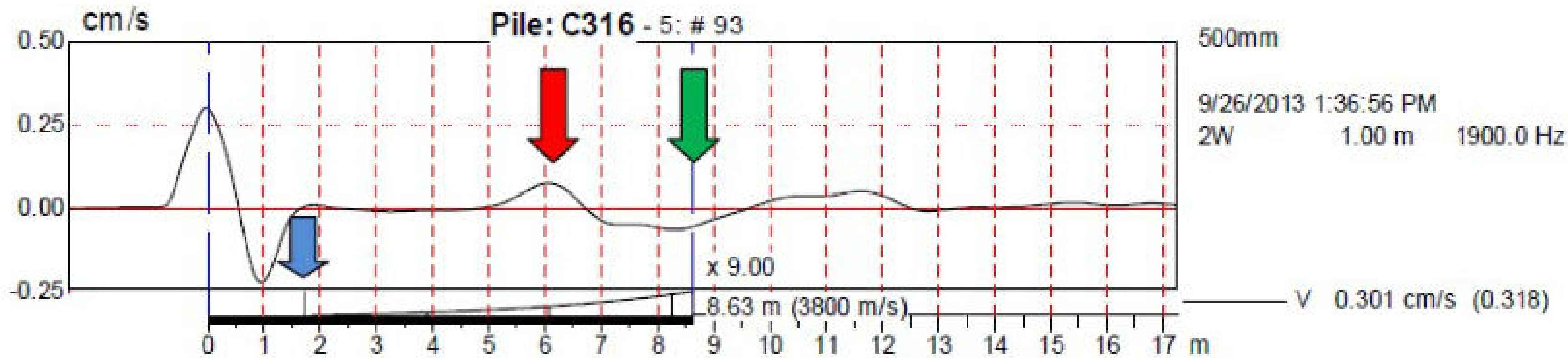


Figure 7 Appropriate MD – Defective Pile

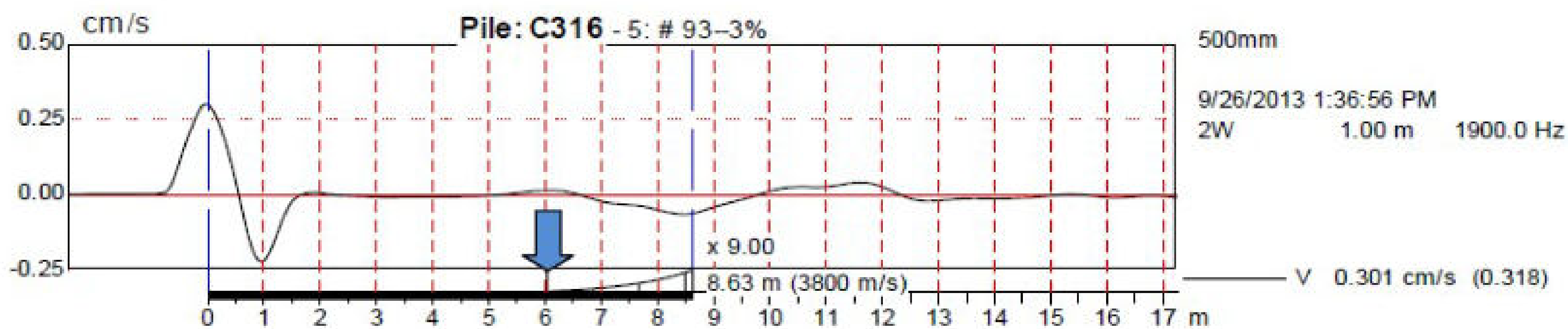


Figure 8 Inappropriate MD – Defective Pile appears OK

Refer to **Figure 7** which shows the data with **proper magnification delay (blue arrow)** and where a defect is apparent (**red arrow**) prior to the expected time of reflection from the pile toe (**green arrow**). However, for the same data, if a **later magnification delay (blue arrow in Figure 8)** is applied, then the defect **diminishes and the defective pile incorrectly appears acceptable due to the inappropriate change in MD value.**

B) Magnification (MA)

A similar MA value should be used for **similar length piles of similar diameter**.

An **MA value equal to its pile length (in meters) is many times a good starting solution**,

although higher values may be needed for piles in strong soils.

Using *very low MA values may mask* apparent defects for questionable piles.

B) Magnification (MA)

In general, if **there is no apparent reflection from the pile toe,**

either the **pile is defective** (as in Figure: 7), or

pile preparation has been inadequate, or

the magnification value is too small, or

the shaft is relatively long and of a sufficiently non-uniform character (e.g. generally with a relatively large bulge) *and the data should be classified as "inconclusive".*

C) Filters

The **Hi Pass Filter (HI)** is used to **eliminate low frequency** drifts in the data.

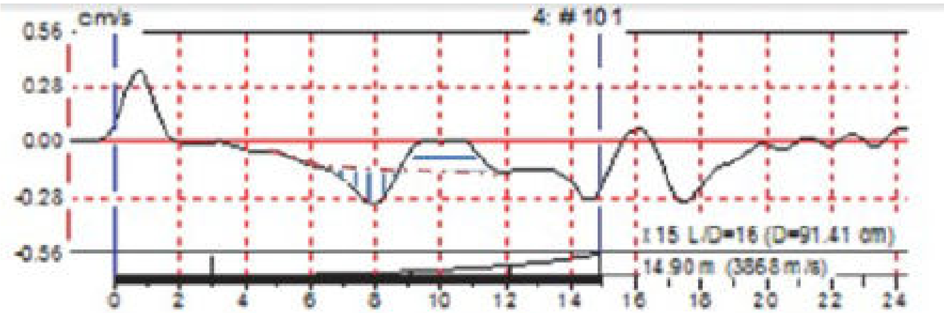
HI is normally **either zero** (indicating no filter is used) or a value which is at **least 20 times the input pulse width.**

Using a **very low HI value between 1 to 30 distorts** the data and the interpretation. Use of LO Pass filters is discouraged;

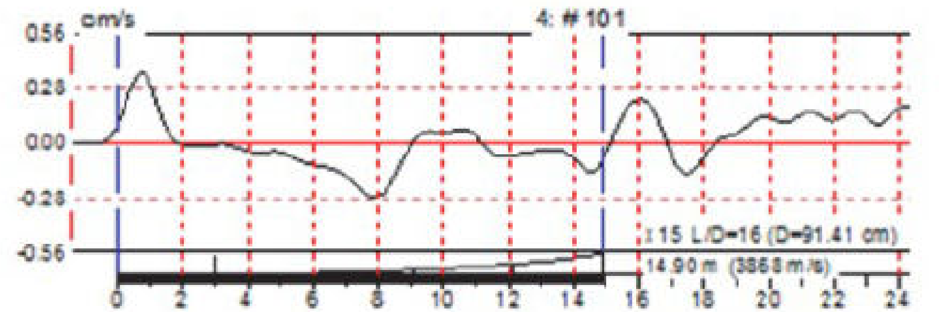
Wavelet (of a value between 1 or 2) is recommended to remove the very high frequency content (generally caused by Raleigh surface waves or short protruding reinforcement).

Long protruding reinforcement (certainly 3 m or more) often results in a low frequency noise of about the same frequency as the input pulse width (1 to 2 m) and makes the data unusable; such long reinforcement should be removed prior to testing.

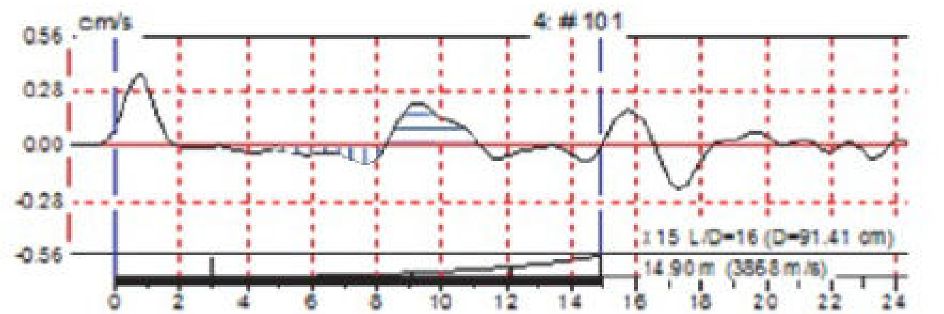
Improper HI Filter



(a)



(b)



(c)

- Without HI

- HI=200m wave length
- frequency = 20Hz

- HI=15m , frequency=250Hz
- ***Remove record components of more than 15m wave length, incorrect data***

Foundation length accuracy is dependent on wave speed accuracy. On low strain tests, like those performed with the PIT and the Acoustic Concrete Tester, **wave speeds for good quality concrete vary between 3500 m/s and 4500 m/s.**

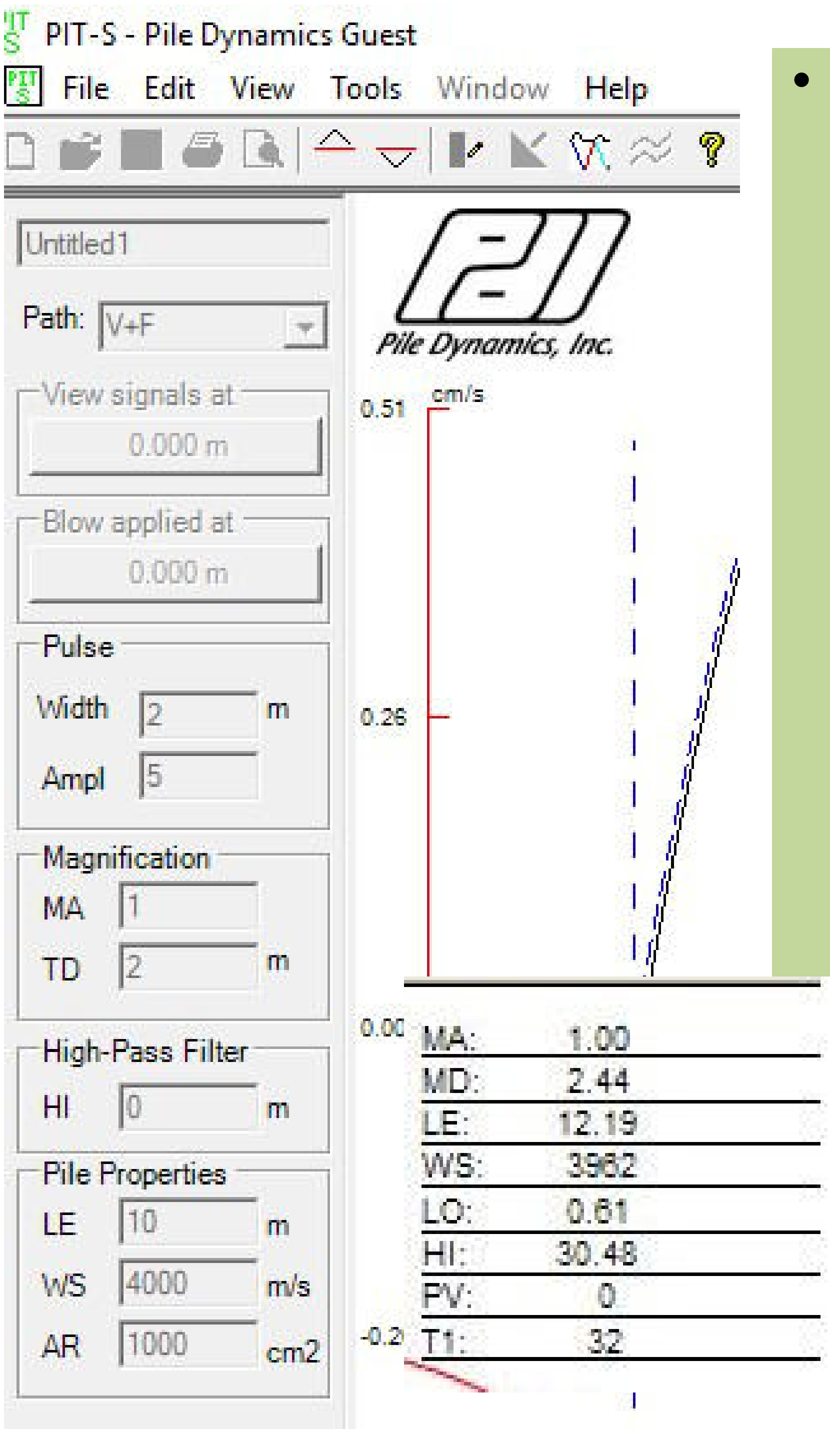
*When using an **average wave speed of 4000 m/s** , there is a possibility of reaching a maximum variation of **+/- 12.5%.***

Pile Concrete Strength, Mpa	20	25	30	35
Adopted Wave Velocity, C m/s	3400	3500	3600	3700

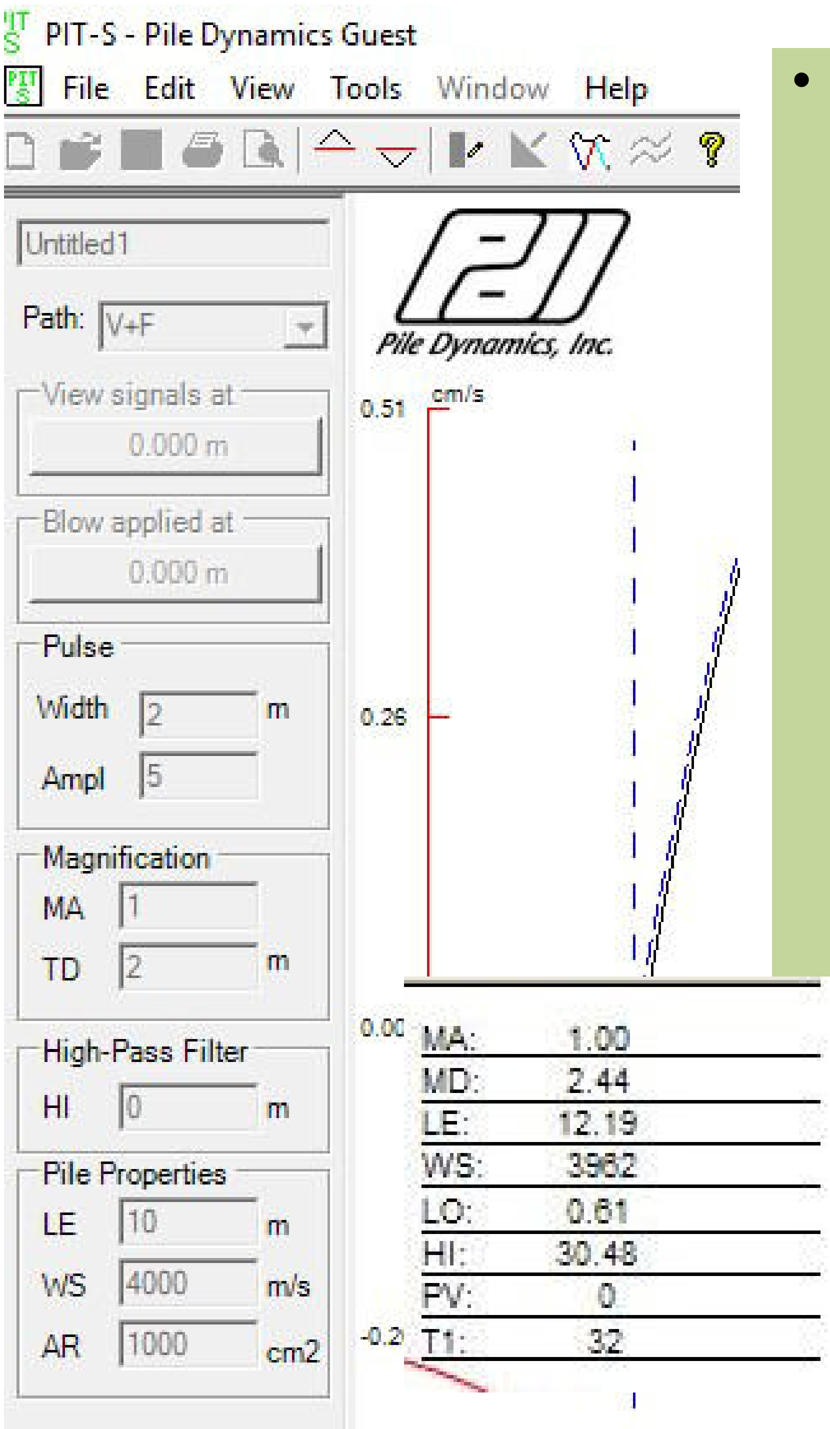
c = Sqrt (E/ ρ)

- **With what certainty can pile lengths be determined by PIT?**
- The accuracy of the determined length is as accurate as the accuracy of an **assumed wave speed**. This is because TIME is being measured. TIME = 2L/c, where **L** is length and **c** is wave speed. The **TIME equation makes L vary directly with c.**
- An **engineer can determine the wave speed within an accuracy of 15%**, and likely within 10%, based on concrete strength.
- Furthermore, ***<u>if a pile with known length has a clear reflection from the toe, the wave speed can be determined.</u>***
- An engineer, with moderate confidence, can use the same wave speed on other piles at the same site if the concrete is consistent.

- ***Wavelet = 1-2 m***
- ***MD = 20% of Pile Length***
- ***MA = Pile Length, m***
- ***Hi Pass Filter = 0***
- ***Use of LO Pass filters is discouraged***
- ***Soil Data***

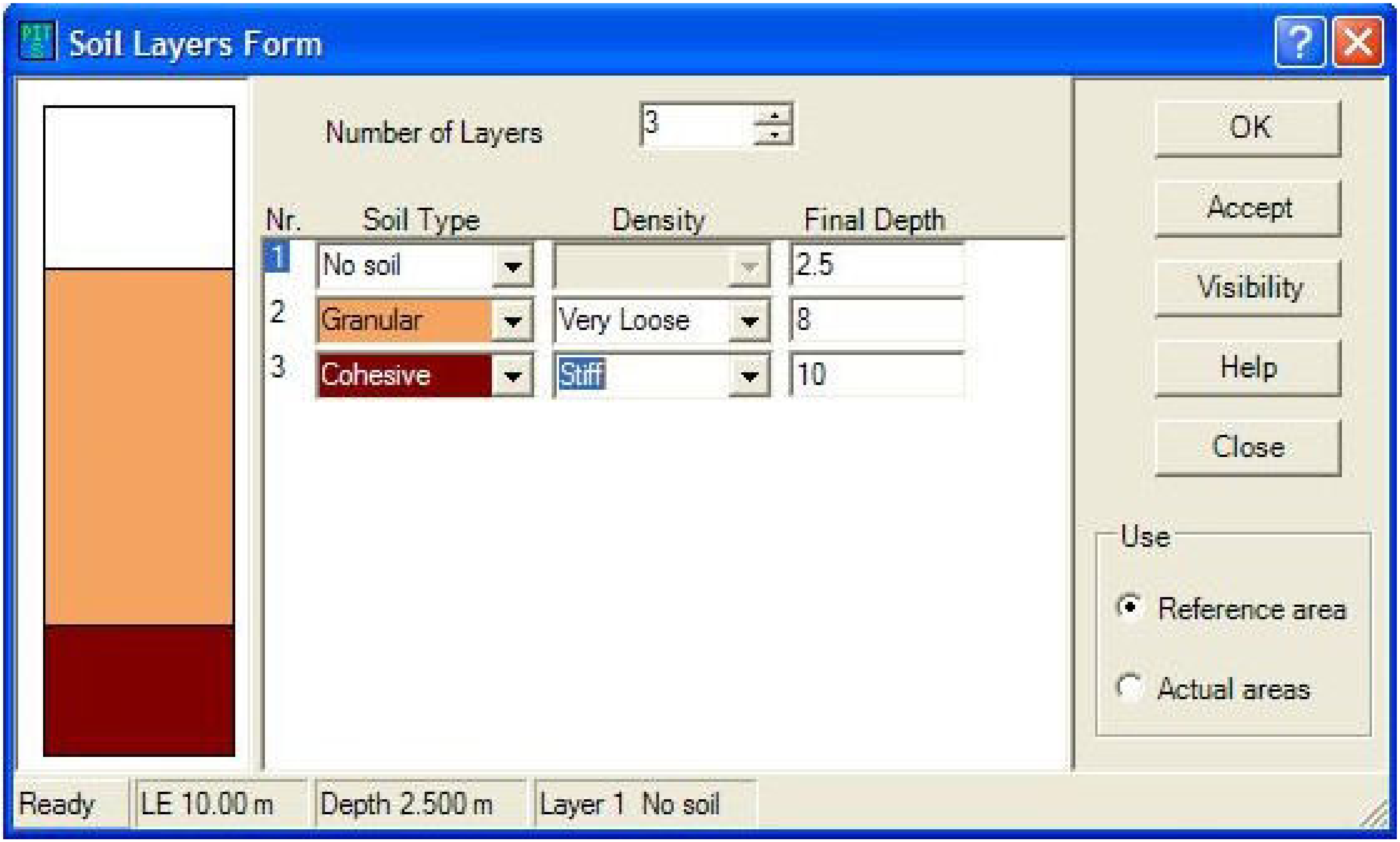


- Input parameters:
  - Pulse width
  - Pulse amplitude
  - Exponential magnification of displayed velocity (MA)
  - Starting point of exponential magnification (TD)
  - Cut-off frequency of high-pass filter (HI), expressed as length (Cutoff frequency=WS/(2*HI))
  - Length (LE)
  - Wave Speed (WS)
  - Top Area (AR)
  - **Cross section area along the pile length - the pile is divided** in elements with lengths of approximately 125 mm (SI units) or 0.5 ft (English units), and the area of each element can be changed individually or in groups. Areas on a selected region can be changed so that the region is shaped as a rectangle, triangle, trapezoid or circumference.



- Input parameters:
  - **Reference Area - the default value is the top area (AR);** changing this value will change the percentage area variations.
  - **Soil resistance along pile shaft and at toe - the soil is divided in the same number of elements as the pile**, plus one additional element for the toe. The resistance of each element can be changed individually or in groups. Furthermore, a soil layers distribution can be entered, with different soil types and densities; the program will automatically estimate the resistances accordingly.
  - **Quakes of soil elements** along the shaft and at the toe
  - **Dampings of soil elements along the shaft and at the toe;** the value is automatically changed according to soil type if a layers distribution is entered

Soil Layers



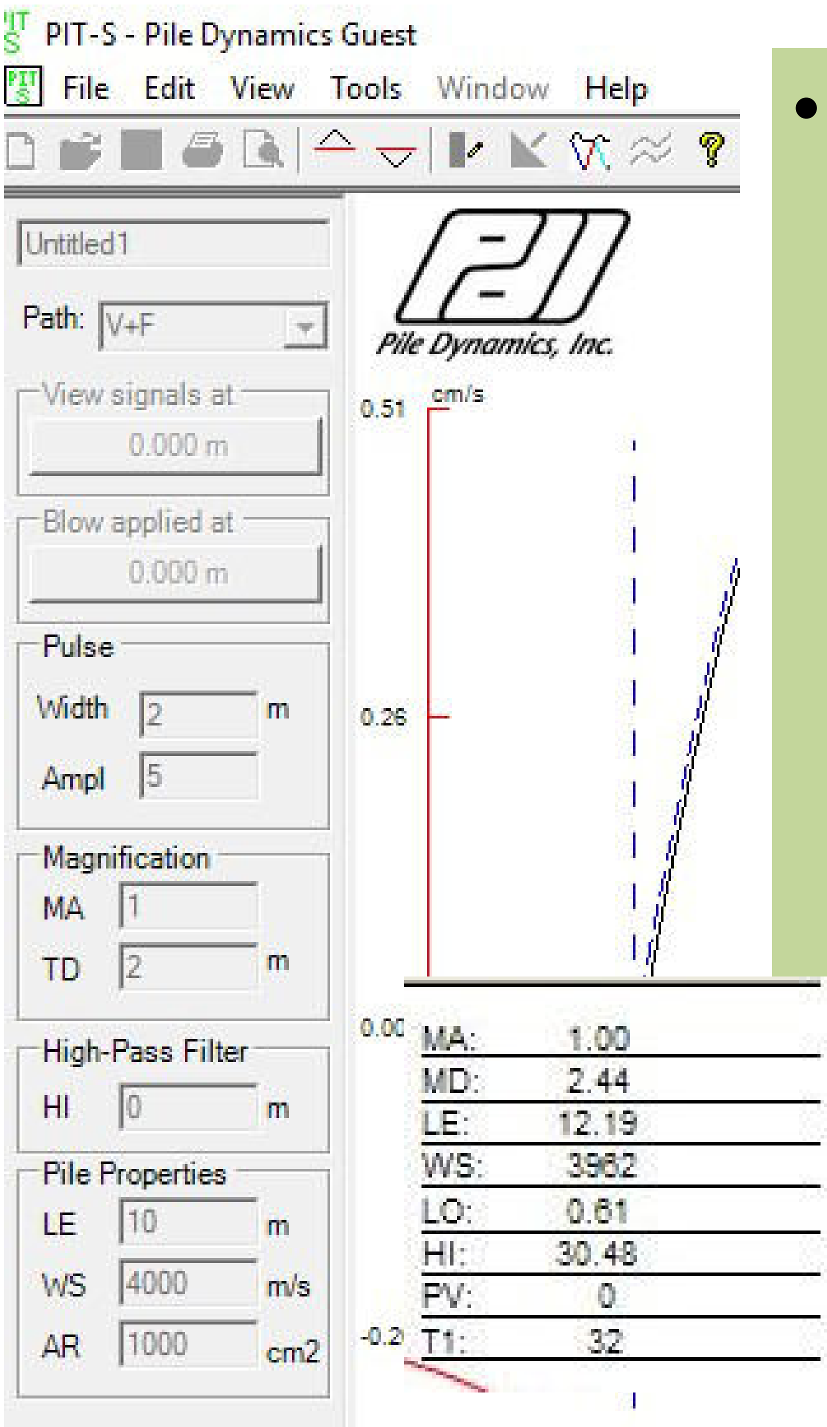
Soil Layers Form
Number of Layers
3
Nr.
Soil Type
Density
Final Depth
1
No soil
2.5
2
Granular
Very Loose
8
3
Cohesive
Stiff
10
OK
Accept
Visibility
Help
Close
Use
Reference area
Actual areas
Ready
LE 10.00 m
Depth 2.500 m
Layer 1 No soil

Placement of Transducers—The **motion sensor should be placed at or near the pile head** using a suitable, or temporary, **thin layer of bonding material (that is, wax, vaseline, putty etc.)** so that it is assured that it correctly measures the axial pile motion (transducer axis of sensitivity aligned with the pile axis).

The motion sensor is placed generally near the center of the pile.

Additional locations(min.2) should be considered for piles with diameters greater than 500 mm.

The low strain impact should be applied to the pile head within a distance of 300 mm from the motion sensor.



- Outputs (as a function of time):
  - **Acceleration (ACC)**
  - **Velocity only (VEL)**
  - **Force and Velocity (F+V - default)**
  - **Displacement (DIS)**
  - **Velocity at top and at another view location along the pile (V+V)**

D) Integrity Testing Report Formats

integrity test report should clearly specify

1. Piles that are **acceptable**.
2. Piles that show **major defects** and are not acceptable
3. Piles that show **minor defects and maybe acceptable after review of** loads, **additional** tests etc.
4. Piles that are **inconclusive due to bulges, high soil resistances etc.**

- Category A—Clear indication of a sound pile shaft;
- Category B—Clear indication of a serious defect;
- Category C—Indication of a possibly defective pile shaft; and
- Category D—Inconclusive data.

❑ **Shafts with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted.**

❑ **Where no clear toe reflection is apparent, the experienced test engineer shall state to which shaft depth the test appears to be conclusive.**

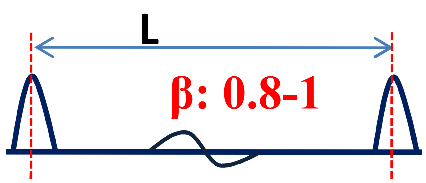
❑ **Where reflections from locations with significant reductions in pile area or pile material strength or stiffness above the pile toe are observed, the pile has a serious defect.**

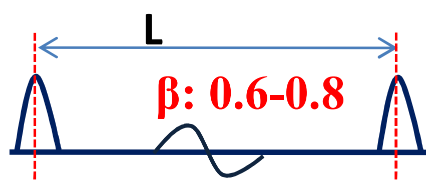
❑ **If the record is complex, the results may be deemed inconclusive. : GO for Another Test**

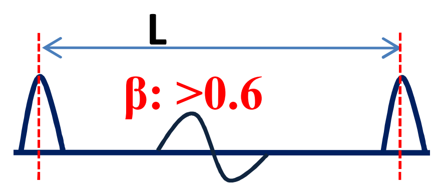
The intensity of the defect is quantified in terms of the parameter β defined as Z1/Z2. Following classification of defects could be made based on the value of β (Rausche & Goble, 1979).

$Z = A\sqrt{(E.\rho)}$ or $=EA/c$

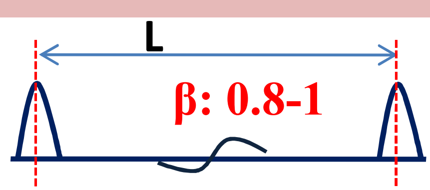
β=Z1/Z2	Damage assessment (Rausche & Goble, 1979).
1.0	Uniform
0.8 – 1.0	Slight damage
0.6– 0.8	Damage
0.6<	Pile with a major discontinuity

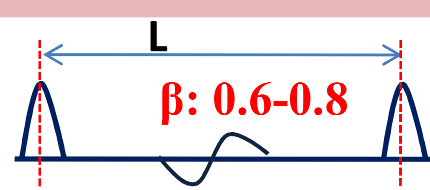


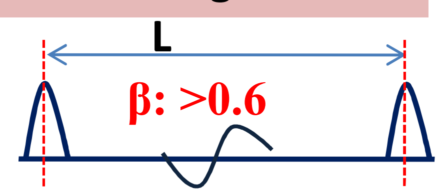




Local : Small Defect Medium Defect Large Defect







Bulge : Small Medium Large

Pile with impendence change in between -10 to -25 % are considered to have serious defects and need further evaluation by the Geotechnical expert and designer.

Piles with impedance change **greater than -25%** shall be automatically rejected.

- ***If difference in Construct Area and Minimum Profile (X-Section Area) % <10% : OK***

- ***If difference in Construct Area and Minimum Profile (X-Section Area) % >10 - 25% : Serious Defect, details to be verified***

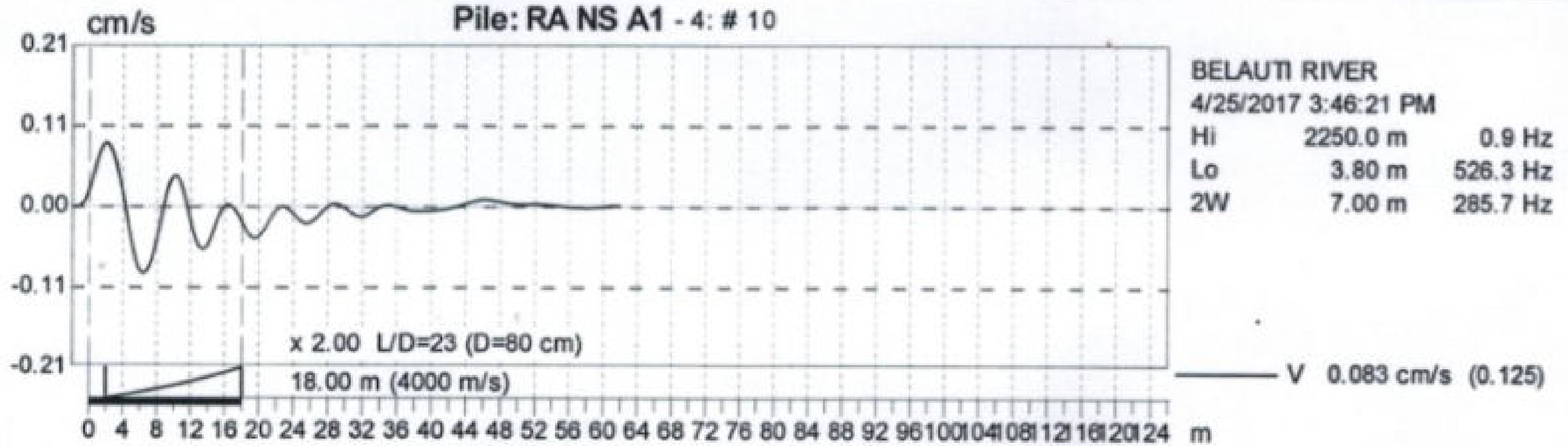
- ***If difference in Construct Area and Minimum Profile (X-Section Area) % >25% : Rejection of Pile***

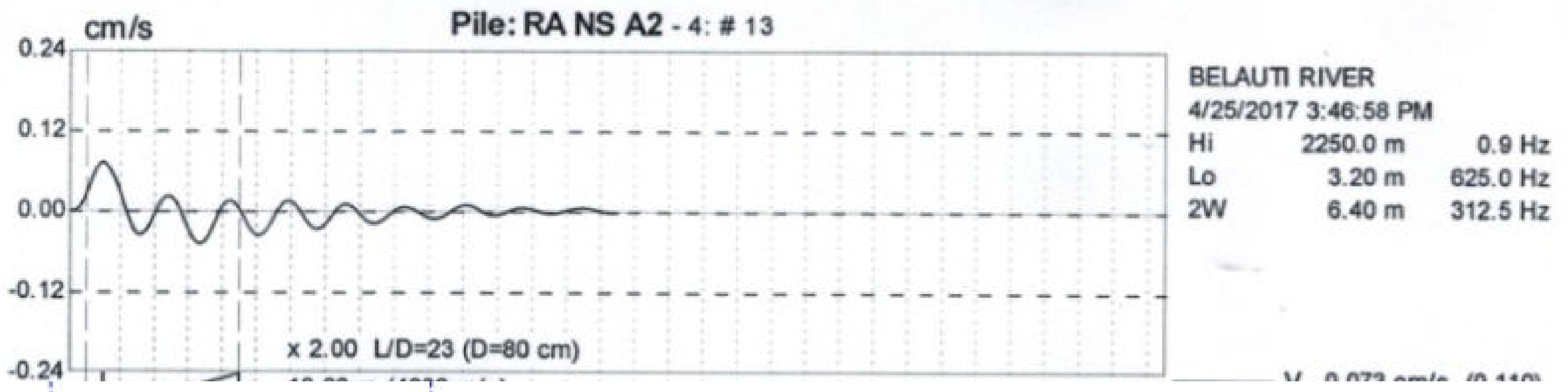
Though X-section of entire pile is ok but ,

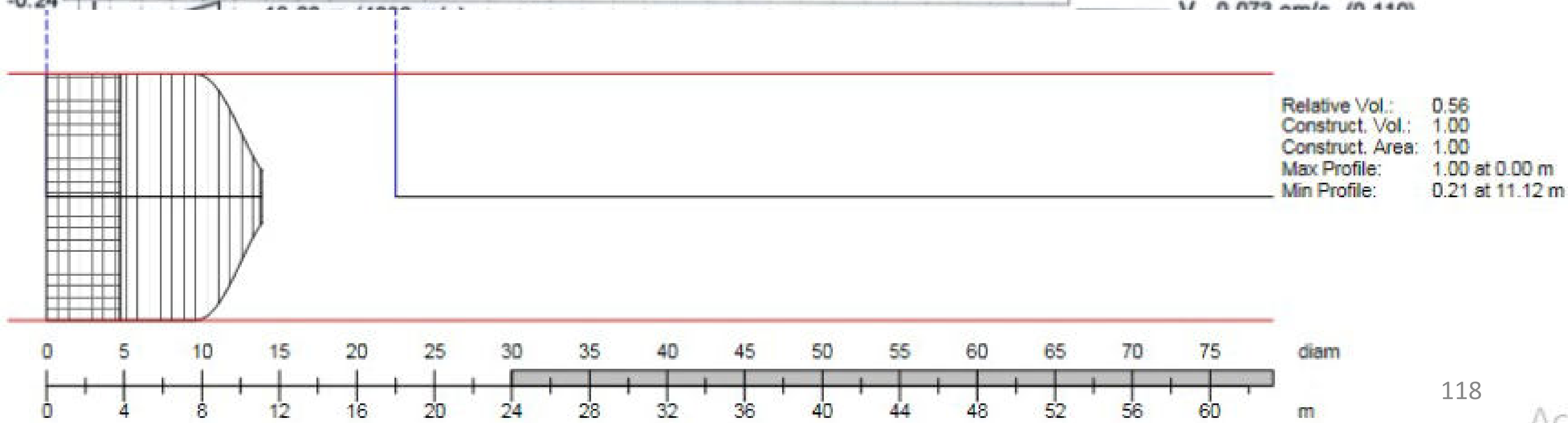
- ***If Impendence change % <10% : OK***

- ***If Impendence change % >10 - 25% : Serious Defect, details to be verified***

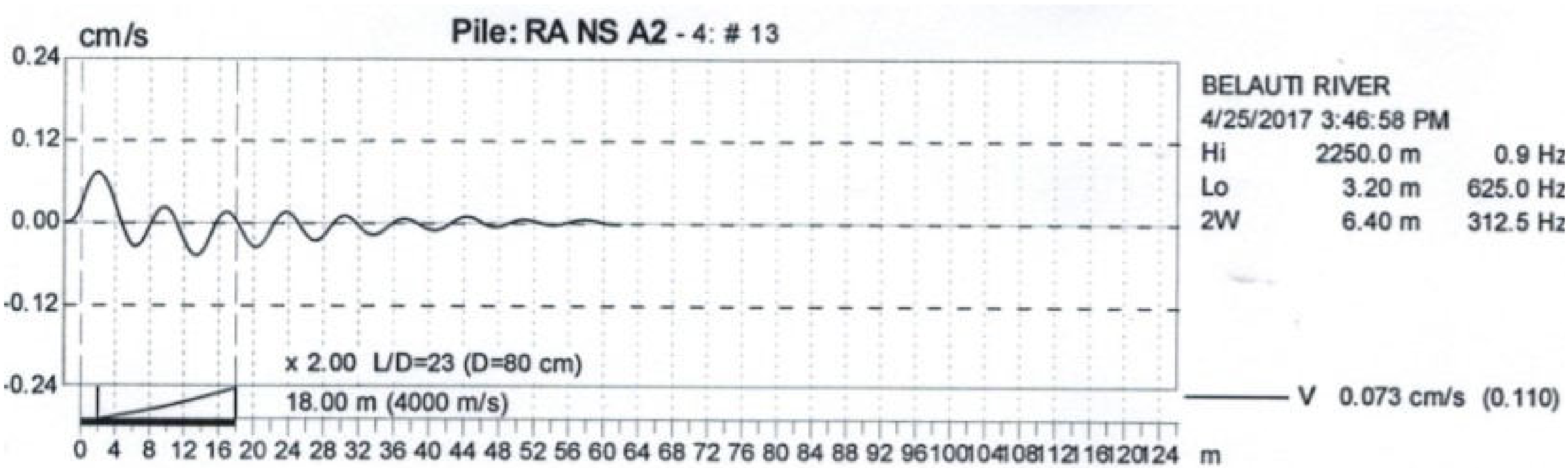
- ***If Impendence change % >25% : Rejection of Pile***

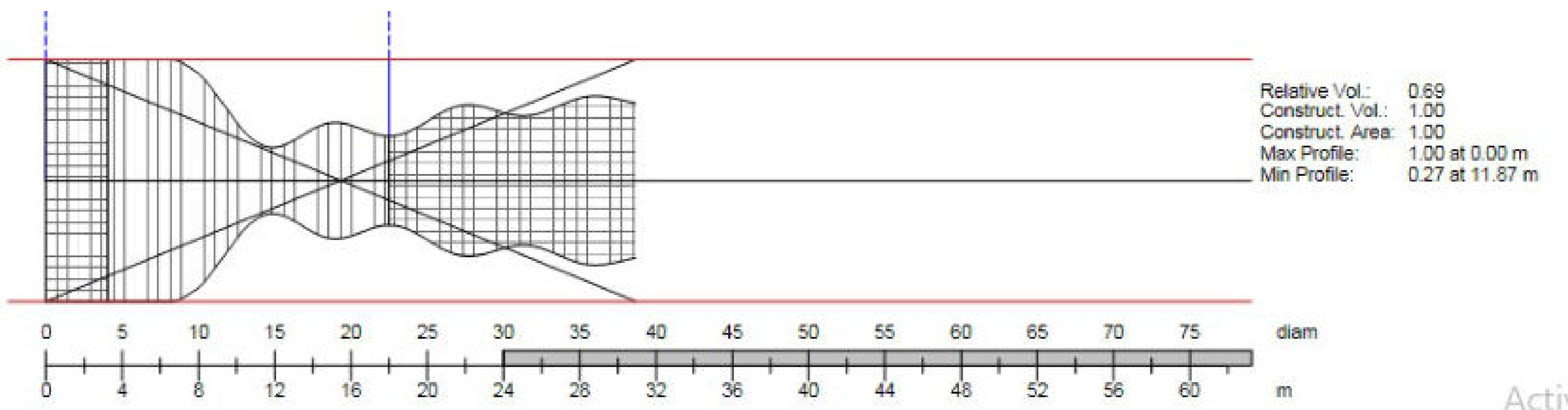

Pile: RA NS A1 - 4: # 10
cm/s
0.21
0.11
0.00
-0.11
-0.21
x 2.00 L/D=23 (D=80 cm)
18.00 m (4000 m/s)
BELAUTI RIVER
4/25/2017 3:46:21 PM
Hi 2250.0 m 0.9 Hz
Lo 3.80 m 526.3 Hz
2W 7.00 m 285.7 Hz
V 0.083 cm/s (0.125)
m

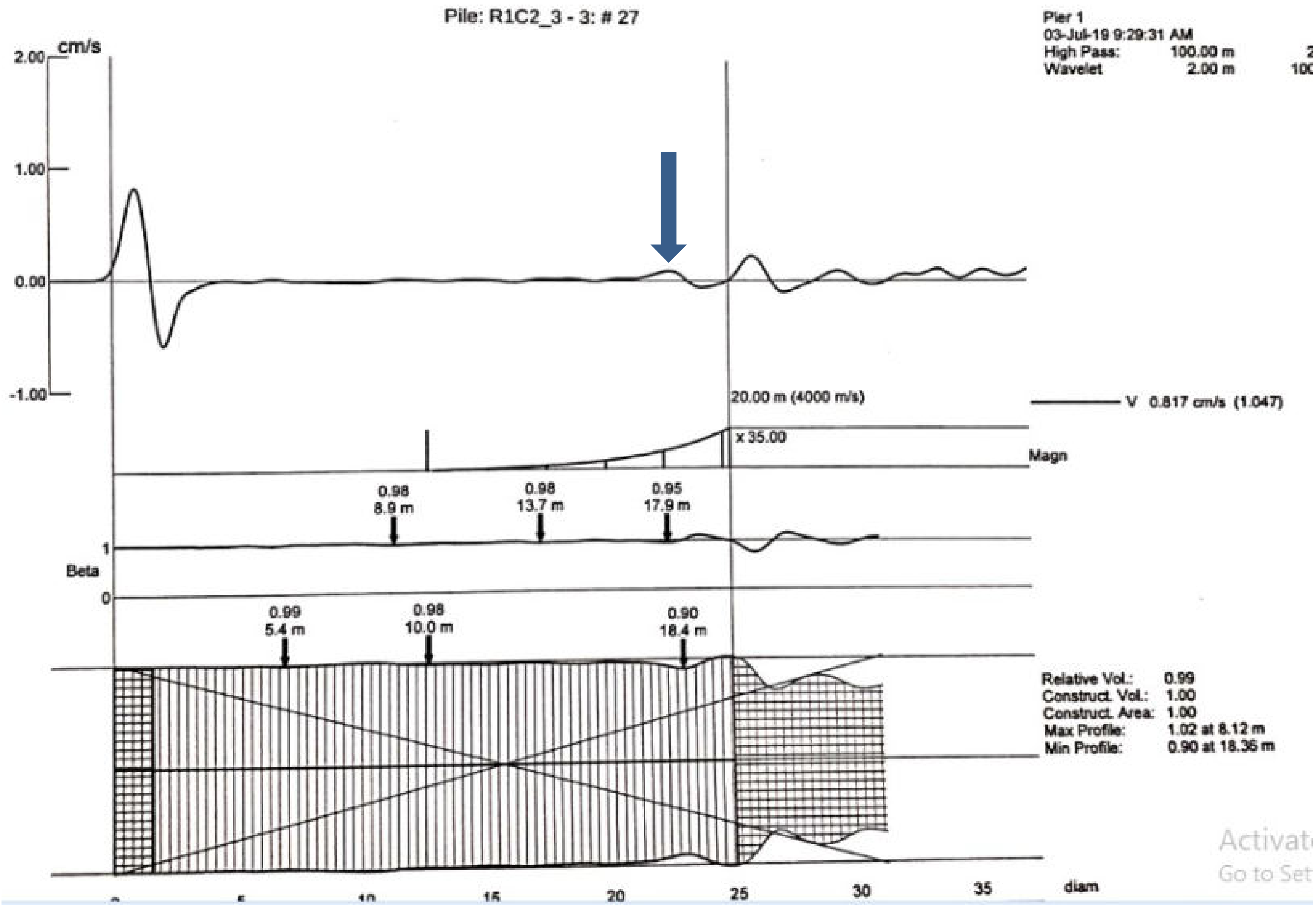

Pile: RA NS A2 - 4: # 13
cm/s
0.24
0.12
0.00
-0.12
-0.24
x 2.00 L/D=23 (D=80 cm)
BELAUTI RIVER
4/25/2017 3:46:58 PM
Hi 2250.0 m 0.9 Hz
Lo 3.20 m 625.0 Hz
2W 6.40 m 312.5 Hz

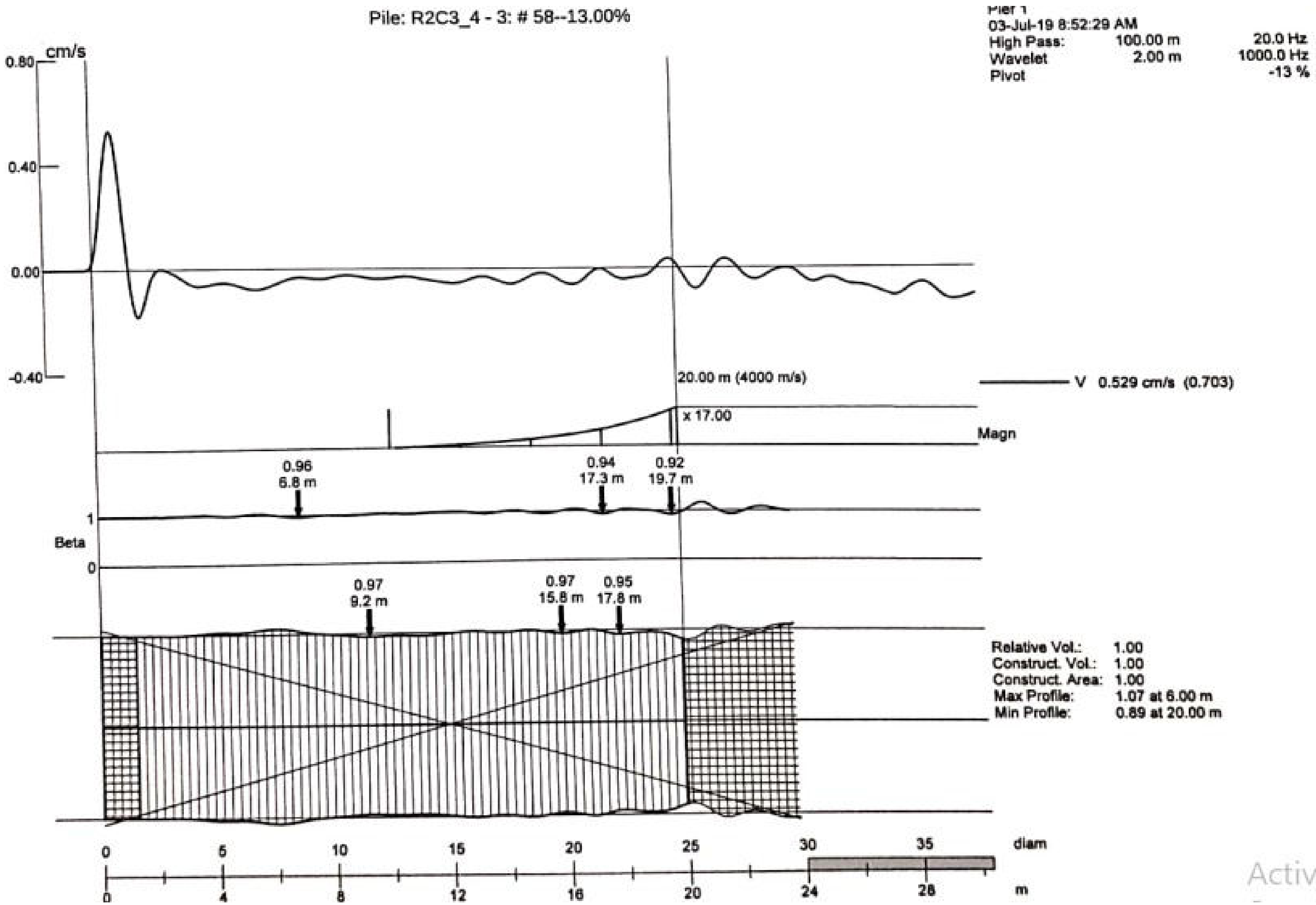

Relative Vol.: 0.56
Construct. Vol.: 1.00
Construct. Area: 1.00
Max Profile: 1.00 at 0.00 m
Min Profile: 0.21 at 11.12 m
diam
m

Real case


cm/s
Pile: RA NS A2 - 4: # 13
0.24
0.12
0.00
-0.12
-0.24
BELAUTI RIVER
4/25/2017 3:46:58 PM
Hi 2250.0 m 0.9 Hz
Lo 3.20 m 625.0 Hz
2W 6.40 m 312.5 Hz
x 2.00 L/D=23 (D=80 cm)
18.00 m (4000 m/s)
V 0.073 cm/s (0.110)
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84 88 92 96 100 104 108 112 116 120 124 m


Relative Vol.: 0.69
Construct. Vol.: 1.00
Construct. Area: 1.00
Max Profile: 1.00 at 0.00 m
Min Profile: 0.27 at 11.87 m
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 diam
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 m


Pile: R1C2_3 - 3: # 27
Pier 1
03-Jul-19 9:29:31 AM
High Pass: 100.00 m
Wavelet 2.00 m
cm/s
2.00
1.00
0.00
-1.00
20.00 m (4000 m/s)
V 0.817 cm/s (1.047)
x 35.00
Magn
0.98
8.9 m
0.98
13.7 m
0.95
17.9 m
Beta
1
0
0.99
5.4 m
0.98
10.0 m
0.90
18.4 m
Relative Vol.: 0.99
Construct. Vol.: 1.00
Construct. Area: 1.00
Max Profile: 1.02 at 8.12 m
Min Profile: 0.90 at 18.36 m
20
25
30
35
diam



Pile: R2C3_4 - 3: # 58--13.00%
Pier 1
03-Jul-19 8:52:29 AM
High Pass: 100.00 m 20.0 Hz
Wavelet 2.00 m 1000.0 Hz
Pivot -13 %
cm/s
0.80
0.40
0.00
-0.40
20.00 m (4000 m/s)
V 0.529 cm/s (0.703)
x 17.00
Magn
0.96 6.8 m
0.94 17.3 m
0.92 19.7 m
1
Beta
0
0.97 9.2 m
0.97 15.8 m
0.95 17.8 m
Relative Vol.: 1.00
Construct. Vol.: 1.00
Construct. Area: 1.00
Max Profile: 1.07 at 6.00 m
Min Profile: 0.89 at 20.00 m
0 5 10 15 20 25 30 35 diam
0 4 8 12 16 20 24 28 m

Be Aware with Such report

3.3 Acceptance and Rejection of Piles

Shafts with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted. Where reflections from locations with significant reductions in pile area or pile material strength or stiffness above the pile toe are observed, the pile has a serious defect. Construction records (concrete usage, grout pressure records, soil borings) may be valuable in result interpretations or additional numerical analysis modeling may be used to quantify the record. The decision to reject and replace, or repair, any defective Pile is the responsibility of the Client in accordance with standards norms.

4.0 Summary and Results

- Pile Integrity Test (PIT) of 16 piles on Pier 1 of Jallad Khola were performed.
- The results obtained from PIT tests are satisfactory from Profile Analysis and Beta Analysis.
- Detail results of individual piles of PIT tests are presented on Appendix of this report. It is recommended to correlate the results with standard norms.

Limitations of Piles Integrity Tests:

i) The present experience of NDT of piles is upto diameter of 1500 mm.

ii) This is applicable to cast in situ concrete bored and driven piles. The test cannot be conducted after provision / casting of pile cap.

iii) This method is not suitable for piles surrounded by water as it may not give correct results.

iv) It does not provide information regarding verticality or displacement (in position) of the piles.

v) Local loss of cover, small intrusions or type of conditions at the base of piles are undetectable.

Contractor ______________________ Pile type and method ______________

Site ____

Working drawing no. ______________ cased excavation ________ ☐
unsupported excavation ________ ☐

1 Pile data

a) Diameter ________ m
b) External casing diameter ________ m
c) Cutting shoe diameter ________ m
d) Boring tool diameter ________ m
e) Excavation under water ________ ☐

e) Aggregate (maximum size) ________

f) Water cement ratio W/C = ________
W = weight of water C = weight of cement

g) Concrete admixtures ________
% of cement weight ________

h) Retarding admixtures ________
Workability time ________

2 Reinforcement

Drawing no. ________

a) Placement of the reinforcement cage
- before concrete placement ________ ☐
- subsequent to concrete placement ________ ☐

b) Spacers ________ ☐
- type ________
- qty./longitudinal intervals ____ / ____ m

3 Concrete

a) Nominal strength: C ________
Consistency: S/F/superplasticized ________

b) Ready-mixed concrete ________ ☐
Site mixed concrete ________ ☐

c) Cement type (Supplier) ________

d) Cement content ________ kg/m³

4 Concrete placement

a) Submerged conditions ________ ☐
Dry conditions ________ ☐

b) Method of placement
- tremie pipe ∅ ________ m ☐
- pumping hose ∅ ________ m ☐
- different placing method ________ ☐
- description ________

c) Cleaning of pile base ________

d) Measures for separating concrete from water at commencement of placement ________

5 Comments/ observations ________________________

Bored pile no.		Compression pile	☐
		Tension pile	☐
		Rake	

☐ Mark as appropriate

1 Ground strata

m below working level	m above principal datum	Ground description	Groundwater	Boring tool casing from .... to .... m
	±0	working level ∇		

Scale 1 :

2 Times of execution

1	2	3	4	5
Process	Ambient temperature °C	Times from	to	Date
Excavation				
Chiselling				
Interruption				

3 Pile data

a) Depth measurement after excavation

____________ m below working level

b) Chiselling: from

____________ m to ____________ m

c) Deviation of position at working level

Axis: __:____ cm Axis: __:____ cm

4 Stabilizing fluid actual values

	Unit	Before concreting	After concreting
Density	g/cm^3		
Marsh val.	sec		
Fluid loss	cm^3		
Sand cont.	%		
Alkalinity	pH		

Fluid level above bottom level of

guide wall/lead-in tube __________ m

above Groundwater __________ m

5 Reinforcement

Deviations from drawing no. __________

Deviations along length __________

Modifications __________

6 Concrete

Special events __________

7 Concrete placement

Fluid level inside the bore at start of placement above bottom level of guide wall/lead-in tube

__________ m

Concrete consumption

Theoretical ______ m^3 actual ____ m^3

8 Comments/observations

Deviations from general data __________

9 Signatures/date

Foreman/superintendent __________

Contractor's representative

B.7 Checklist for Bored Pile Construction.

Description	YES	NO	NA
1.Has the contractor submitted bored pile installation method, sequence of works & QC, etc, to show compliance with the specification and design drawings?			
2.Has the bored pile installation Method Statement been checked & approval ?			
3.Does the Contractor have an approved concrete mix design that can meet the requirement specified?			
4.Has the contractor run the required Tail Mix and slump loss test for the concrete mix design up to maximum estimated concreting time for each bored pile?			
5.If conceting is estimated to take than 2 hours, has the Contractor perfomed a satisfactory slump loss test for the extened time period?			
6.If the contractor proposed a blended bentonite or polymer slurry, do they have an approved slurry Management plan/method statement to meet all the QC equirements {pH value, density, sand content & viscosity} Specified?			
7.Is the Contractor's technician qualified to log, to describe subsoll strata ?			
8.Has the Contractor carried out dilaidation survey to meet the safety & protection requirements dor the nearby structure/utilities as specified?			
9.Has the site clearing & platform preparation been completed and ready for bored pile installation?			
10.Does the Contractor have all the equipment and tools proposed in the method statement and mobilized to the site for inspection?			

Reinforcement Cage Placement			
39. Is the rebar the correct sizes and configured in accordance with the project design drawings?			
40. Is the rebar properly tied to ensure rigidity and stiffness as required without excessive deformation during handling ?			
41. Does the Contractor have fixed the proper and adequate spacers for the reinforcement cage to ensure the reinforcement cage is centralized in the hole?			
42. Does the Contractor have an approved method for centering & supporting the reinforcement cage configuration?			
43. If the reinforcement cage was spliced/coupled, was it done in accordance with the specification?			
44. Is the reinforcement cage secured from settling and from floating (during concrete placement the cage sometimes rises with the placement of the concrete)?			
45. Is the top of the steel cage at the proper elevation in accordance with the specification?			
Concreting Operations			
46. Prior to concrete placement, has the slurry been tested in accordance with the specification to check quality?			
47. If required, was the temporary casing removed in accordance with the specification?			
48. Was the discharge end of the tremie pipe maintained in the concrete mass with proper concrete head above it?			

Thanks