GROUND INVESTIGATION FOR HS2

Nick Sartain, Lead Geotechnical Engineer, HS2

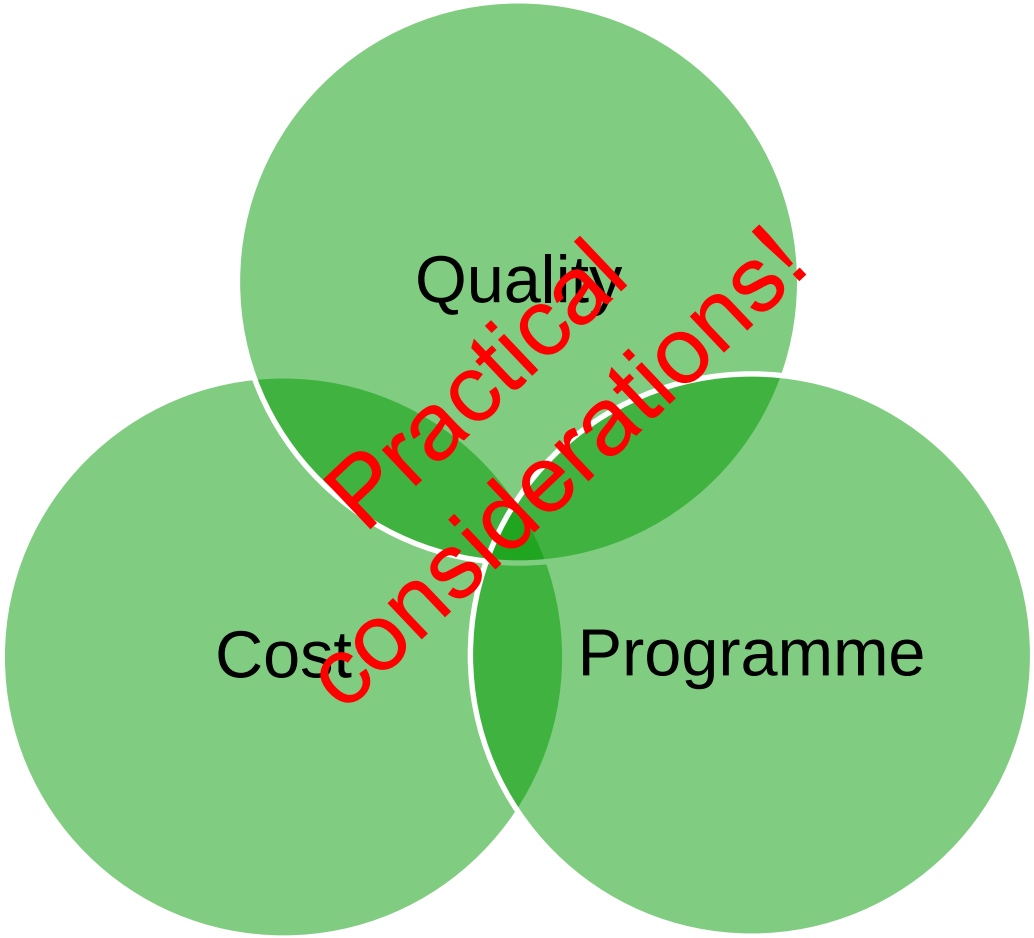
nick.Sartain@hs2.org.uk

INTRODUCTION

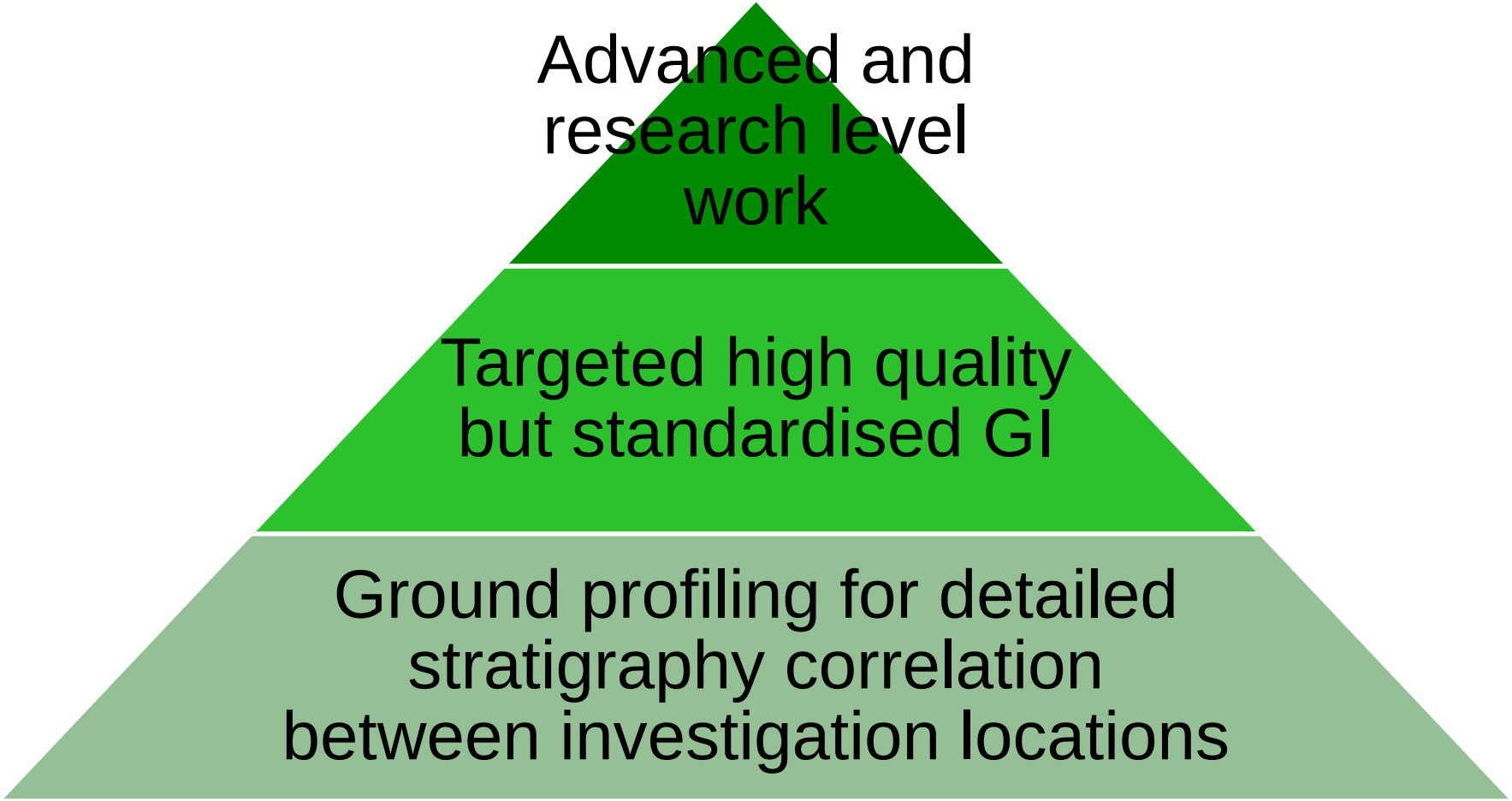

To Carlisle and Scotland
To Newcastle
Leeds
Manchester Piccadilly
Manchester Airport High Speed station
Sheffield
East Midlands Hub
Birmingham Curzon Street
Birmingham Interchange
Old Oak Common
London Euston

HS2 ROUTE

DRIVERS OF DESIGN



STRATEGY


Advanced and research level work
Targeted high quality but standardised GI
Ground profiling for detailed stratigraphy correlation between investigation locations

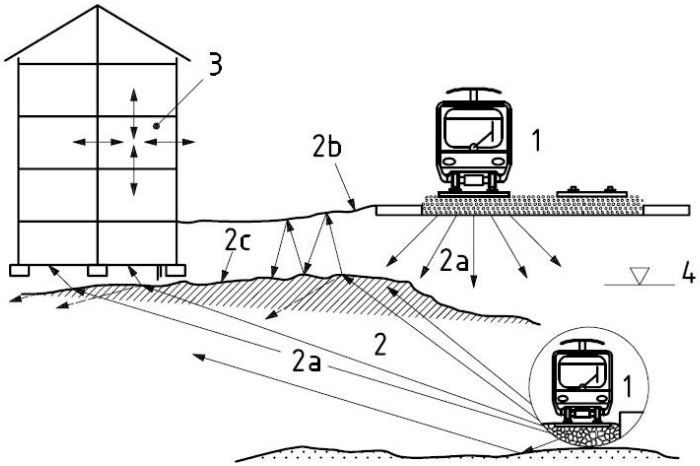
TECHNICAL TOPICS – SMALL STRAIN PARAMETERS

Various design requirements

- Noise & vibration
- Geodynamics
- Advanced analyses

Various possible solutions:

- Crosshole seismic
- Downhole seismic
- Seismic cones
- Small strain laboratory testing
- MASW
- CSW



Key

1 source
2 propagation:
2 a body waves (compression, shear)
2 b surface waves (e.g. Rayleigh, Love)
2 c interface waves (e.g. Stoneley)
3 receiver (vibration, re-radiated noise)
4 water table

NOTE The components of the system comprising source, propagation and receiver are interdependent.

Figure 1 — Example of source, propagation and receiver system

Ref BS ISO 14937-1

TECHNICAL TOPICS – LINE OF ROUTE

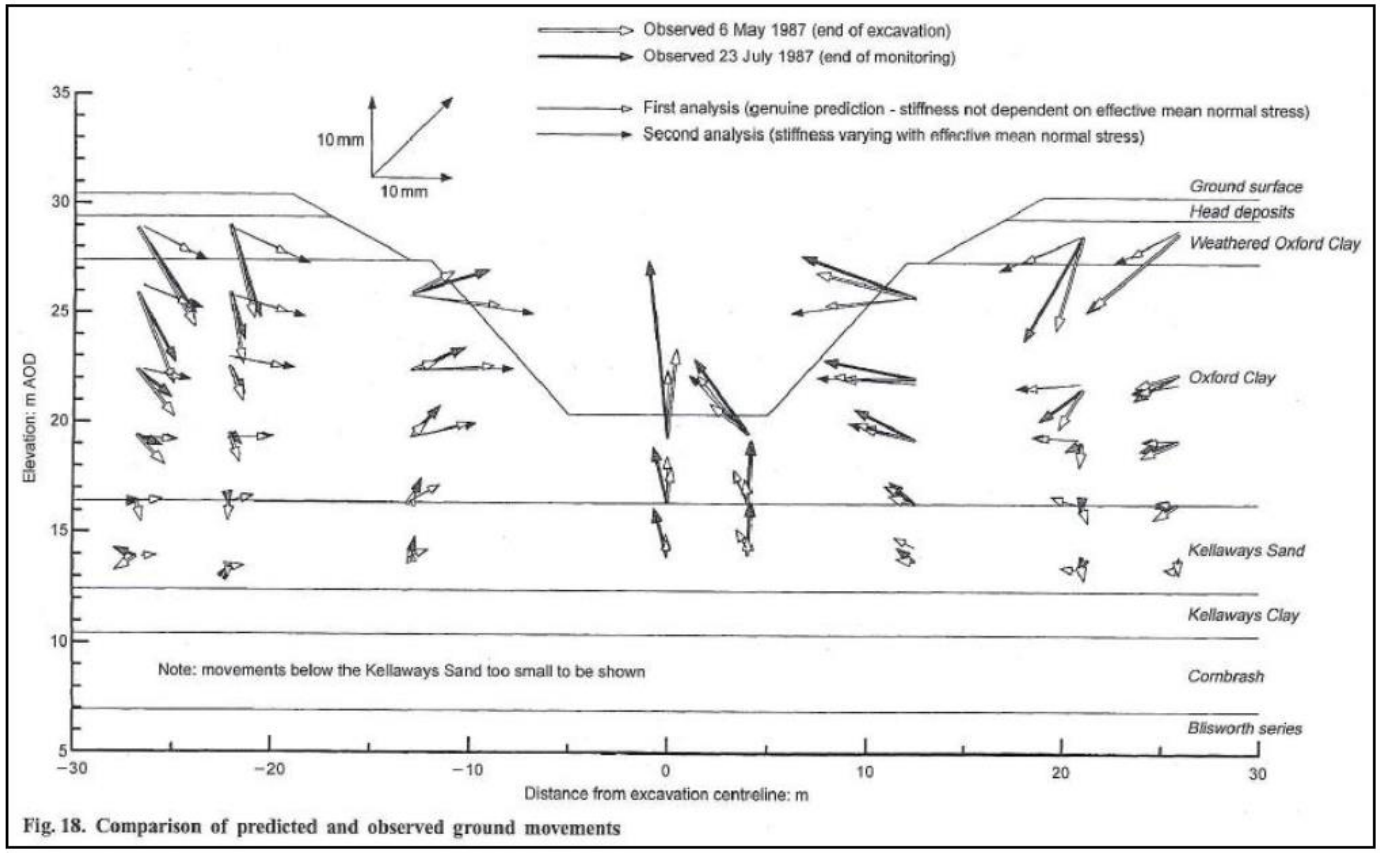


Fig. 18. Comparison of predicted and observed ground movements

From Hird CC and Pierpoint ND, 1997, Geotechnique 47, No 3, 665-691

TECHNICAL TOPICS – LINE OF ROUTE

Parameter	Symbol	Description	In-situ tests for derivation	In-situ tests for derivation
Stiffness	G_0	Shear modulus at very small strains	Crosshole Seismic, Downhole Seismic, Suspension Logging, Seismic Cone, Seismic Dilatometer	Bender element Resonant column
	G_{50}	Secant stiffness at 50% yield strain		Stress path testing – Anisotropically consolidated undrained triaxial extension with local strain measurements Compression with unload-reload loop
	E_{ur}	Elastic unloading/reloading stiffness	Self Boring Pressuremeter, High Pressure Dilatometer, Cone Pressuremeter	
	E_{oed}	Tangent stiffness		Oedometer
	$\gamma_{0.7}$	Shear strain at which $G_{sec} = 0.722G_0$.	Self Boring Pressuremeter, High Pressure Dilatometer, Cone Pressuremeter	Bender element Resonant column
Strength	ϕ'	Effective friction angle		Anisotropically consolidated undrained triaxial
	c'	Drained cohesion		Anisotropically consolidated undrained triaxial
Stress history	K_0	In situ coefficient of earth pressure (or stress ratio)	Self Boring Pressuremeter, Seismic Dilatometer	High Pressure Oedometer
Permeability	k_h, k_v	Permeability	Variable head tests, Self Boring Permeameter, Pumping Test, Self Boring Pressuremeter, CPTu (piezocone)	Rowe Cell – simulation of stress history and stress state Oedometer Advanced triaxial tests

TECHNICAL TOPICS – LOGGING

Use of Formation Experts:

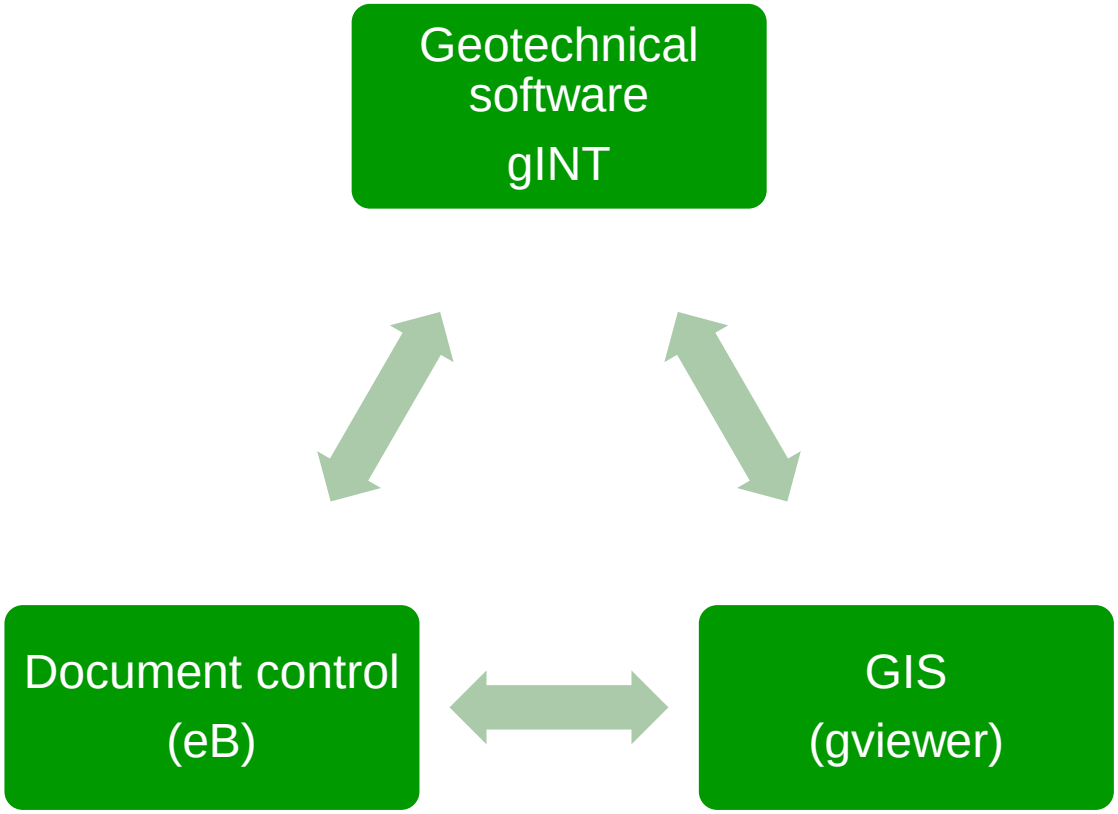
- Consistency
- Opportunities for learning
- Good feedback so far

Identification of geo-hazards

- Glacial effects
- Geomorphological clues

There is no substitute for having high quality people on site

TECHNICAL TOPICS - DATA



GI is the first step towards creating a digital environment

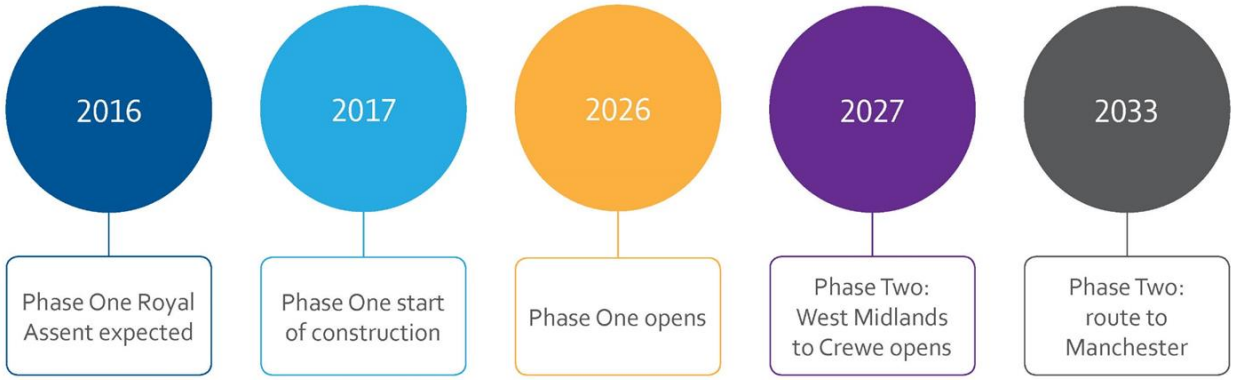
LOOK TO THE FUTURE

More detail

New geology

New technical topics

- Karst
- Mine workings
- Contaminated land
- Landfill
- Urban GI
- Remote monitoring



LOOK TO THE FUTURE

CONCLUSION