

Regulatory System and Control of Explosives and Blasting in Hong Kong

Vincent Tse
HKIE Seminar
18 January 2008



**Classification,
Definition
and
Chemistry
of
Explosives**

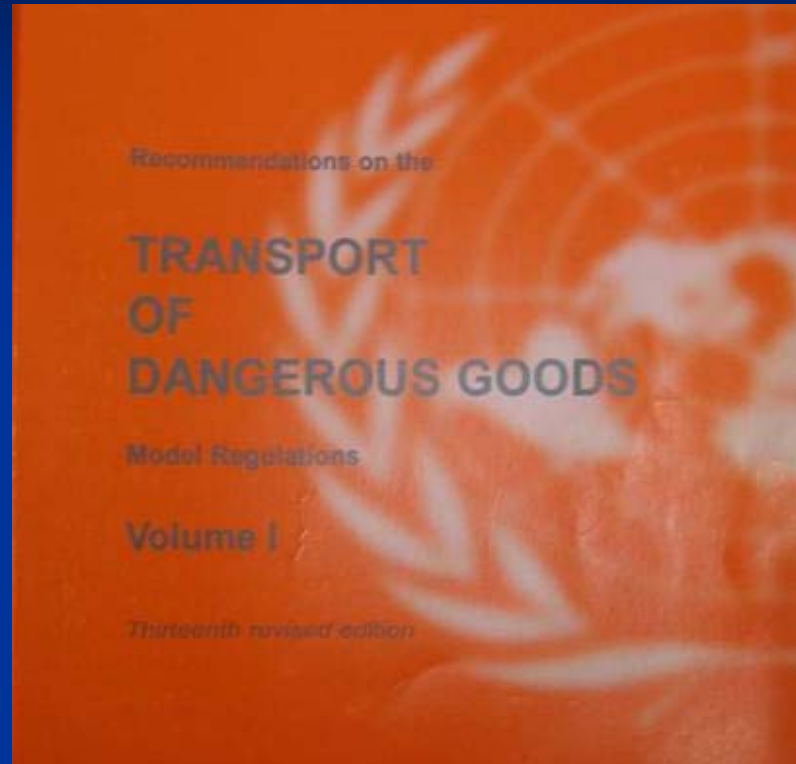
Dangerous Goods Ordinance Cap. 295

Category 1 Dangerous Goods (Explosives)

- Divided into 8 classes based on chemical compositions of the explosives
 - **Class 1 Gunpowder**
 - **Class 2 Nitrate mixture**
 - **Class 3 Nitro-compound**
 - **Class 4 Chlorate mixture**
 - **Class 5 Fulminate (detonators)**
 - **Class 6 Ammunition**
 - **Class 7 Firework (aerial shells, fire crackers)**
 - **Class 8 Other**

UN Dangerous Goods Classification System

- Class 1 Dangerous Goods – Explosives
- 6 Divisions in Class 1
- Class 1.1 to 1.6
- Definition according to the explosion hazard and sensitivity
- Normally, blasting explosives are in Class 1.1 and detonators are in Class 1.4



UN
**Orange
Book**

Explosives

**= Category 1 Dangerous Goods
in DGO**

**= Class 1 Dangerous Goods in
United Nations Classification for
Transportation of Dangerous
Goods**

Effect of Explosion

- Shockwave
- Gas
- Heat
- Sound
- Smoke
- Light



Explosion Chemistry for ANFO

- ANFO – Ammonium Nitrate and Fuel Oil



- $3\text{NH}_4\text{NO}_3 + \text{CH}_2 \Rightarrow 7\text{H}_2\text{O} + 3\text{N}_2 + \text{CO}_2 + \text{Heat}$

(oxidizer)

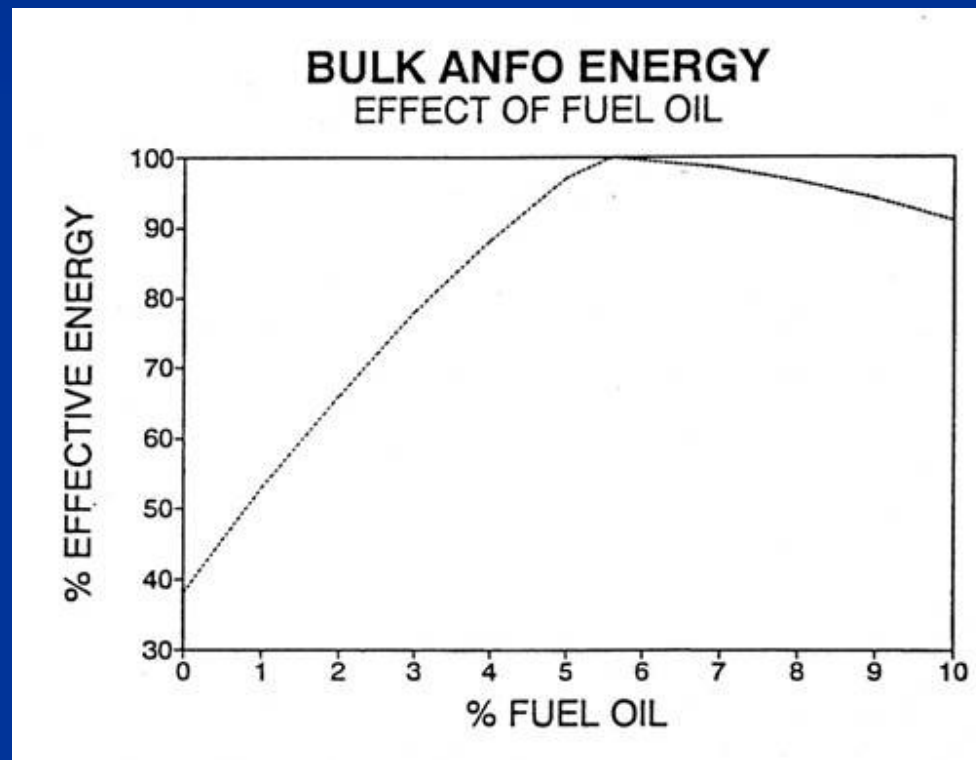
(fuel)

(gases)

(energy)

- Less Fuel Oil produces NO which oxidizes to NO_2 in air as toxic brown fumes

**About 6% of Fuel Oil in ANFO
achieves oxygen balance
and maximum effective energy**



Explosives are substances or articles capable by **chemical** reaction in itself of producing **gas**

- at such a **temperature** and **pressure**
- and at such a **speed**
- as could **cause damage** to surroundings.

- 1 kg of explosive can expand to 1,000 litres of gas in milliseconds and releases up to 5,000 kJ of heat
- Velocity of detonation (VOD) – speed at which the detonation proceeds through the explosive column – ranges from 2,000 to 7,500 m/s.

**Regulation of
Explosives
under
Dangerous Goods
Ordinance**

Dangerous Goods Ordinance Cap. 295

includes the following subsidiary legislations:

- Dangerous Goods (Application and Exemption) Regulations
- Dangerous Goods (General) Regulations
- Dangerous Goods (Government Explosives Depots) Regulations
- Dangerous Goods (Shipping) Regulations

In Hong Kong, the **manufacture, storage, transport and use** of explosives are regulated by the Dangerous Goods Ordinance (DGO) Cap. 295

Dangerous Goods Ordinance Cap. 295:

To ensure safety and security on the use of explosives in Hong Kong

Authority :

The Commissioner of Mines is the Director of Civil Engineering and Development

The duties are undertaken by the Mines Division

Commissioner of Mines

- Prior to 1964, Commissioner of Police and Director of Fire Service shared the authority of Commissioner of Mines
- In 1964, Commissioner of Labour took over the authority as Commissioner of Mines
- In 1991, the authority of Commissioner of Mines was transferred to Director of Civil Engineering and Development

Dangerous Goods Ordinance Cap. 295

- Section 6 - No person shall **manufacture, store, convey or use** any dangerous goods except with a licence granted by the Authority.

Licences and Permits

- Licence to **Manufacture**
- Licence to **Store**
- Removal Permit (**Transport**)
- Permit to **Use**
- Mine Blasting Certificate (**Shotfirer**), which is issued under Mining Ordinance Cap.285

Explosives for Rock Blasting



Detonators



Cartridge explosives



Boosters



Detonating cords

Cartridged Explosives

UN Number : 0241

Class : 1.1



Detonators

UN Number : 0361

Class : 1.4



Explosives Manufactured on Site



Mobile manufacturing unit



Bulk emulsion



Ammonium nitrate prills

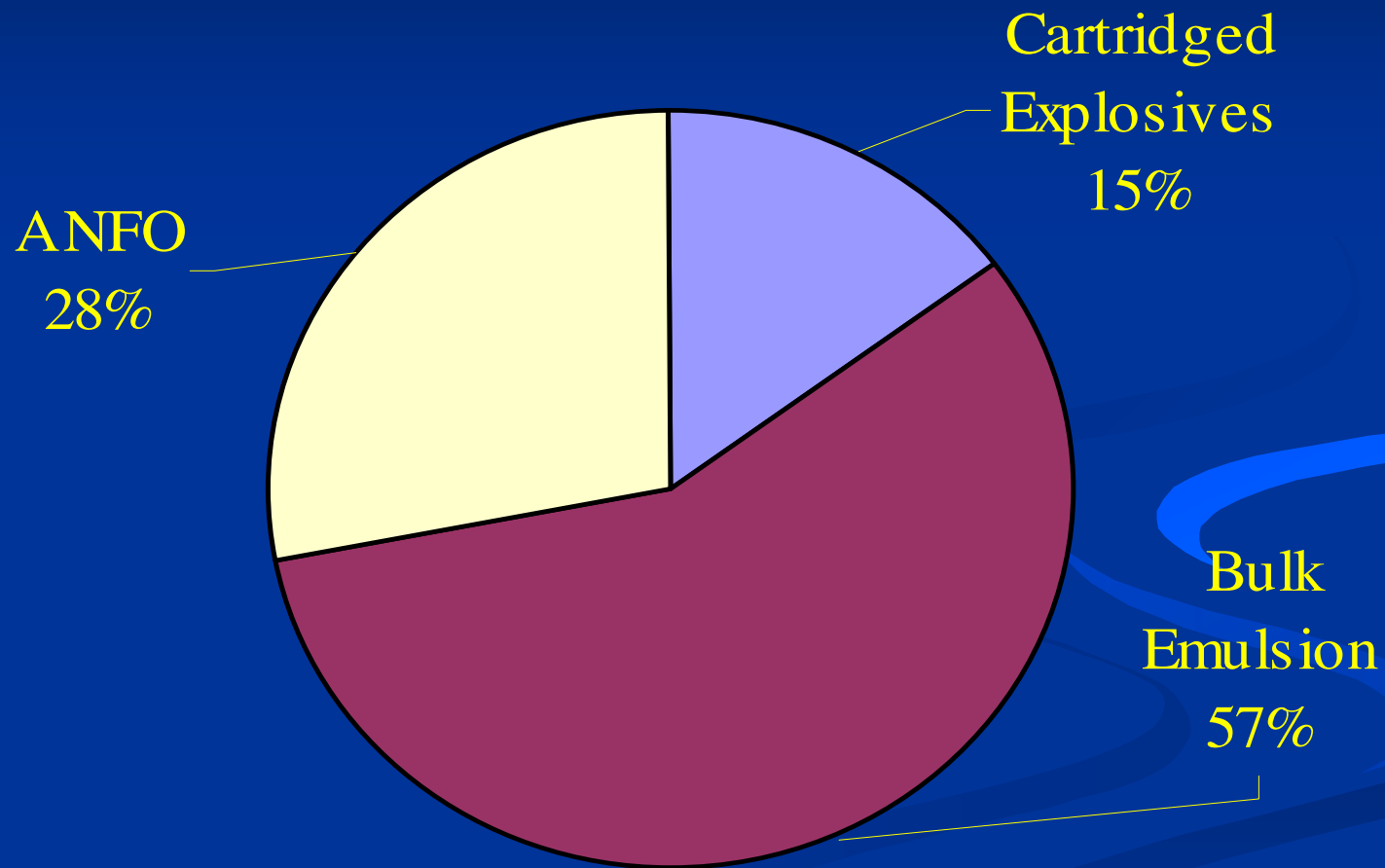


Bulk ANFO

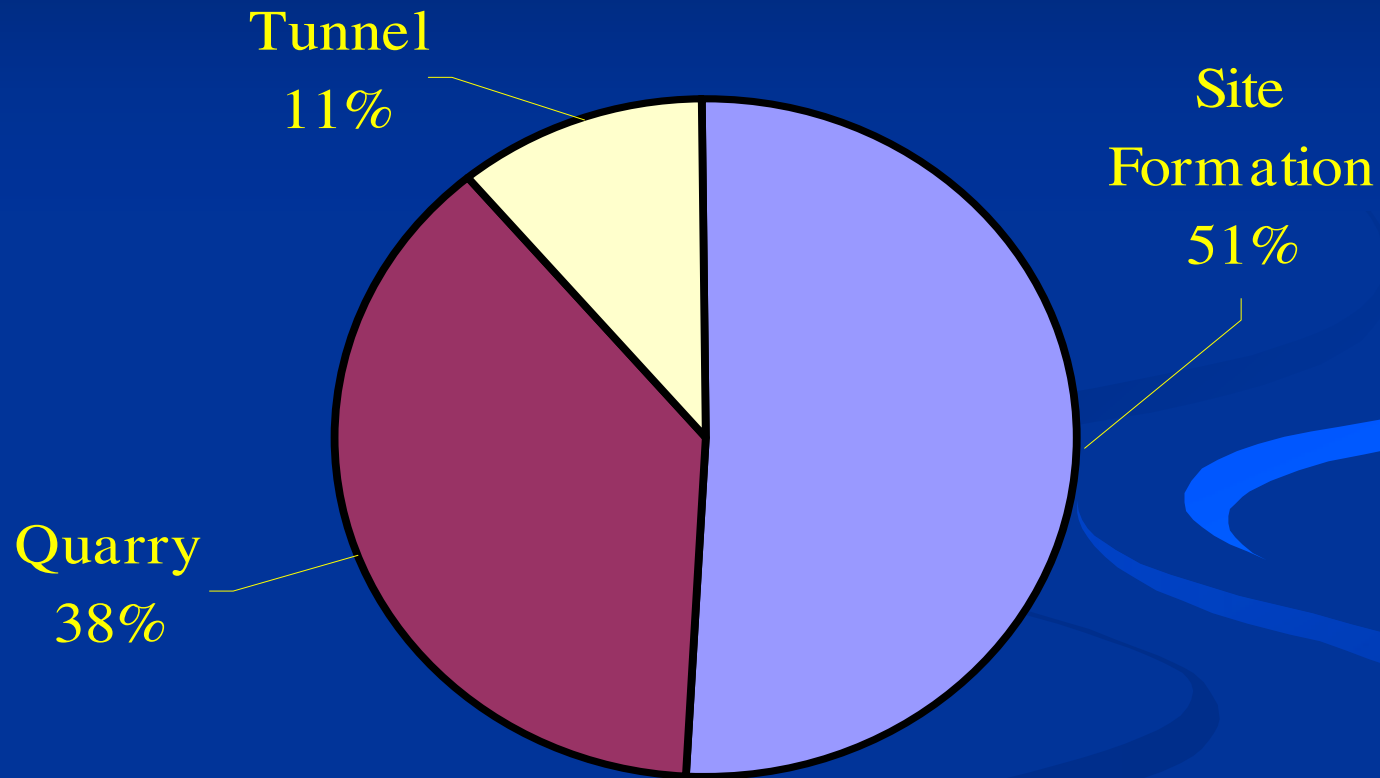
Approval of Explosives for Use in Hong Kong

- Explosives suppliers to submit application to Commissioner of Mines
 - UN No. (Orange Book)
 - Hazard Classification
 - Material Safety Data Sheet (MSDS)
- List of approved explosives for use in Hong Kong maintained by Commissioner of Mines
- The list can be obtained from the CEDD Mines Division Website

Average Consumption of Explosives by Types for 1995-2007



Average Consumption of Explosives in Various Activities for 1995-2007



Storage of Blasting Explosives

- Government Explosives Depots at Kau Shat Wan and Kowloon Hill
- Licensed Mode A Stores
(Site Magazine)

Government Explosives Depot at Kau Shat Wan



**8 Surface
magazines**

**10 Underground
magazines**

Transport of Explosives from KSW to Blast Sites

- Mines Division's fleet of explosives delivery vessels and trucks
- Daily delivery of the required quantities of explosives from Government explosives depots to blasting sites
- Contractor to pay scheduled delivery fee

Explosives Off-loading Points



Government's Explosives Delivery Vessel





KSW Explosives Depot



TKO Area 137



Siu Lam

Government's Explosives Delivery Vessel



Flooding Control Valve



Government's Explosives Delivery Truck



Left Side



Right Side

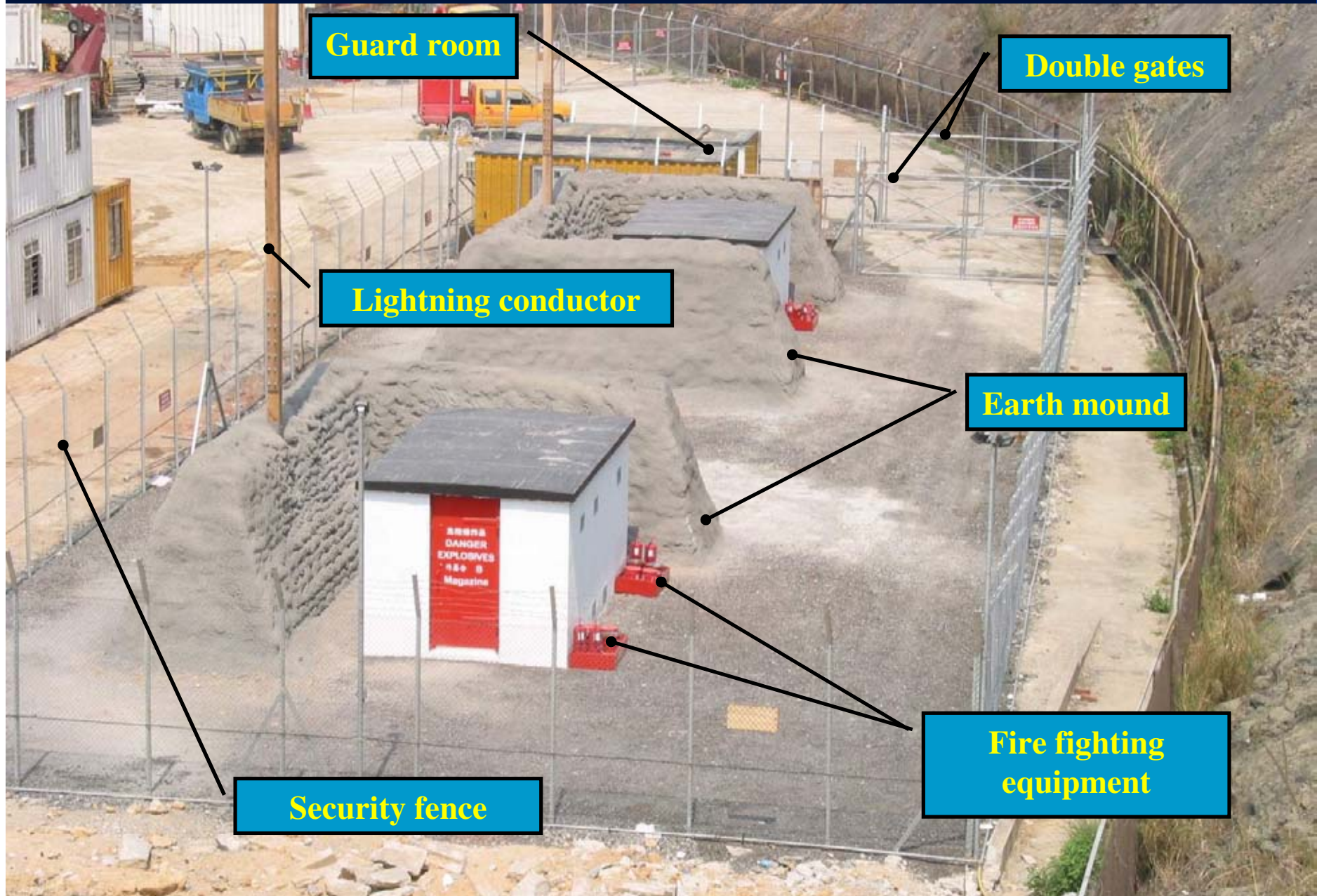


Rear

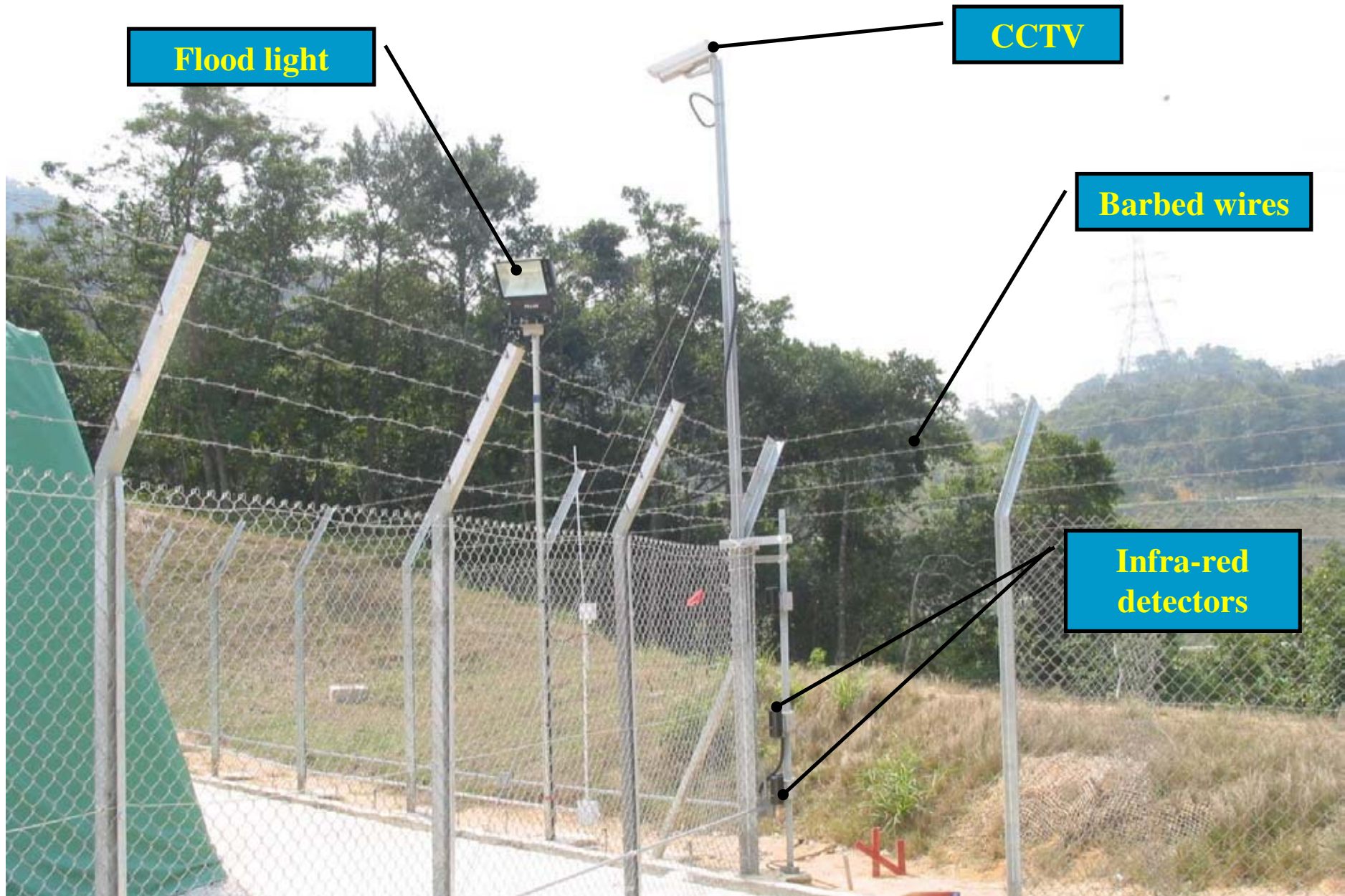
Licensed Mode A Store (Site Magazine)



Licensed Mode A Store (Site Magazine) General Layout



CCTV and Infra-red Detector



24 hours Armed Guard and Dog-patrol



Lightning Conductor and Earth Mound



Timber Raised Floor



Warning Signs



Contractor's explosives delivery truck



**Regulatory Requirements
for
Planning, Design and
Construction Stages**

Planning for Blasting Work during Project Feasibility Stage

- Public Projects - Technical Feasibility Statement to include a Preliminary Geotechnical Appraisal (PGA) to identify key hazards and constraints for blasting
- Private Projects – Geotechnical Assessment at Building Plan stage to identify key hazards and constraints for blasting
- Estimate practical rock excavation rate to prepare a realistic works programme

EIA Study for Designated Projects

- Potential Hazard to Life Assessment (QRA) for overnight storage of explosives, i.e. if a site magazine is planned for the blasting work
- EPD approve EIA Report and issue Environmental Permit

Design and Contract Preparation Stage

- Prepare Blasting Assessment Report (BAR)
- Follow up recommendations in the approved EIA Report
- BAR to be prepared by a competent person with at least 4 years relevant experience in design and supervision of blasting works

Requirement for Submission of Blasting Assessment Report

- GEO Circular 27 – Geotechnical Control of Blasting
- Hong Kong Government Project Administration Handbook (PAH) for Civil Engineering Works
- Buildings Department Practice Note for Authorized Persons (PNAP) No. 178 – Control of Blasting

Main Elements of Blasting Assessment Report

1. Identification of sensitive receivers
2. Assessment of effects of blasting on sensitive receivers
3. Outline blast design
4. Proposed preventive, protective and precautionary measures to ensure public safety
5. Environmental considerations (vibration, air-overpressure, etc.)
6. Overnight storage and delivery of explosives
7. Monitoring



Blasting Site

Residential buildings

MTR railway

Existing slope

Public road

Flyover

Issues to be addressed in Blasting Assessment Report

- Flyrock
- Effect on Slopes
- Vibration
- Air Overpressure

Contract Preparation Stage

- Relevant requirements in BAR and EIA included in contract document
- Supervision personnel requirements and monitoring requirements included in contract document
- Programme of works prepared based on BAR's estimated blasting production rate

Supervision Requirements

- RSS to include a competent supervisor to take up the overall supervision of the blasting works.
- The competent supervisor should have at least 4 years of relevant experience in blast design and supervision of blasting works

Construction Stage

Contractor to apply for Blasting Permit

- Supported by Blasting Assessment Report and Method Statement
- Application for Mode A Store Licence (site magazine) for storage of explosives, if appropriate

Application for a Blasting Permit by Contractor

- Submission of Documents :
Blasting Assessment Report, Method Statement
- Site Preparation Works

Revision of Blasting Assessment Report during Construction Stage

- Contractor can revise it to suit his method of work or site conditions
- Revision to be endorsed by Project Department
- Submit to GEO/District & Mines for agreement

A Typical Method Statement should include:

- Blast design and sequence –maximum amount of explosives used, non blast zones, direction of rock throw etc
- Blast details – hole size, depth, spacing, burden, powder factor etc
- Details of proposed protective measures and slope strengthening works
- Arrangements for on site storage and transport of explosives

A Typical Method Statement should include:

- Limits on vibrations and air overpressure
- Location of monitoring stations
- Evacuation and road closure arrangements
- Responsibilities of key personnel
- Contingency plan on loaded explosives not being discharged on delivery day, misfire, thunderstorm situation etc.

General Pre-licensing Requirements and Site Preparation Works

- Fabrication of protective measures, like screens & cages, blast door etc.
- Completion of necessary slope strengthening works
- Establishment of site magazine, explosives off-loading point and safe transport route
- Clearance of vegetation around blast boundary and removal of overburden above rock
- Establishment of monitoring stations

Permit No. A 005201
許可證號碼

HONG KONG
香港
DANGEROUS GOODS ORDINANCE, CHAPTER 295 SECTION 6
第一類危險品使用許可證
PERMIT TO USE CATEGORY I DANGEROUS GOODS
依照香港法例第二九十五章危險品條例第六條發給

Blasting Permit

Name (H.K. I/D No.)
姓名 香港身份證編號
of (Address)
地址

(Site Code) is hereby granted permission to use the following Category I Dangerous
地盤編號 茲批准上述持證人使用下列第一類危險品：

Goods:—

Cartridged Watergel/Cartridged Emulsion/Slurry Watergel/Slurry Emulsion/ANFO Blasting Agent/Safety
水膠炸藥條 / 乳化炸藥條 / 漿狀水膠炸藥 / 漿狀乳化炸藥 / 硝酸銨柴油爆炸劑 /
Fuse/Fuse Igniter/Detonating Fuse/Primer/Plain Detonator/Delay Electric Detonator/Magnadet/Nonel Detonator/
安全引線 / 引線點火桿 / 導爆索 / 炮碼 / 普通雷管 / 電雷管 / 電磁雷管 / 非電起爆雷管 /

Nonel Connector/Detonating Relay/ or*
非電起爆聯接塊 / 導爆索連接管 / 或

for blasting work to be carried out only in the area/s delineated on the plan/s attached to the Permit from
於 許 可 證 附 圖 所 劃 定 地 區 內 進 行 爆 石 工 程 於 有 效 日 期 由

..... To inclusive or until completion of blasting work whichever
..... 至 或 至 爆 石 工 程 完 成 為 止 ， (二 者 中 以 較 早 之 日

is earlier. Loading of drill holes with explosives is to commence immediately after the explosives are delivered to the
取 決) 。 裝 炸 藥 入 鑽 孔 須 於 炸 藥 運 至 爆 炸 地 盤 後 立 即 執 行 。 在 鑽 孔 內 裝 入
blasting site. Blasting is to take place immediately after the loading of the explosives into the drill holes has been
炸 藥 完 竣 ， 須 立 即 進 行 爆 石 。
completed.

Date
發 證 日 期

File Ref. in/...../.....
檔 案 編 號

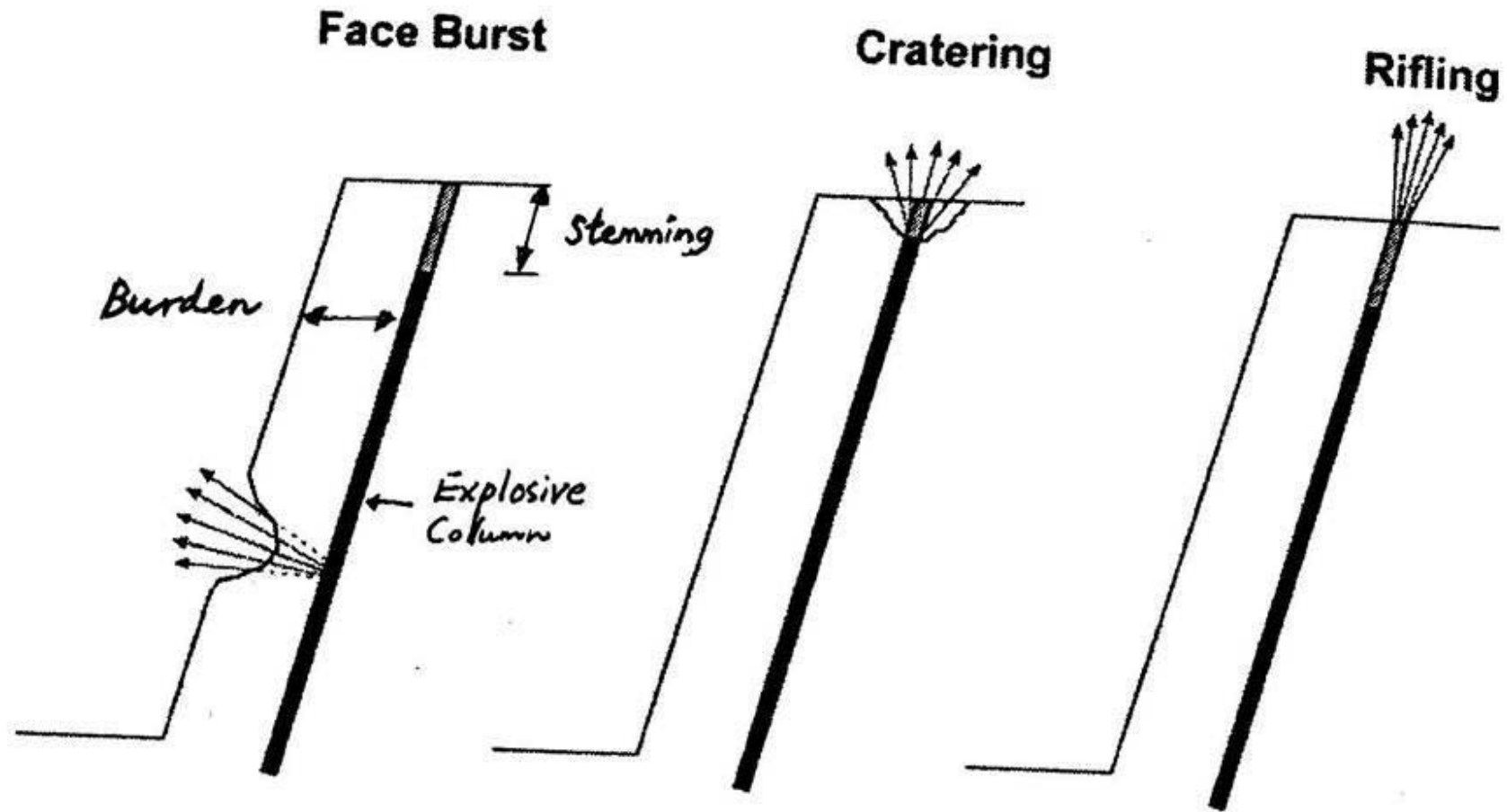
(Delete as Applicable)
(將不適用字句刪去)

.....
for Commissioner of Mines
Licensing Authority
鑛務處處長(發證當局)

- NOTES: 1. THIS PERMIT IS NOT TRANSFERABLE.
附註： (一) 本許可證不得轉讓。
2. This permit is subject to the provisions of the Dangerous Goods Ordinance, Chapter 295 and any of the Regulations made thereunder for the time being in force and is further subject to such Conditions as may be attached.
(二) 本許可證乃依照香港法例第二九十五章危險品條例之規定與按該條例現行制定施行之規例，以及此許可證所附帶之條件而發給。
3. This Permit must be kept at the blasting site during all stages of blasting operations.
(三) 在爆石工程任何階段之過程中，本許可證須存放於爆石地盤內。
4. The Authority reserves the right to amend other conditions of this permit as and when he thinks fit during the currency of this permit.
The Government would not be liable for any consequences arising from the use of this permit.

Safety Requirements

Flyrock Mechanism for Surface Blasting



Blast Cages and Vertical Screens For Surface Blasting



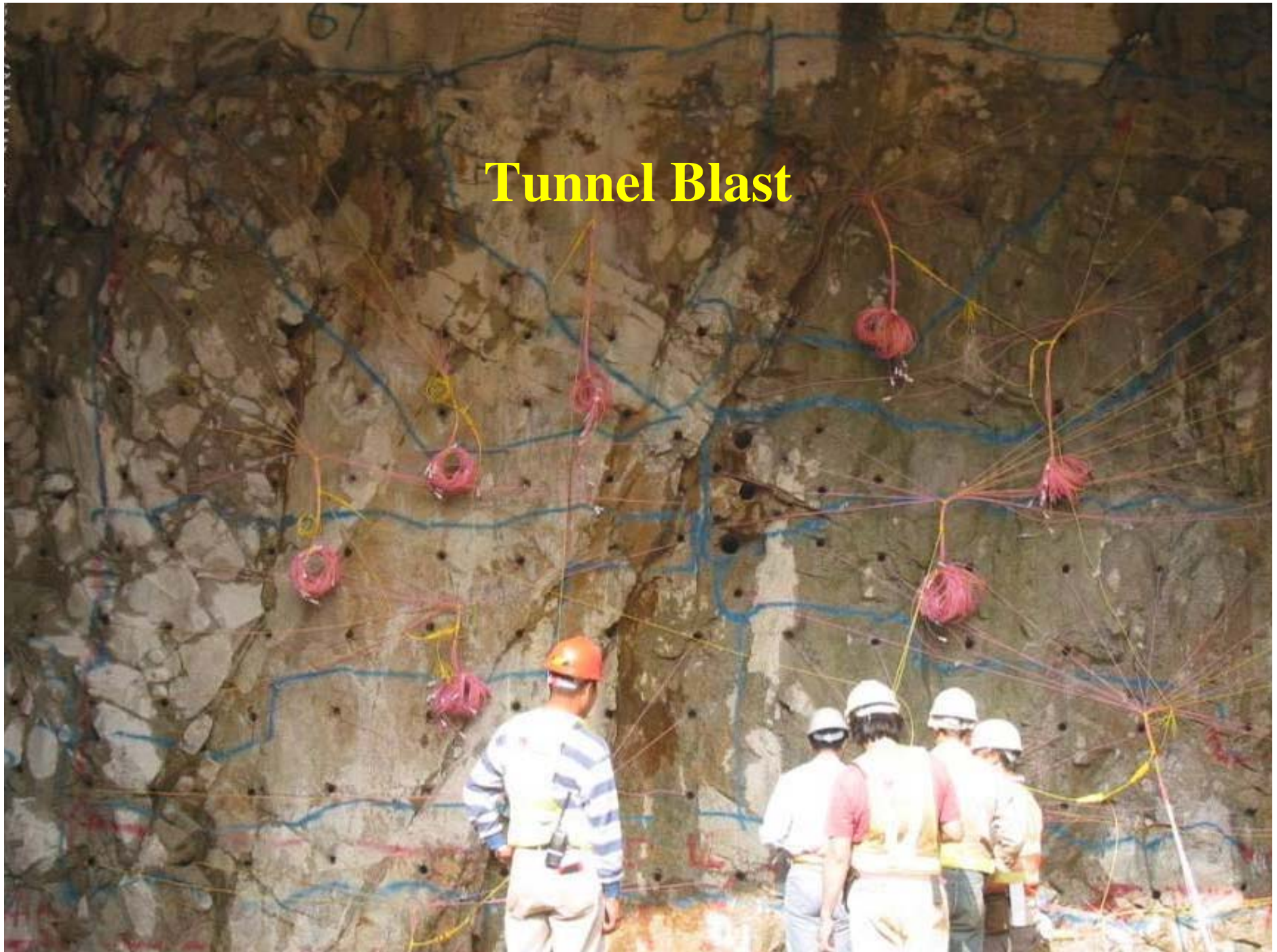
Roof-over Protective Cover



Roof-over Protective Cover (inside view)



Tunnel Blast



Hanging Mesh and Rubber Mat



Blast Door for Tunnel



Temporary Road Closure



Vibration and Air Overpressure Monitoring



Warning Gongs

- For a period lasting from 5 minutes prior to the blasting until all charges have been fired, warning gongs shall be beaten continuously...



Site Activities to Prepare for a Blast

Surveying and Mapping of Free Face and Bench



Setting Out of Holes



Checking Hole Depth after Drilling



Inserting Detonator into Booster



Loading Booster with Detonator into Blast Hole



ANFO from Mixing Truck for Charging Blast Hole



Checking Emulsion Density



Loading Emulsion from Mixing Truck



Loading Bulk Emulsion into Blast Hole



Stemming of Blast Hole



Preparing Surface Connection



Completed Surface Connection



Ground Cover for Surface Blast



Responsibilities of Contractor's Key Personnel

- Blasting Engineer – overseeing all blasting activities
- Blasting Designer – blast design and parameters
(hole depth, spacing, burden, charges, etc.)
- Shotfirers – charging and firing
- Surveyor – setting out of holes and surveying face
profile
- Geologist – unusual geological conditions
- Earthwork Superintendent – protective measures
- Safety Officer – providing training, assessment of
hazards etc

RSS Personnel for Blasting Works

The supervision team should be supported by

- A Competent Supervisor with at least 4 years of relevant experience in design and supervision of blasting works
- A Geologist providing necessary geological input

Responsibilities of Resident Site Staff

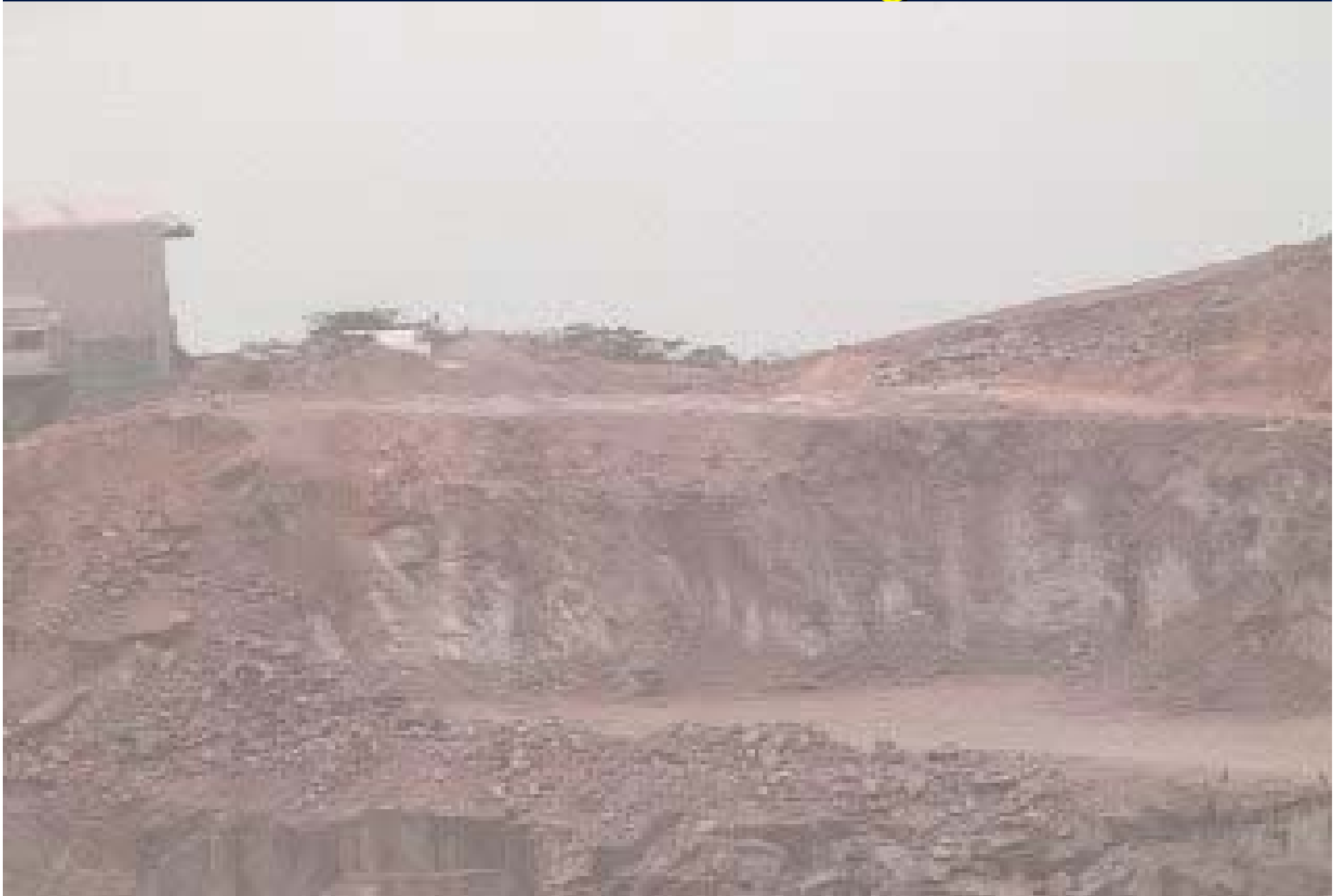
- Check Contractor's daily blast design
- Survey of blast area
- Supervise the blasting operation. Check blast face, setting out of holes, hole depth, charge depth, stemming length and connections
- Supervise and check the safety and evacuation arrangements etc., prior to firing
- Supervise the safety and security of contractor's explosives storage, transport and handling of explosives
- Supervise Contractor's monitoring work and review Contractor's blast monitoring data

Video for Blasting

Video for Blasting



Video for Blasting



Video for Blasting



Video for Blasting



Video for Controlled Failure



Blasting Accidents

中華民國僑務委員會登記證台新字第一〇二號

星島晚報

號九二八三一第

元一份每張大四紙出日今

司公報有無編熟星：印承及印發

星大聞新號五三六道登發：址地

本報銷數最多 廣告效力最大

今日天
(本報專訊)由東方吹來之潮濕氣流，影響香港區域。本港及今晚天氣預測，多雲有陣雨，多雲有陣雨，多雲有陣雨。下午十二時氣溫廿一度，百分之八十。昨晚午夜至今日，文台並無雨量。

康山爆石意外調查報告

方向及技術有錯誤

當局建議控承建商

(本報專訊)勞工處礦務部指出，昨日調查康山地段地盤爆石意外初步調查報告顯示：今次發生意外的主因有二，其一為爆石方向錯誤，其二是地盤在進行工作時出現技術上的錯誤或疏忽情況。

勞工處消息又顯示，當局建議警方，控告康山地盤承建商疏忽處理爆石工程。

勞工處礦務部建築主任程衍基今晨表示，在昨日發生爆石意外事件後，礦務部人員已迅速與康山地盤監察，初步估計，發生意外的主因之一為爆石方向錯誤地向着對面的住宅區，其二則可能是爆石技術的錯誤，如爆石的放置位置及爆石次序出現問題等。

程衍基指出，一個安全措施良好，管理嚴格的地盤，是很少會出現爆石意外事件的，本港每年有一百三十至一百六十六個地盤施工，但不平均而言，因爆石而出現意外者每年只有十宗左右；而像今次這樣飛石甚遠的意外，實在少見。

程衍基說，若果地盤按照正常的操作安排炸藥數量和位置，即使四周完全沒有圍屏，碎石最多亦不會飛出超過一百米。今次碎石飛出逾二、三百米，主要原因相信和打孔埋藥的角度錯誤，錯估石質有關，同時，調查人員又懷疑地盤方面沒有遵照指示用布蓋著被爆石頭。

承建商人暫被停牌

地鐵收到賠償要求

現時負責康山地盤的承建商已被礦務部暫時停牌，程衍基說，俟調查報告完成後礦務部便會去信承建商，質詢其管理及安全設施問題，而在當局恢復其爆炸牌照之前，必須經由工作

人員再到地盤實地視察

程氏又指出，康山地盤並非是目前最大規模使用炸藥爆石的地盤，每日使用炸藥數量只是一噸左右，至於較大型規模的使用炸藥地盤，目前仍以青山及兩丫島發電廠工程為首。

另一方面，地鐵發言人表示，受此事故影響的住戶，傷者及其他市民，可向地鐵以書面提出賠償。截至今晨為止，地鐵只收到一個住戶發出的市民的賠償要求。

現時負責康山地盤的承建商已被礦務部暫時停牌，程衍基說，俟調查報告完成後礦務部便會去信承建商，質詢其管理及安全設施問題，而在當局恢復其爆炸牌照之前，必須經由工作

人員再到地盤實地視察

另一方面，地鐵發言人表示，受此事故影響的住戶，傷者及其他市民，可向地鐵以書面提出賠償。截至今晨為止，地鐵只收到一個住戶發出的市民的賠償要求。

新報

HONG KONG DAILY NEWS
ESTABLISHED 5 OCT. 1959.

1986年平均每日實銷
116,226份

ABC
總印務：新報有限公司
承印：星球印刷所
地址：香港德輔道西444號
香港工業大廈17樓
新聞熱線：5-8180261
5-8180881
傳真專線：5-8180742
廣告部：5-8180281

中華民國七十六年
六月 10 星期三
丁卯年五月十五日

每份六張半 零售一元半
第27年 第247號

今日要聞
藍田爆石發生意外
學校民居均被擊毀
事務隊員拘捕小販
被指施暴遭眾包圍

藍田走鬼 千人包圍 指事務隊員

【新報特訊】九龍，指責警務處第一區巴士總站四名兄弟，因該區警員發生小販與警員衝突，勞動大批小販，於廿八日午時，在該區巴士總站，包圍警務處第一區辦事處，指責警務處第一區辦事處警員，指責警務處第一區辦事處警員，指責警務處第一區辦事處警員。

觀塘鯉魚門道開山地盤爆石有意外 石塊飛越三百米 擊毀學校及民居

【新報特訊】觀塘鯉魚門道開山地盤，昨午發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。據悉，該地盤位於觀塘鯉魚門道，由地產發展商興建，現正進行開山工程。昨午約下午二時，地盤發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。據悉，該地盤位於觀塘鯉魚門道，由地產發展商興建，現正進行開山工程。昨午約下午二時，地盤發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。



康田苑七單位 窗框傢俬被毀

【新報特訊】觀塘鯉魚門道開山地盤，昨午發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。據悉，該地盤位於觀塘鯉魚門道，由地產發展商興建，現正進行開山工程。昨午約下午二時，地盤發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。



石塊穿窗射入 一名女生傷額



石塊意外後，康田苑一大廈外牆亦被擊毀(圖中)

【新報特訊】觀塘鯉魚門道開山地盤，昨午發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。據悉，該地盤位於觀塘鯉魚門道，由地產發展商興建，現正進行開山工程。昨午約下午二時，地盤發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。

地盤爆石須依規定 砲王負責一切事宜

【本報特訊】觀塘鯉魚門道開山地盤，昨午發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。據悉，該地盤位於觀塘鯉魚門道，由地產發展商興建，現正進行開山工程。昨午約下午二時，地盤發生爆石意外，石塊飛越三百米以外，擊毀學校及民居。

VT-258E 錄影機

Old quarry face before failure



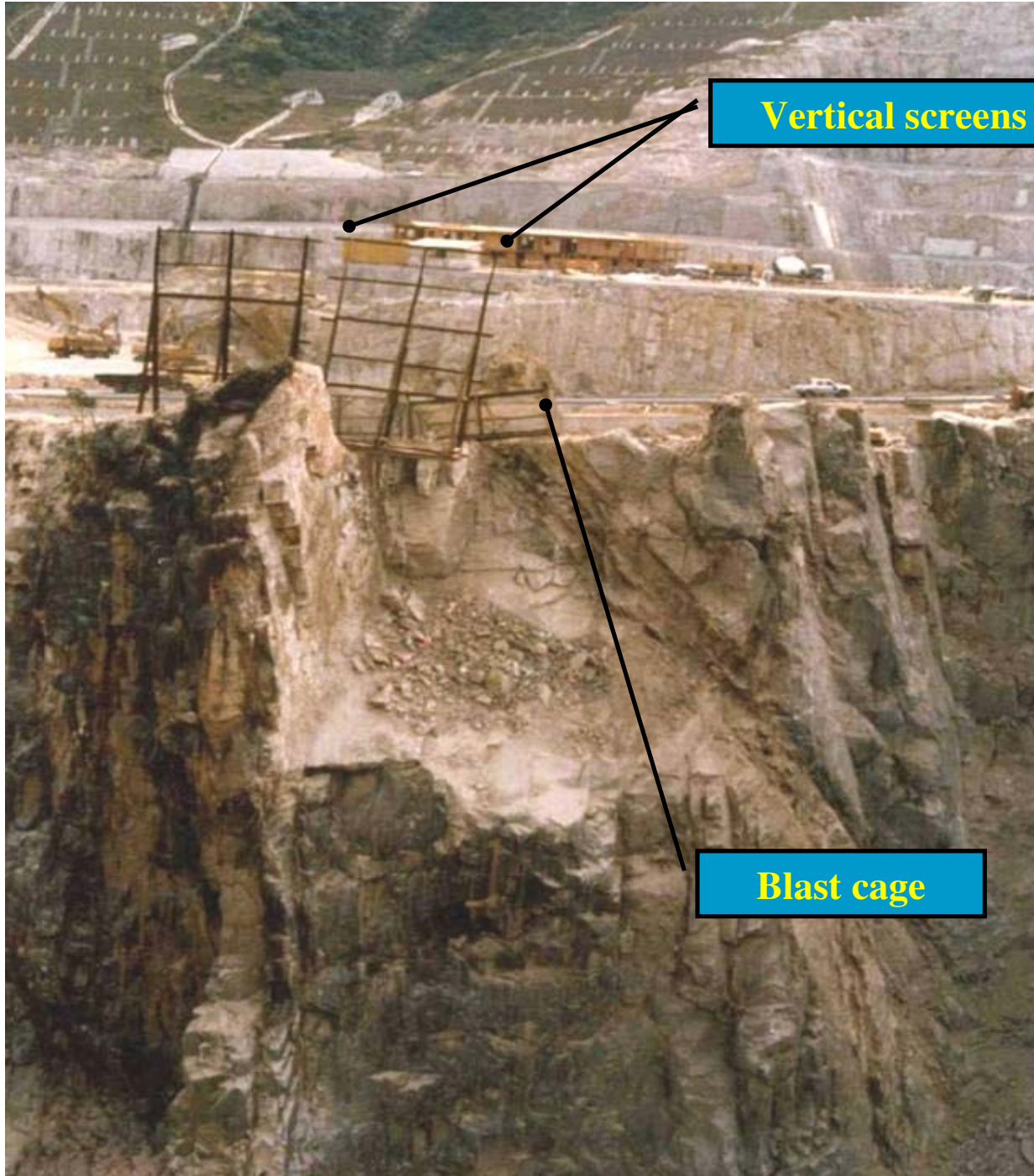
Failure Debris at Slope Toe

**Vertical screen
fallen from crest**

**Damaged steel
fence**

**Damaged containers and
cars**





Vertical screens

Blast cage

Blasting induced failure at Shau Kei Wan East Development Site on 28.2.1991 causing injury and damage to properties

Failure surface after clearance of debris

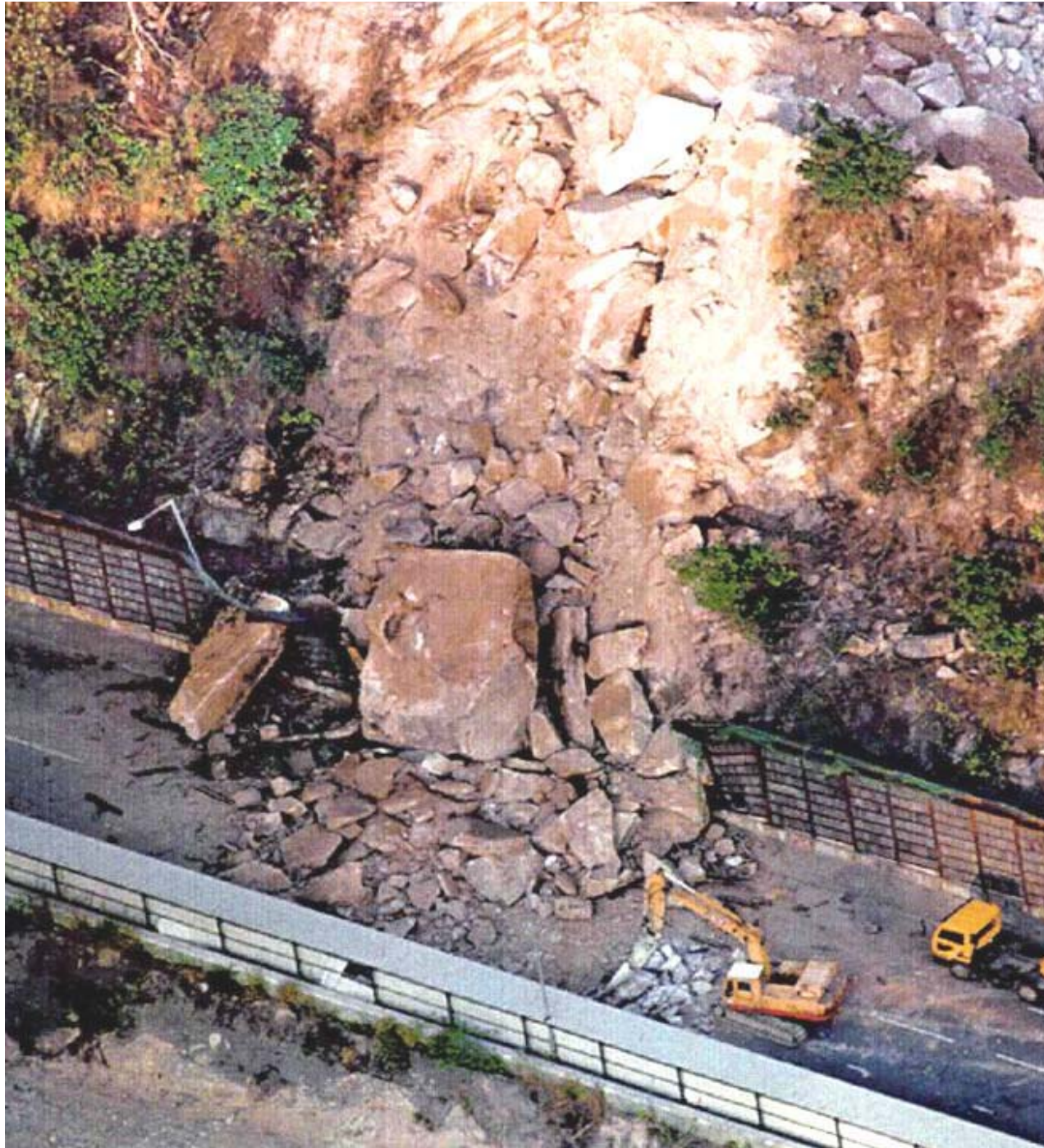


Shau Kei Wan Rock Slope Failure in 1991

- 28.2.1991 – Failure of rock slope due to blasting work at Shau Kei Wan East site formation works
 - Blasting behind a 50m high old quarry face
 - 2,000 cu.m. of failure debris
 - Debris damaged 4m high fence at 5m away from toe, six container offices and four cars damaged, one person injured
 - Debris travelled up to 30m from toe
 - Dust covered streets and cars 100m away

Follow-up on Shau Kei Wan Failure

- GEO SPR 6/91 (1991) Landslide Study Report issued.
- GEO Circular No. 14/92 and 1/94 issued.
Blasting Assessment requirement introduced
- GEO Report No. 15 (1992) issued.
Assessment of stability of slopes subject to blasting vibration



Sau Mau
Ping Road
Failure on
4.12.1997

Crest of the Failure Slope



General view of site before failure



Closed up view of blast area before failure

Sau Mau Ping Road Blast-induced Failure in 1997

- Blasting behind a 30 m high rock slope at Sau Mau Ping Road
- Failure debris 1,000 cu m.
- Sau Mau Ping Road completely blocked
- The protective rock fence at toe was completely crushed
- No person was injured as the section of road was closed during blasting



Flyrock Incident at Jordan Valley on 17.2.2003

Damage Caused and Findings

- Broke eight windows in five units of a residential block
- Rock fragments found on the podium of the building
- Unfavourable rock jointings in free face allowed rock fragments to fly in an unexpected oblique direction.

Flyrock Incident on 6.6.2003 at Jordan Valley



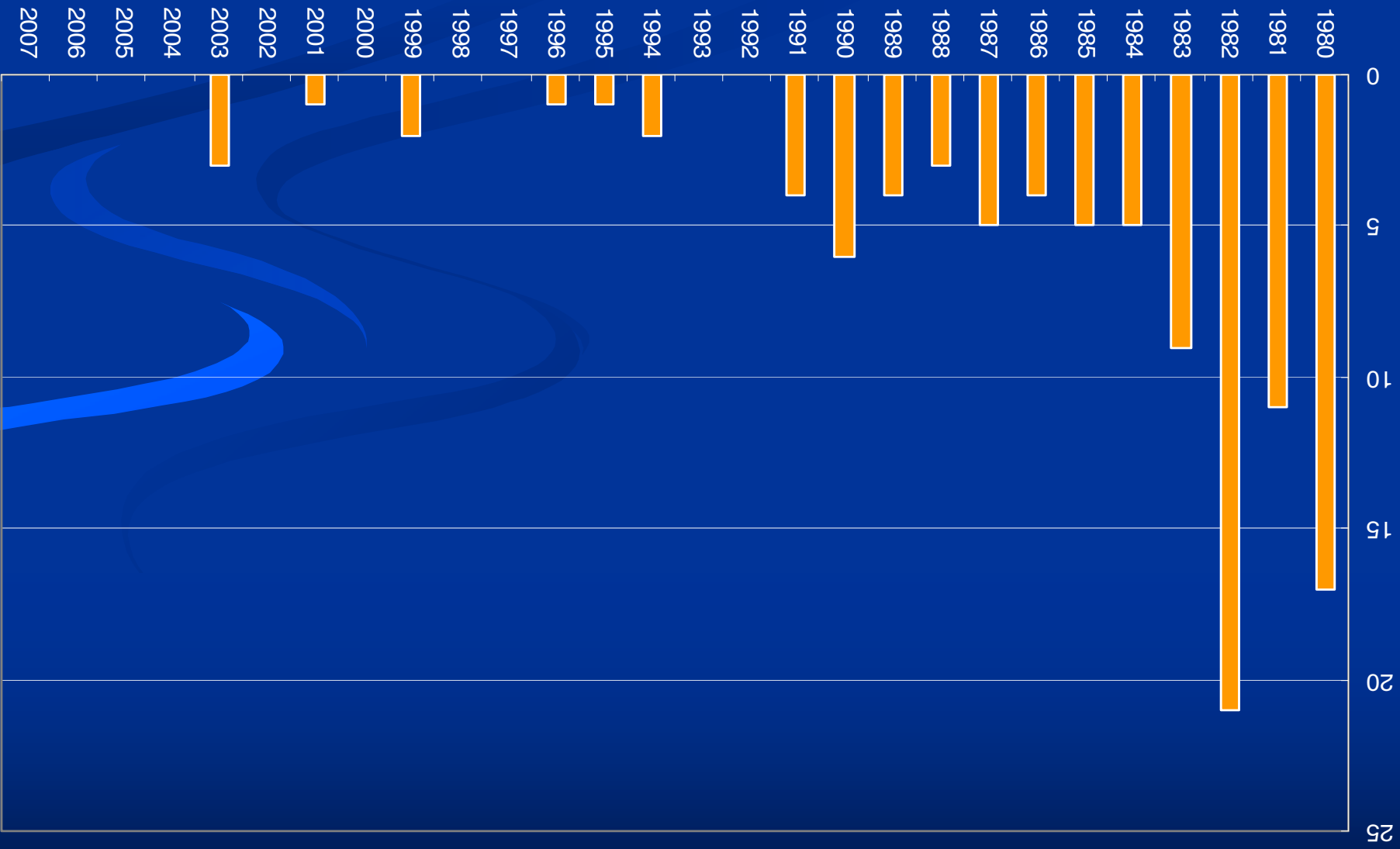


Flyrock incident on 6.6.2003 at Jordan Valley

Damage caused and Findings

- Rock fragments landed on Clearwater Bay Road caused injuries to nine persons
- Four vehicles, including a bus, site hoardings and two bus shelters were also damaged
- The geology was identified as a likely contributing factor for the flyrock incident

Blasting Accident Statistics 1980 – 2007



Classification of Blasting Accidents since 1991

15 accidents in total

- Flyrock (10)
- Rock slide (2)
- Rockfall in tunnel (1)
- Air blast (1)
- Pre-mature detonation (1)

Blasting Accidents since 1991 with Casualties

Year	No. of accidents	Casualty
1991	2	1 death + 1 injury
1992	0	0
1993	0	0
1994	1	4 minor injuries
1995	0	0
1996	1	1 death
1997	0	0
1998	0	0
1999	2	4 minor injuries
2000	0	0
2001	0	0
2002	0	0
2003	1	9 minor injuries
2004	0	0
2005	0	0
2006	0	0
2007	0	0

Reference Documents

Regulatory Requirements:

- DG Ordinance and Regulations
- Mines Division Practice Notes and Guidance Notes in CEDD Website
- PNAP No. 178
- Project Administration Handbook

Technical Reports on Blasting :

- GEO Report No. 15
(Assessment of Stability of slopes subjected to Blast Vibrations)
- GEO Report No. 100
(Method of Assessment and Monitoring of Gas Pressures for Blasting at Near Field)
- GEO Report No. 102
(A Study of the Effects of Blast Vibration on Green Concrete)

Investigation Reports on Blasting Incidents:

- GEO Report No. 94
(Sau Mau Ping Rock Slope Failure)
- GEO SPR 6/91
(Shau Kei Wan Blast Induced Rock Slide Study)
- GEO Investigation Report on Flyrock Incident on
6.6.2003

End

HONG KONG
香港
DANGEROUS GOODS ORDINANCE CHAPTER 295 SECTION 6
危險品條例(香港法例第二百九十五章第六條)
CATEGORY I DANGEROUS GOODS LICENCE
第一類危險品執照

Licence to Possess

..... (Name), (H.K. I/D No.)
姓名 香港身份證編號

of (Address)
地址

..... (Site Code) is hereby licensed, under a Mode A/B* Licence, to have in his possession at
地盤編號可由一九 年 月 日至

any one time as from to inclusive or until the completion of
一九 年 月 日 止 或 直 至 爆 石 工 作 完 成 為 止 ,

blasting work whichever is earlier,* at

兩者以時間較早者為準,*同一時間在

the following quantities of Category I Dangerous Goods:
存放第一種危險品,所存放之數量如下:

Cartridged Explosives 條狀炸藥	{	Watergel kg 水膠炸藥 千克	{	Plain Detonators nos 普通雷管 個
		Emulsion kg 乳化炸藥 千克		Delay Electric Detonators nos 電雷管 個
		ANFO Blasting Agent kg 硝酸銨柴油爆炸劑 千克		Magnedet nos 電磁雷管 個
Slurry Explosives 漿狀炸藥	{	Watergel kg 水膠炸藥 千克	Detonators 雷管	Nonel Detonator nos 非電起爆雷管 個
		Emulsion kg 乳化炸藥 千克		Nonel Connector nos 非電起爆聯接塊 個
		Safety Fuse cls 粉繩 副		Detonating Relay nos 導爆索速接管 個
Other Accessories 其他附件	{	Fuse Igniter nos 粉繩點火桿 個	Actuator, Power Device for Fire Extinguisher nos 消防系統自動引發雷管 個	
		Detonating Fuse m 導爆索 米		Smoke-dye Security Pac nos 煙幕源染盒 個
		Igniter Cord m 導火索 米		Smoke Cartridge nos 煙幕彈 個
		Primer nos 炮碼 個		Others nos 其他 個
Ammunition rds 彈藥 發				
Manufactured Fireworks (Distress Pyrotechnics) kg 炮竹烟花(求救訊號火箭) 千克				

Date
日期

File Ref. in/...../
檔案編號

*(Delete as Applicable)
(如不適用請刪去)

NOTES: 1. THIS LICENCE IS NOT TRANSFERABLE.
注意事項 本執照不得轉讓別人。

2. This Licence is subject to the provisions of the Dangerous Goods Ordinance, Chapter 295 and any of the

.....
for Commissioner of Mines
Licensing Authority
礦務處處長(發證當局)

Vibration Prediction

(Li & Ng 1992)

$$PPV = 644 \times (D/\sqrt{W})^{-1.22}$$

PPV = resultant peak particle velocity (mm/s)

D = distance of interest (e.g. slope, wall, structure, utilities etc.) (m)

W = mass of explosives per delay (kg)

(site specific formula may be proposed based on relevant blast monitoring data obtained on site)

PPV Vs SD

