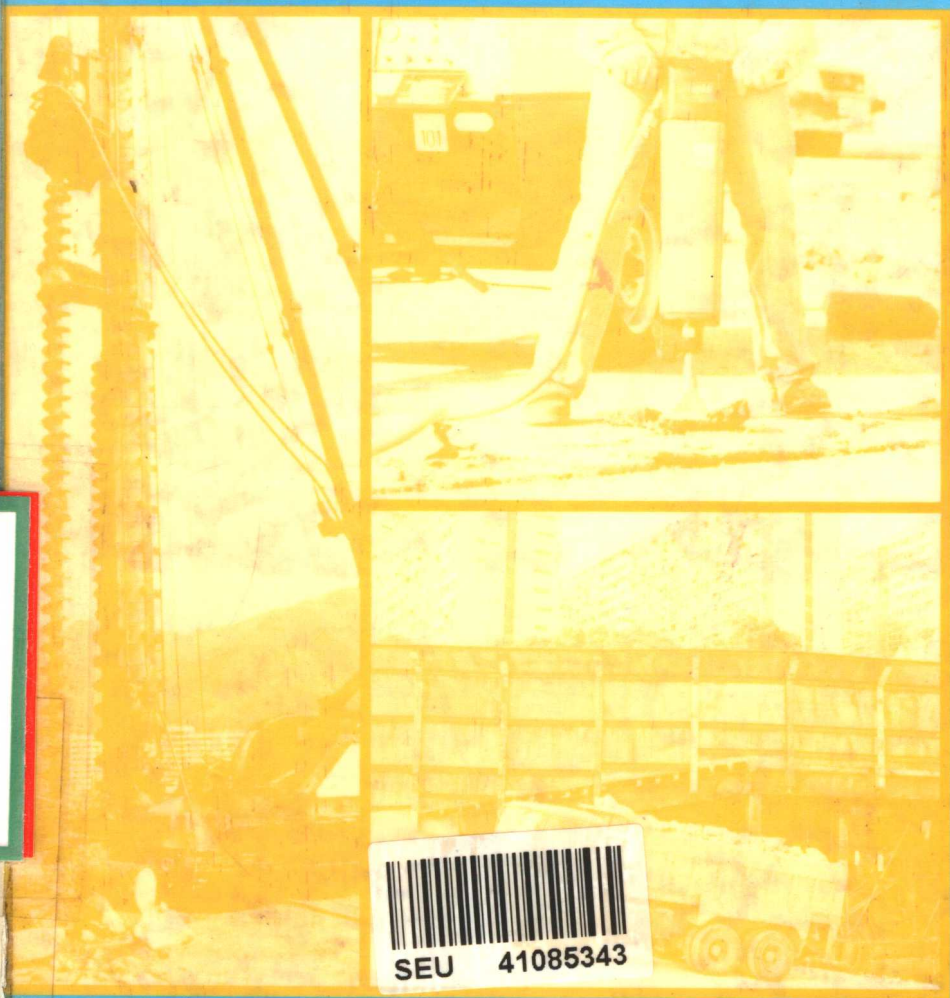


A Practical Guide for the Reduction of Noise from Construction Works

消減建築噪音實用指南



SEU 41085343



香港政府環境保護署
Environmental Protection Department

補充資料

本小冊子的內容，將會不時增添及作出最新修訂，本署鼓勵有關寧靜建築設備的製造商或供應商提供有關資料，以備本小冊子將來再版時，增添材料之用。請填妥下列表格，並連同有關目錄，規格及其他資料，寄香港政府環境保護署。

如有查詢，請與噪音政策組聯絡，電話：5-8351124。

致： 首席環境保護主任
環境保護署
噪音政策組
香港灣仔軒尼詩道 130 號
修頓中心 27 樓

28351018
28383111

寧靜建築設備資料

本公司是製造 / 供應寧靜的建築設備，願意提供本公司的產品並附上產品目錄 / 規格給 貴部門參考，日後若「消滅建築噪音實用指南」一書再版時，作為加添資料之用。

公司名稱： _____

機器類別： _____

聯絡人姓名： _____

職位： _____

地址： _____

電話： _____ 傳真機號碼： _____



HONG KONG POLYTECHNIC
LIBRARY

香港理工學院圖書館

DONATED BY

ENVIRONMENTAL PROTECTION
DEPARTMENT, H.K.

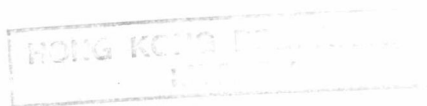
TB535
25

A PRACTICAL GUIDE FOR THE REDUCTION OF NOISE FROM CONSTRUCTION WORKS

ENVIRONMENTAL PROTECTION DEPARTMENT
NOISE POLICY GROUP
27th Floor, Southorn Centre
130 Hennessy Road
Wan Chai
Hong Kong

WITHDRAWN

July 1989



TB535
25

CONTENTS

	<i>Page No.</i>
LIST OF FIGURES	5
LIST OF TABLES	6
INTRODUCTION	7

Part I: Noise from General Construction Equipment

1. CONCRETE OR ROCK BREAKING EQUIPMENT	
1.1 Noise sources and noise control techniques	8
1.2 Silenced equipment	10
1.3 Alternative concrete or rock breaking techniques	11
1.4 Sound levels for various types of concrete or rock breaking equipment	17
2. POWER UNITS FOR VARIOUS TYPES OF PLANT	
2.1 Noise sources and noise control techniques	17
2.2 Silenced equipment	19
3. PORTABLE AIR COMPRESSORS	
3.1 Noise sources and noise control techniques	20
3.2 Silenced equipment	20
4. NOISE CONTROL PRACTICE ON SITE	
4.1 Selection of quiet equipment	21
4.2 Siting of equipment	21
4.3 Scheduling of work	21
4.4 Use of acoustic barriers	22
4.5 Use of acoustic machinery enclosures	23
4.6 Maintenance of equipment	24
4.7 Site supervision	24

Part II: Noise from Piling Operations

5. NOISE FROM PILE DRIVING	
5.1 Percussive piling methods	26
5.2 Non-percussive piling methods	27
5.3 Sound levels for various piling methods	27
6. QUIETER PROPRIETARY PILING METHODS	
6.1 Introduction	29
6.2 Internal Drop Hammers	29
6.3 Hydraulic Hammers	29
6.4 BSP Impulse Pile Driver	30
6.5 HUSH Piling System	31
6.6 Delmag Noise Reduction Mantle and the JASPP-type Sound-proof Cover	32
6.7 SERF Pilemaster	33

Contents—Contd.

	<i>Page No.</i>
7. CONTROL OF PILING NOISE	
7.1 Adoption of quieter piling methods	34
7.2 Use of resilient packing and dolly	34
7.3 Shrouding	34
7.4 Damping of steel pile	35
7.5 Scheduling of work	35
7.6 Maintenance	35
 Part III: Construction Noise Control Specifications and Clauses	
8. GENERAL CONSIDERATIONS	37
9. SPECIFICATIONS FOR TENDER AND CONTRACT	37
 Glossary of Acoustic Terminology	42
 References and Bibliography	43
 Appendices: Information on Commercially Available Quiet Construction Equipment, Noise Control Products and Quiet Concrete Breaking Techniques	44
APPENDIX A: SILENCED TYPE HAND-HELD PNEUMATIC BREAKER	45
APPENDIX B: HAND-HELD HYDRAULIC BREAKER	46
APPENDIX C: QUIETER CONCRETE BREAKING EQUIPMENT AND TECHNIQUES	47
APPENDIX D: SILENCED TYPE DIESEL/GASOLINE GENERATOR AND POWER UNIT	49
APPENDIX E: SILENCED TYPE PORTABLE AIR COMPRESSOR	50
APPENDIX F: NOISE CONTROL MATERIALS	51
APPENDIX G: SILENCERS	52
APPENDIX H: QUIETER PROPRIETARY PILING METHODS	53
 Additional Information	55

LIST OF FIGURES

	<i>Page No.</i>
Figure 1 Pneumatic breaker noise sources	8
Figure 2 Muffler design to reduce the exhaust noise and body radiated noise	9
Figure 3 Damping of ringing noise from the steel bit	10
Figure 4 Sound proof hammer bracket	11
Figure 5 Excavator-mounted hydraulic concrete crusher	13
Figure 6 Thermal lance set-up and operation	14
Figure 7 Non-explosive demolition method	14
Figure 8 Mini-concrete cruncher	15
Figure 9 Pile-cracker	16
Figure 10 Typical example of CARDOX in operation	16
Figure 11 Major noise sources for internal combustion engines and ancillary systems	18
Figure 12 Anti-vibration mounts	19
Figure 13 Enclosure for engine	19
Figure 14 Work schedule for removal of earth	21
Figure 15 Noise barrier	22
Figure 16 Example of a machine enclosure	24
Figure 17 Example of an enclosure for concrete breaking operations	24
Figure 18 Mucking-out yard for stockpile of spoil	25
Figure 19 Noise sources from percussive pile driving	27
Figure 20 Example of a hydraulic hammer	29
Figure 21 BSP ID17 Impulse Driver driving steel sheet piles	30
Figure 22 HUSH drop hammer piling rig	32
Figure 23 JASPP-type Sound-proof Cover	33
Figure 24 SERF Pilemaster Hydraulic Jack	34
Figure 25 Resilient packing and dolly	35
Figure 26 Acoustic shroud for pile driving	36
Figure 27 Flexible vinyl curtain for pile driving	36

LIST OF TABLES

	<i>Page No.</i>
Table 1—Comparison of sound levels for various types of concrete or rock breaking equipment	17
Table 2—Comparison of costs for standard and silenced type compressors	20
Table 3—Sound insulation materials for machine enclosures	23
Table 4—Approximate sound pressure levels in dB(A) Leq at 15 metres for various piling methods	28
Table 5—Sample specifications	38

INTRODUCTION

This booklet provides information on quiet construction equipment and working practices which will be useful in reducing noise from construction works. It is intended that the booklet will be updated and expanded from time to time and the Environmental Protection Department would therefore be pleased to receive any additional relevant information.

The booklet is arranged in three parts:

Part I : Noise from General Construction Equipment

Part II : Noise from Piling Operations

Part III: Construction Noise Control Specifications and Clauses

Part I and II of this booklet are for the benefit of contractors and other readers who might have little acoustical background. Part I describes ways in which noise from commonly used items of construction equipment can be reduced and Part II deals with noise from piling operations. Sound data for various items of equipment obtained from manufacturers and research institutions are also presented for information and comparison so that equipment producing less noise can be selected for the construction works. All of the silenced equipment described in Parts I and II are commercially available either in Hong Kong or overseas.

Part III gives examples of noise control specifications and clauses which can be incorporated into construction work contracts. The inclusion of such clauses is a useful preventive measure and can help to avoid unexpected and expensive noise control work during the construction phase.

The inclusion of any information of any company or product or reference to brand names of any particular product in this booklet does not in any way imply recommendation or endorsement by the Hong Kong Government. The inclusion or reference is for demonstration purpose only and the non-inclusion of any product or company herein shall not be construed as disapproval of the Hong Kong Government. The data regarding any product herein have been certified to be accurate by relevant manufacturers or their authorized agents or representatives. However, no warranty or guarantee whatsoever is or shall be construed as having been given by the Hong Kong Government in respect of any product referred to herein. Readers are advised to seek independent expert or technical advice regarding the operation, use, installation, maintenance or otherwise of any product referred to herein.

PART I: NOISE FROM GENERAL CONSTRUCTION EQUIPMENT

1. CONCRETE OR ROCK BREAKING EQUIPMENT

1.1 *Noise sources and noise control techniques*

Breaking of concrete or rock will normally involve the use of hand-held or excavator mounted breakers. In the case of pneumatic breakers, the noise is caused primarily by three sources, as shown in Figure 1. The relative magnitude of each source will vary according to the type of equipment. It should be noted that the elimination of only one source will not significantly reduce the overall noise level if other sources are left untreated.

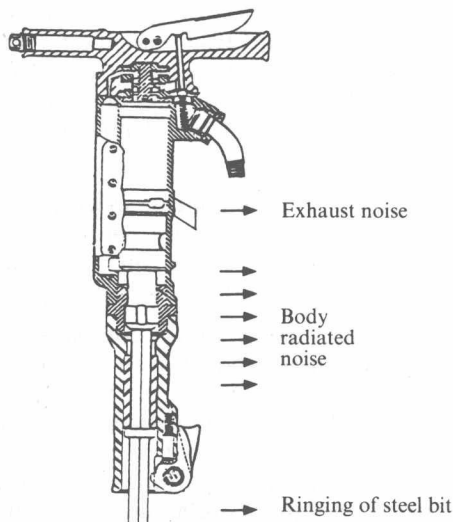


Figure 1 Pneumatic breaker noise sources

The principal noise sources are:

(a) Exhaust noise

Exhaust noise is generated by sudden release of exhaust air from the pneumatic breaker. This effect can be minimized by the use of a muffler which reduces the exhaust velocity of the air through a longer exhaust passage, thus reducing the impulsive character of the noise. In general, the use of a muffler can reduce exhaust noise by up to 15 dB(A) (see Figure 2).

(b) Body radiated noise

Body radiated noise originates from the cylinder enclosure and the front head enclosure, and is caused by the impact of the piston on the anvil and hammer body.

Some manufacturers provide mufflers which enclose the complete cylinder. These mufflers can reduce the body radiated noise by as much as 6 dB(A) (see Figure 2). It should be noted that wrapping the body with canvas or cloth will not result in any comparable reduction in noise.

(c) Ringing noise

The ringing of the steel bit causes a distinctive high frequency noise which is a result of the vibration caused by the impact of the bit on a rigid surface.

This high frequency ringing noise can be reduced by applying a constrained damping layer to the steel bit. There are commercially made dampers which incorporate steel collars to keep the damping material in place and protect it from abrasion (see Figure 3). The noise reduction by this method is about 3 dB(A). Such a noise reduction can subjectively reduce the degree of annoyance.



Figure 2 Muffler design to reduce the exhaust noise and body radiated noise
(Courtesy of Ingersoll—Rand Co.)

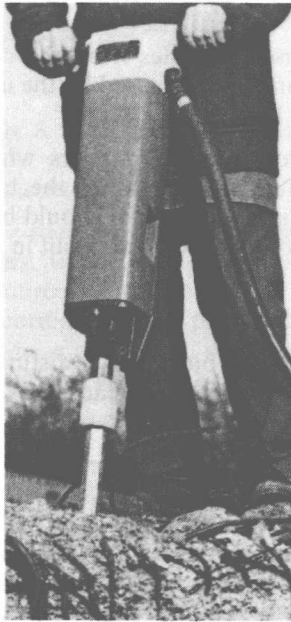


Figure 3 Damping of ringing noise from the steel bit
(Courtesy of CompAir Holman Ltd.)

1.2 Silenced equipment

(a) Hand-held pneumatic breakers

(Hand-held pneumatic breakers fitted with mufflers and damping collars as described in Section 1.1 are commercially available. Most of these are manufactured to meet either the European Economic Community directives or the noise emission standards established by United States Environmental Protection Agency. The average purchase cost for a silenced breaker is about 6% higher than that for a standard one. It should be noted, however, that due to the back pressure caused by the exhaust muffler, the power of silenced breakers may be slightly less than that of the standard item. Information on silenced type pneumatic breakers can be obtained from several manufacturers, including those listed in Appendix A.

(b) Hand-held hydraulic breakers

Unlike hand-held pneumatic breakers, hand-held hydraulic breakers do not generate exhaust noise. Noise from hand-held hydraulic breakers is, therefore, less disturbing and the noise level is typically 7 dB(A) lower than that of a comparable-sized pneumatic breaker. However, this is not the case for large capacity breakers for which body radiated noise is dominant.

The cost of adopting a hydraulic system is comparable to that of a pneumatic system and can in fact be more economical, particularly when the lower long-term operating costs are taken into account. Information on hand-held hydraulic breakers can be obtained from several manufacturers, including those listed in Appendix B.

(c) Excavator-mounted breakers

Excavator-mounted pneumatic or hydraulic rock breakers are amongst the noisiest items of general construction equipment, generating noise levels comparable to those caused by piling by diesel hammers. Figure 4 shows a commercially made hammer bracket which is applicable to a limited range of hydraulic breakers. The bracket is made of special alloy and the inside of it is lined with sound insulation material. The whole assembly, when fitted onto the hammer, may achieve a noise reduction of up to 10 dB(A). The cost of installing such bracket to a hydraulic breaker varies with the size and capacity of the breaker but would typically be around 10%–20% of the cost of the hammer itself.



Figure 4 Sound proof hammer bracket
(Courtesy of Krupp Industrietechnik)

1.3 Alternative concrete or rock breaking techniques

Described below are a number of quiet alternative concrete/rock breaking techniques available which can replace the conventional impact tools. Details of the manufacturers can be found in Appendix C.

(a) Excavator-mounted hydraulic concrete crusher

The crusher breaks concrete or other hard materials by bending and snapping, thus avoiding the generation of impact noise (see Figure 5). It is also suitable for breaking concrete foundations, asphalt pavement, floor slabs, columns and other concrete structures where reinforcing is to be cut or exposed. According to manufacturer's data, a crushing force of approximately 90 tonnes exerted by the jaws can be achieved. Breaking the concrete causes negligible noise and the overall noise level is no higher than that emitted by an excavator. In addition, the set of jaws can be replaced by a bucket with no major alteration for excavation purpose.

(b) Thermal lance

Use of a thermal lance is a quiet technique for boring or cutting which can be used in combination with other methods of demolition. The equipment cuts concrete or brick structures into small pieces for subsequent removal by an excavator. A thermal lance consists of a steel tube packed with steel rods and connected to an oxygen cylinder via a hose and a pressure regulator valve. Heat from the ignited oxygen stream maintains combustion of the steel with a flame temperature of about 3 500°C which is capable of cutting or burning holes through concrete (see Figure 6).

(c) Non-explosive demolition agent

This commercially available method works on the principle that a chemical agent is put into holes drilled in rock or concrete and the agent gradually hardens and expands resulting in the propagation of cracks and the breakage of the rock or concrete (see Figure 7). The depth, diameter and location of the holes are carefully designed to achieve maximum crack propagation. The fractured rock or concrete can subsequently be removed by an excavator.

(d) Mini-concrete cruncher

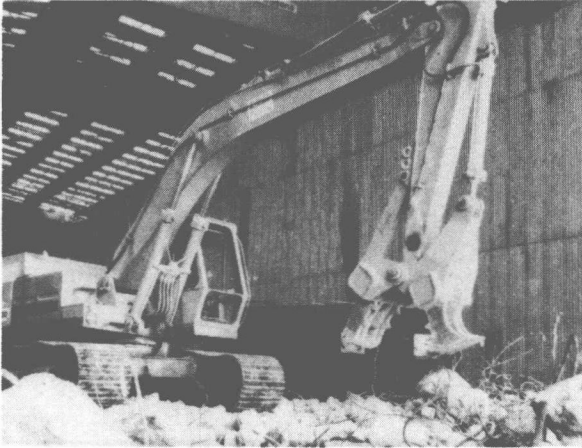
The equipment comprises of a silenced electric powered compressor and pairs of hydraulically operated jaws which are suitable for concrete wall demolition works. For bigger capacity, the cruncher is positioned by hand using a wire rope (see Figure 8). According to manufacturer's data, the crushing force exerted by the jaws can be as much as 52 tonnes. The noise level for such crunching operation is far less than that for conventional breaking method by a jack hammer. The equipment is commercially available in various sizes.

(e) Pile-cracker

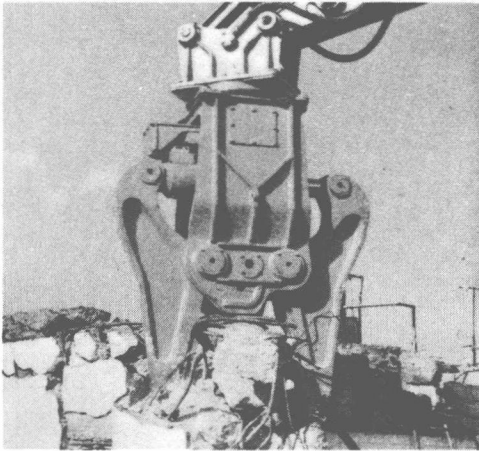
This commercially available equipment is specially made for breaking concrete piles without the emission of excessive noise. It consists of a number of hydraulically operated pistons which have pointed ends and operate in a radial direction. These pistons are extended towards the concrete pile, exerting a high compression force on the concrete and cause the concrete to crumble without damaging the reinforcement (see Figure 9).

(f) Cardox (Alternative to explosives)

The Cardox System uses the high pressure discharge of carbon dioxide gas to break down hard materials including rock and reinforced or mass concrete. The Cardox tubes, which consist of high tensile steel tubes filled with liquid carbon dioxide, are placed in holes drilled in the material to be broken. Upon application of an electrical charge, carbon dioxide is released at high pressure. The force exerted by this gas breaks up the material (see Figure 10).



(Courtesy of Allied Construction Equipment Ltd.)



(Courtesy of Nippon Pneumatic Mfg. Co. Ltd.)

Figure 5 Excavator-mounted hydraulic concrete crusher



Figure 6 Thermal lance set-up and operation
(Courtesy of Hong Kong Oxygen & Acetylene
Co. Ltd.)

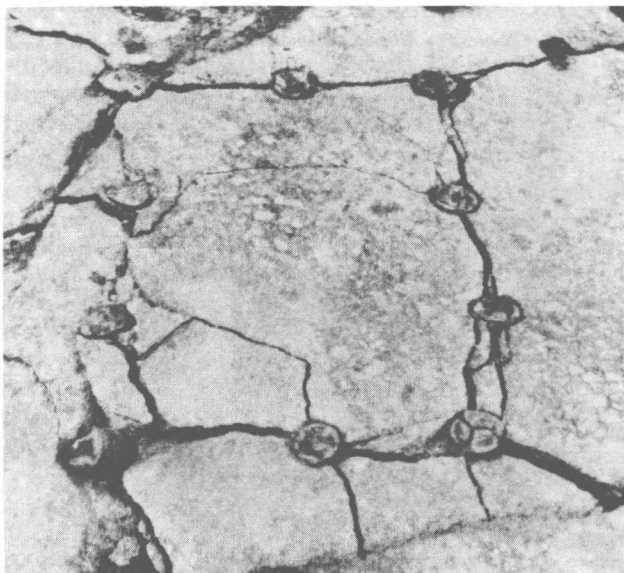
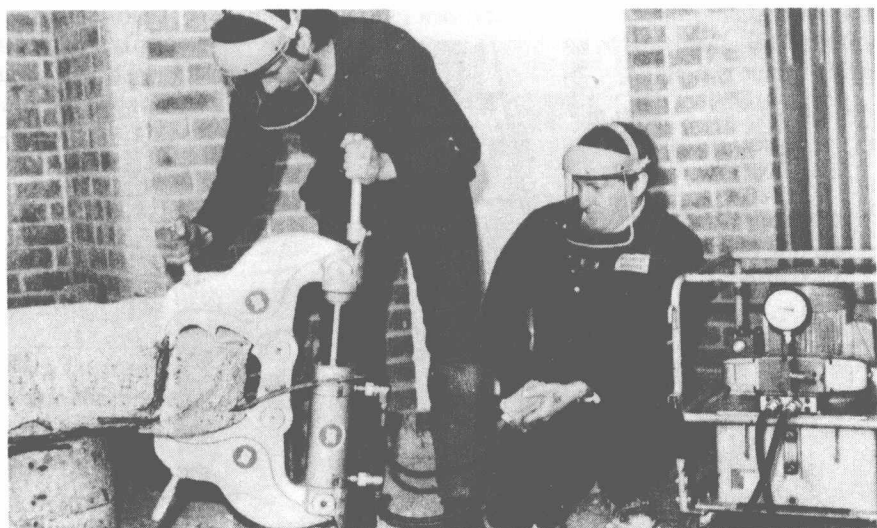
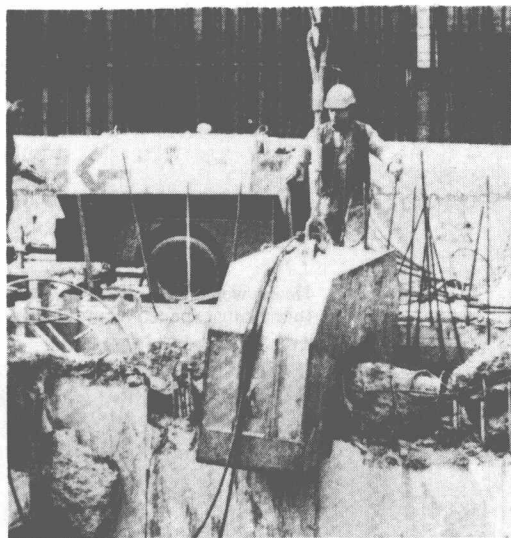


Figure 7 Non-explosive demolition method
(Courtesy of ONODA Corporation)



(Courtesy of Specialist Services)



(Courtesy of Diaber)

Figure 8 Mini-concrete crusher