APPLICATION OF
THE OBSERVATIONAL METHOD
AT KINGS PLACE
LONDON
OM at Kings Place

- The decision making process for construction of the 16m deep basement
- Applying the observational method
- Outcomes and lessons learnt
The Project Team

• Client - Parabola Land (Peter Millican)
• Main Contractor - Sir Robert McAlpine
• Engineer - Arup Newcastle
# Ground conditions

## Made ground

- **Made ground**
- **London Clay**
- **Lambeth Group**

## basement

<table>
<thead>
<tr>
<th>Depth</th>
<th>Layer Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0m</td>
<td>Made ground</td>
</tr>
<tr>
<td>1.2m</td>
<td>London Clay</td>
</tr>
<tr>
<td>3.0m</td>
<td>Lambeth Group</td>
</tr>
<tr>
<td>5.0m</td>
<td>Made ground</td>
</tr>
<tr>
<td>15.0m</td>
<td>London Clay</td>
</tr>
<tr>
<td>25.0m</td>
<td>Lambeth Group</td>
</tr>
</tbody>
</table>

## Made ground

- **BASEMENT**

## London Clay

- **from 17.0m to 17.05m:** clayey sand
- **at 19.05m:** organic remains of plant rosettes

## Lambeth Group

- **at 23.05m:** heavy stiff clayey brown
- **at 25.05m:** becoming blue grey modified brown

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Sir Robert McAlpine
Design Group
16m deep basement construction

Original scheme
1.2m secant wall
• 2 levels of props
• 240 bearing piles
• 1.5m thick raft

Alternative scheme
• 1.0m diaphragm wall
• 1 level of props
• 1.0 to 1.5m raft slab
Decision process
Capping beam/prop analysis
Analyses

- Demonstrate that the proposal works
  - By hand
  - 2D analyses - Wallap
  - 3D analyses - FLAC
FLAC3D 2.10

Step 9096  Model Perspective
16:56:17 Tue Jan 18 2005

Center:  
X: 4.800e+001  Y: 4.500e+001  Z: -9.125e+000

Rotation:  
X: 30.000  Y: 0.000  Z: 40.000

Dist: 3.388e+002  Mag.: 1.95  Ang.: 22.500

Block Model: Mechanical

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Design Group, Knutsford

Week 21
FLAC3D 2.10

Step 9096  Model Perspective
16:56:52 Tue Jan 18 2005

Center:  Rotation:
X: 4.800e+001  X: 30.000
Y: 4.500e+001  Y: 0.000
Z: -9.125e+000  Z: 40.000
Dist: 3.388e+002  Mag.: 1.95
Ang.: 22.500

Block Model: Mechanical

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Week 23
FLAC3D 2.10

Step 9096 Model Perspective
10:35:45 Mon Jan 24 2005

Center:
X: 4.800e+001
Y: 4.500e+001
Z: -9.125e+000
Dist: 3.388e+002

Rotation:
X: 30.000
Y: 0.000
Z: 40.000
Mag.: 1.95
Ang.: 22.500

Sir Robert McAlpine Ltd
Design Group, Knutsford
FLAC3D 2.10
Step 9096 Model Perspective
10:36:16 Mon Jan 24 2005

Center: X: 4.800e+001 Y: 4.500e+001 Z: -9.125e+000
Rotation: X: 30.000 Y: 0.000 Z: 40.000
Dist: 3.388e+002 Mag.: 1.95 Ang.: 22.500

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Displaced shape and contours of displacement magnitude at 4.5 years

E = 800Cu/1600Cu
Maximum Displacement = 27.6mm

E = 600Cu/1200Cu
Maximum Displacement = 33.1mm

E = 400Cu/800Cu
Maximum Displacement = 42.0mm
Prop failure?

With slab and prop
-0.009/+0.019

Without slab and prop
-0.122/+0.040

Contour interval = 0.020
Monitoring considerations

- Limit criteria for adjacent property
- Primary monitoring system
- Trigger level definition
- System accuracy
- Contingency measures
- Frequency of readings
- Secondary monitoring system
- Key personnel
- Data dissemination

0  Hairline cracks of less than about 0.1 mm which are classed as negligible. No action required.

1  Fine cracks which can be treated easily using normal decoration. Damage generally restricted to internal wall finishes; cracks rarely visible in external brickwork. Typical crack widths up to 1 mm.
Monitoring equipment

Primary monitoring
• Inclinometers
• Prisms
• Strain gauges
• Survey points
• Piezometers
• Tilt meters

Secondary system
• Reflector targets
• Prisms
• Survey points

Wish list
• Extensometers
Wall monitoring locations
Contingency propping

- Each wall panel would have to be propped
- Adequate wall reinforcement was provided
- Couplers would be required slab reinforcement
Full depth excavation of east wall
East wall displacement
South wall displacement
Inclinometer results

East wall

West wall
Inclinometer results

North wall

South wall
Prop loads
Comparative outcome
Prop removal
Lessons learned

General
• Minimising damage to adjacent property is the critical issue
• Real data informs the whole process
• Calculations must be ‘honest’
• Corners are stiff
• Excavation sequences can be used positively
• Data volumes need to be manageable

Kings Place specific
• High strain response due to relatively flexible wall
• Vertical movements on retained side less than predicted