Hiriya Landfill Slope Failure (1997)

Temporarily.

Waste Mass Slippage
Hiriya Landfill Slope Failure (1997)

Progressive Failure Crack
MSW Strength - Method 3 Based on Back-calculation

BACK-CALCULATED MSW PEAK SHEAR STRENGTH FOR SECTION AA:

\[ \phi = 33 \]
\[ C = 167 \text{ psf} \]

Circular Shear Surface
Back Calculated Shear Strength
Hiriya LF- wet, decomposed MSW

(MODIFIED FROM SINGH & MURPHY (1990))

"Because of the scatter and scarcity of data, it is difficult to draw any definitive conclusions on the shear strength characteristics of sanitary landfill material."

<table>
<thead>
<tr>
<th>COHESION IN PSF</th>
<th>FRICTION ANGLE IN DEGREES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>40</td>
</tr>
<tr>
<td>1500</td>
<td>36</td>
</tr>
<tr>
<td>1000</td>
<td>32</td>
</tr>
<tr>
<td>500</td>
<td>28</td>
</tr>
</tbody>
</table>

- **LABORATORY SHEAR TESTS (1971-1987)**
- **VANE SHEAR OR SPT-TEST (1988)**

Hiriya, 2002
Modified Traditional Approach:
“What is the Goal of Your Bioreactor?”

1. Increased waste density - (measurable ±15%)
   - Increased moisture content
   - Compression, settlement
   - Ravelling (particle re-orientation)
   - Decomposition of organics

2. Change in waste shear strength - ?
   - Density increase vs. decomposition
   - Pore pressures (liquid build-up)
   - Preferential shear surfaces
In-Place Density Factors

\( \gamma_{\text{wet}} = \text{actual in place density} \)

- Increases with overburden pressure
- " with compactive effort
- " with soil daily cover
- " with time and settlement
- " with moisture content addition

Cumulative effects significant

~40% to >70%

1000 pcy waste will increase to 1400 - 1700 pcy
Example calculation

Initial Condition:
\[ \gamma_{\text{wet}} = 1000 \text{ pcy} @ w=25\% \text{ (250# water/cy)} \]

Alternative Daily Cover (intermediate cover soil only)

Moisture Addition:

To achieve \( w=40\% \Rightarrow 250\# \text{ water/cy} \) (30 gal)

New \( \gamma_{\text{wet}} = 1250 \text{ pcy} \) (assumes no by-pass)

Settlement (compression) + Decomposition = 20%

New \( \gamma_{\text{wet}} = (1250 \text{ pcy})/(0.80) = 1562 \text{ pcy} \)

Net Density Increase = \( (1562-1000)/(1000) \Rightarrow 56.2\% \)