

# Review of Past Failures of Trench Excavations

Ir Y S Au-Yeung

## Studies on Excavation Failures in HK

- “Review of Collapses & Excessive Deformation of Excavations” (GEO, 1992)
- “QRA of Collapses & Excessive Displacements of Deep Excavations” (Ove Arup & Partners, 1999)
- “A Study on Past Failures of Trench Excavations” (GEO, 2001)

## 1992 Review of Deep Excavations

31 cases of collapses or excessive displacements associated with **deep excavations** between 1980 and 1991

## QRA Study of Deep Excavations (1999)

- Based on GEO records of geotechnical checking of **deep excavations** between 1980 and 1999. (about 1800 cases)
- Based on failure cases known to GEO
- QRA framework adopted

## Sheetpile Failure at Yun Ping Road



## Sheetpile Failure at Yun Ping Road



### Sheetpile Failure at Yun Ping Road

10m long pavement subsided



### Sheetpile Failure at Yun Ping Road

Fence wall and ground floor slab of adjacent building collapsed



### Ground Subsidence at Mau Lam Street

Footing foundation of the adjacent building undermined



No fatality was recorded for those deep excavation failures reviewed

### However !

- Between 1986 and 2000, there were 15 known failure cases associated with trench excavations, resulting in 10 deaths.
- This triggered a study of past failures of trench excavations.



## The GEO Study

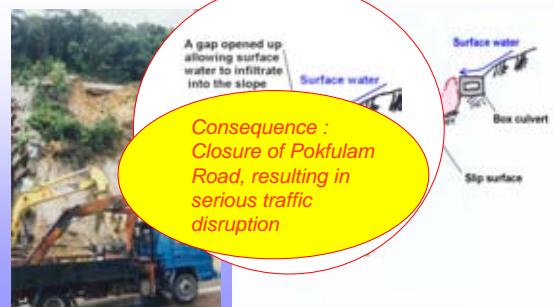
Review of known past failure cases occurred between 1986 and 2000, plus a very serious fatal incident in 1966

## Trench Study

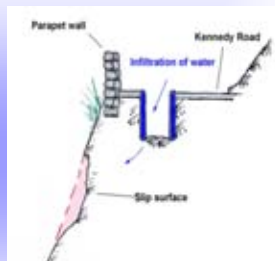
- A total of 17 cases have been reviewed
- Review of records which could be retrieved from newspapers, file records, LD's incident reports, etc
- Review of Landslide Investigations

## Types of Failures

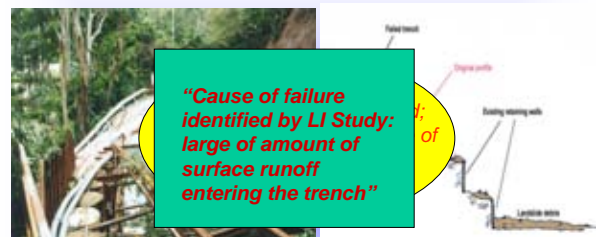
- Collapses of Slopes Adjacent to Trenches
- Collapses of Trenches



Pokfulam Road, opposite the Chinese Christian Cemetery (August 1999)



Kennedy Road near Hau Fung Lane (August 1999)



Kennedy Road near HK Park (August 2000)



**Cause of failure identified by LI : major loss of soil material due to water ingress into the trench**

**Kennedy Road, St. Francis Canossian College**  
**(August 2000)**

**GILMANS South China**  
FOR RADIO SERVICE AND REPAIRS  
Vol. XXII, No. 111 HONGKONG

**WALL COLLAPSE KILLS SIX**  
*Sixteen Hurt In Kowloon Bus Queue Tragedy*

**EUROPEAN WOMAN DIES**  
A young European mother of four, and five schoolchildren, were killed yesterday when a ten-foot high concrete wall collapsed on a bus queue during heavy rain in Boundary Street yesterday. Sixteen people were injured.

**6 killed, 16 injured** **8.6.1966**



Brick and plaster fence wall

Blocks falling

**Cause of failure identified by Professor Lumb :**  
**" the collapse of the wall was due to the excavation at the foot of the wall.....Failure might not have been occurred if there had been no trench excavated ....."**

**22.2.1987**

**A broken concrete pavement slab fell inside the trench**

**1 killed**

16.1.1991

A skin wall forming one side of the trench collapsed

1 killed

26.2.1993

Trench side collapsed

1 killed, 1 injured

4.7.1993

Heavy vehicle passed trench side causing it to collapse

1 killed 1 injured

5.11.1999

Trench side collapsed

1 killed 1 injured

### Summary of Failures

<b>Collapse of trenches</b>	<b>Collapse of slopes above trenches</b>	<b>Collapse of slopes below trenches</b>
10 cases	4 cases	3 cases
9 deaths	8 deaths	1 injury
3 injuries	16 injuries	

Inadequate or no shoring

Loss of toe support

Lack of drainage provision

### Summary of Study

#### Main Causes of Failures

- Poor site control / supervision
- Inadequate specifications & standards w.r.t. drainage provisions

## Recommendations

- Prepare a Code of Practice for enhancement of standards & promulgation of good practice
- Enhance site supervision & site audit

## Guide to Trench Excavations

## Objective

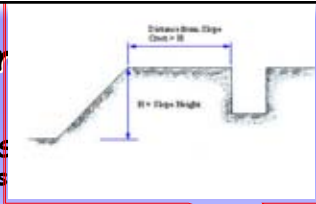
- Enhance construction site safety
- Ensure slope safety

## Scope

- Planning
- Design
- Construction
- Supervision

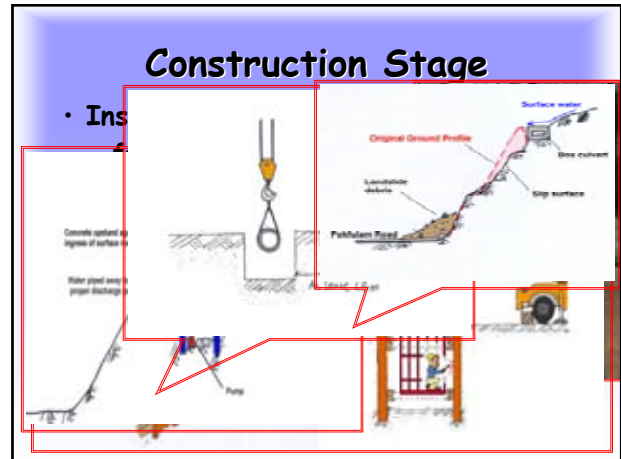
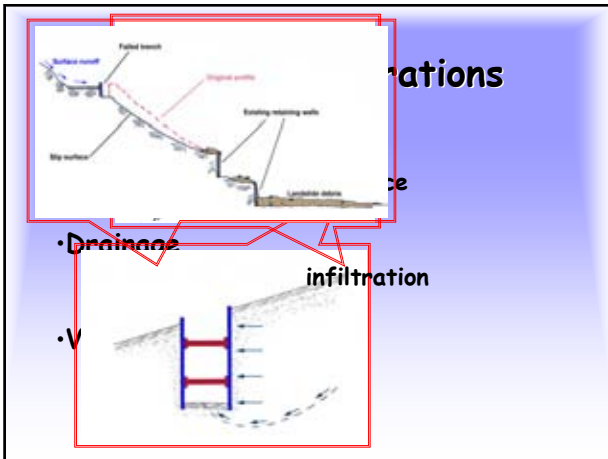
## Plan

- Desk Study
  - utilities, SIS
  - traffic loads
- Timing & Location
  - avoid wet season, on slope, toe or crest of slope
- Statutory Requirements
  - Excavation Permit, Lands Ordinance, BO, Construction Site (Safety) Regulations



## Design Stage

- Temporary Support Design
    - prescriptive design for  $\leq 4.5$  m
    - specific design by RPE for  $> 4.5$  m
- PNAP 148 :
- [ (a) deeper than 4.5m, and greater than 5 m in length; and
  - (b) liable to affect any road, building, structure, slope steeper than 30 deg. Or water main 75mm in diameter or greater, the affected area being defined as within the 45 deg. line up from the base of the excavation to the ground surface. ]



**Site Supervision & Audit**

3-tier supervision :

- CONTRACTOR
- full-time foreman
- weekly by Competent Person
- CONSULTANT / CLIENT
- site supervision / Cat. I & III as in PAH
- random audit by safety advisors
- AUTHORITY
- random audit by HyD, Lands D and Labour D to ensure compliance with Conditions and Regulations.

**The End**