ENFORCEMENT OF THE NOISE AT WORK REGULATIONS 1989 IN THE CONCRETE BUILDING BLOCK MANUFACTURING INDUSTRY AND THE METHODS OF NOISE REDUCTION DEVELOPED

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1. INTRODUCTION

1.1 Noise plays an important part in our everyday life and hearing is one of the two major senses with which we relate to our surroundings and communicate with our fellow human beings. It has long been established that excessive exposure to noise is likely to cause permanent and irreparable damage to hearing and may give rise to the affliction of tinnitus.

1.2 In Great Britain the Noise at Work Regulations 1989 (Ref 1) set out what has to be done to prevent such needless damage to hearing occurring at work. Broadly the duties which need to be addressed require:-

(a) A competent assessment of the likely level of exposure to noise (the risk) and of suitable measures required to obviate the risk.

(b) The provision of information and instruction for people exposed to the risk.

(c) Where required by the Regulations, the reduction of exposure to noise by reasonably practicable means other than the provision of personal ear protectors.

(d) Where people are still at risk after complying with (c), the provision of an effective ear protection programme.

1.3 The reduction of exposure by (c) above is a priority objective of the Regulations as required by European Community Directive 86/188/EC, which the Noise at Work Regulations 1989 are implementing.

1.4 This paper describes the application of the Noise at Work Regulations in that part of the Concrete Products Industry engaged in the manufacture of concrete building blocks and similar products made on block making machines which have combined pressing and vibration of the concrete aggregate in the moulds.

Note** Views expressed in this paper are those of the author and not necessarily those of the Health & Safety Executive.

NOISE IN CONCRETE BLOCK MAKING PLANT

2. THE MANUFACTURING PROCESS

2.1 One of several possible makes of block making machine is shown in FIG 1. All are similar in operating principle. A typical plant layout is shown in FIG 2.

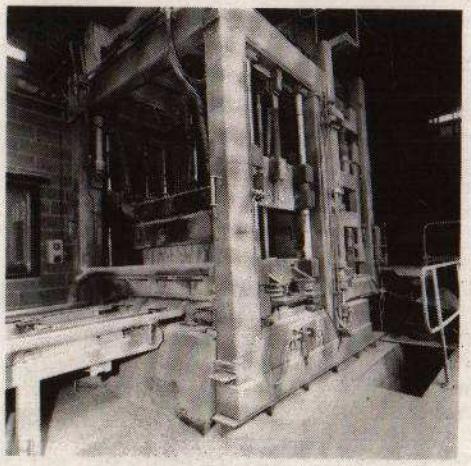

FIG 1 BLOCK MAKING MACHINE

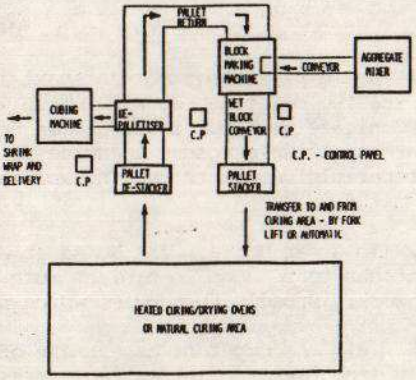

FIG 2 TYPICAL PLANT LAYOUT

The required raw materials are conveyed to the mixer and the mixed concrete aggregate is then transferred to the feed hopper of the block making machine, usually by belt conveyor. In some cases the mixer is located on a platform above the block making machine and the mixed aggregate is then dropped directly into the feed hopper.

2.2 Pallets of flat steel plate or wood are conveyed to the mould box area of the block machine and when located in position the pallet makes the floor of the mould in which the blocks are formed. A feed drawer filled with the requisite amount of aggregate then moves laterally over the mould box discharging the mix. During this filling stage the mould is briefly vibrated to aid filling, typically for less than one second. Once the mould is charged the feed drawer is then withdrawn to await the next cycle. The charge is then tamped into the mould by a combination of hydraulically driven rams compressing the mix from above and simultaneous vibration of the mould usually by out of balance weights. This compression and vibration phase of the cycle lasts typically for approximately 5 seconds and compacts the aggregate to the required size and density. The tamping head and the mould box walls are then raised and the compressed 'wet' blocks are conveyed on the pallet out of the machine. An empty pallet is then positioned and the cycle is repeated.

The complete machine cycle might take 15-30 seconds depending on product.

2.3 The pallet of wet blocks is then conveyed to a stacking machine and finally to the curing/drying area. Curing may be natural or in heated ovens. Following curing the blocks are conveyed to a de-palletiser separating the blocks from the pallet and finally to a cubing machine which packages the blocks ready for sale. The separated pallets continue on the conveyor back to the block making machine. Additionally in some plants the cubed stack of blocks are then wrapped in heat shrunk plastic film prior to despatch.

3. SIGNIFICANT NOISE SOURCES

3.1 The major source of noise exposure in block making plants results from the vibration phases of the block making machine cycle. Even though the machine is small in relation to the total plant, the intensity of noise produced during vibration is such as to significantly contribute to the noise dose of all the operators working in the plant even at positions remote from the machine. Sound pressure levels within one metre distance of the machine can exceed 115 dB(A) and for the block machine operator daily personal noise exposure ($L_{EP,d}$) will, for an untreated machine, typically be 100 - 105 dB(A). The contribution at other possibly manned work stations eg the mixer or the de-palletiser and cubing machines will obviously depend on the particular plant layout but commonly the $L_{EP,d}$ at these positions will be 95 - 100 dB(A) for untreated block machines.

3.2 Other possible sources of exposure are usually associated with the de-palletiser and cubing machine (another regularly manned work station). In most modern plants these are electrically and/or hydraulically actuated and do not emit hazardous levels of noise. In some older plants, however, the de-palletiser and cuber may be pneumatically driven and air exhaust noise can be a very significant source of noise emission and immission. Sample L_{eq}'s at cuber operators of between 95 and 100 dB(A) may result even without the block making machine running.

3.3 Other sources, generally of less significance, include the impact of pallets (particularly the steel sheet type) at transfer or turning points on the conveyor system, the hydraulic generator associated with the block making machine and the gas fuelled flame guns used for shrink wrapping of packaging.

3.4 The level of automation in block making plants varies. In modern installations the whole plant may be run by 2-3 operators. In older, less automated plants, a crew of 5-6 operators might be expected.

4. SURVEY OF THE INDUSTRY

4.1 Six plants were visited during late 1990 and early 1991 ie some

10 - 14 months after the introduction of the Noise at Work Regulations. The prime purpose of the visits was to assess compliance with the regulations in the sample visited and to take appropriate enforcement action, particularly under Regulation 7 which requires the reduction of exposure by means other than the provision of ear protectors. The plants visited ranged from small privately owned companies to large National corporations and from plants some 15 years old to those installed in the previous 12 months.

4.2 The degree of compliance with the various regulations at the time of those initial visits is shown in TABLE 1. Compliance was found to be, in the main, poor and there was no correlation between the size of company, the age of the plant installed, the noise produced or the likelihood of noise control measures having been taken. It was very clear, however, that those plants where effective enclosure for the block making machine had been provided resulted in much lower $L_{EP,d}$'s for operators than those without such provision, typically 10-15 dB(A) less. Operator $L_{EP,d}$'s for untreated plants were typically 100-105 dB(A) and for treated plants 85-90 dB(A).

4.3 In none of the plants visited had an adequate assessment of noise exposure and control methods been made. As a consequence compliance with the other regulations was often poor with the exception of those dealing with the provision of personal ear protection. In only two of the six plants visited had effective measures been taken to reduce noise exposure by engineering or organisational means, both by the provision of good quality enclosures for the block making machines. In these plants the operator $L_{EP,d}$'s had been reduced to less than 90 dB(A) and so several of the regulations did not apply.

All sites had suitable and adequate ear protection provided but some only marginally so. The frequency content and level of noise produced by block making machines requires the careful selection of ear protection.

All but one of the plants had ear protection zones marked but not always in accordance with the specific requirements of the regulations. Only one plant appeared to ensure the use of ear protection in the ear protection zones designated.

Where provision had been made for effective noise reduction the use of such provisions appeared satisfactory.

The understanding of the requirements of the regulations by management at almost all of the plants was poor. None had copies of the regulations or the associated HSE Noise Guides (Refs 2 & 3) available for reference.

5. ENFORCEMENT ACTION

5.1 During our initial visits considerable time was devoted to explaining deficiencies in compliance with the Noise at Work Regulations. Detailed advice was given on equipment and procedures for noise assessment and on the

construction of suitable enclosures for block making machines. This was followed up by formal enforcement procedures in the form of Improvement Notices served under the Health & Safety at Work Act 1974 and where required further advice. Formal action required the provision of effective noise reduction measures at block making machines and where necessary at ancillary plant, the maintenance of equipment already provided and the provision of information instruction and training for operators. In addition noise assessments have been requested.

5.2 The level of compliance at the plants following this enforcement is summarised in TABLE 2. Satisfactory improvements resulted from the combination of formal enforcement and implementing the advice given. In particular all of the plants now have effective noise enclosure of the main noise source, the block making machines.

5.3 The structured approach provided by the NAW Regulations for dealing with enforcement of their provisions proved useful although the natural progression of enforcement was not slavishly pursued. In particular where no effective noise control was provided this was immediately required by formal enforcement whilst at the same time requiring a noise assessment. Such enforcement has resulted in real improvements in the working environment for all of the operators in the plants. It is possible that $L_{EP,d}$'s in block making plant can be reduced to less than 85 dB(A), the first 'action level' of the NAW Regulations.

6. NOISE REDUCTION METHODS ADOPTED

6.1 The main means of noise reduction adopted and indeed the most appropriate has been the provision of effective noise enclosure at the block making machines. In two cases significant further reduction of exposure was achieved by fitting of silencers to control air exhaust noise at de-palletisers and cubing machines.

6.2 Enclosures provided have been either of standard acoustical panels or indeed built from the product itself, concrete blocks. Ideally the enclosure would be designed to surround the block machine completely. In practice up to four openings in the basic enclosure are required:

- an entrance for raw material input
- an entrance for the pallet
- an exit for the 'wet' blocks on the pallet
- possibly ventilating paths and extraction ducts for dust control.

Examples of enclosures provided and of the measures taken at the required openings are illustrated in FIGS 3-8.

6.3 Other considerations in designing suitable enclosures include:

- the provision of adequate space and possibly vehicular access to the enclosure for changing of the moulds
- adequate access for cleaning up of spillage
- access for major maintenance and overhaul of the machine
- provision of local exhaust ventilation to control and remove dust from the enclosure
- provision of good lighting in the enclosure and viewing panels in the enclosure wall for visual observation of the machine. Such panels require to be constructed to provide adequate acoustic insulation
- the proper interlocking of access doors to prevent access during machine operation. In some cases the original interlocked safety fencing was retained inside the enclosures provided
- the inclusion of the hydraulic generator inside the machine enclosure.

6.3 In existing installations limitations on available space makes the design, construction, installation and operation of effective enclosure more challenging. Where limitation on space makes provision of the required length of absorbent tunnel at the exit position difficult, an alternative shutter door, interlocked with the machine drives so as to remain closed during the vibration phases of the cycle is possible (FIG 7).

7. REFERENCES

[1] The Noise at Work Regulations 1989. ISBN 011 097790 4.

[2] HSE Noise Guide 1 - Legal duties of employers.

HSE Noise Guide 2 - Legal duties of designers, manufacturers, importers and suppliers.

Guides 1 & 2 in Single Volume - ISBN 0 11 885512 3.

[3] HSE Noise Guides 3 to 8: Noise Assessment Information and Control One Volume ISBN 0 11 885430 5.

[4] Report of Swedish Study Group on Noise in the Concrete Products Industry - Booklet 12 Block and Slab Machines
- Translated paper.

[5] Health & Safety Executive Specialist Inspector Report - Noise & Noise Control in the Concrete Products Industry - H Lester Specialist Inspector Report No.33 1992.

NOISE IN CONCRETE BLOCK MAKING PLANT

REGULATORY REQUIREMENT	BLOCK MAKING PLANT					
	A	B	C	D	E	F
COMPETENT ASSESSMENT	X	X	X	X	X	X
NOISE REDUCTION	X	X	√	√	X	X
INFORMATION & INSTRUCTION	X	X	X	X	X	X
PROVISION OF EAR PROTECTION	√	√	√	√	√	√
MAINTENANCE AND USE	X	X	√	√	X	X

TABLE 1: LEVEL OF COMPLIANCE AT INITIAL VISITS

REGULATORY REQUIREMENT	BLOCK MAKING PLANT					
	A	B	C	D	E	F
COMPETENT ASSESSMENT	√	√	√	√	√	√
NOISE REDUCTION	√	√	√	√	√	√
INFORMATION & INSTRUCTION	√	√	√	√	√	√
PROVISION OF EAR PROTECTION	√	√	√	√	√	√
MAINTENANCE AND USE	√	√	√	√	√	√

TABLE 2: LEVEL OF COMPLIANCE AFTER ENFORCEMENT

Key: √ Compliance X Non-Compliance or ineffective attempt

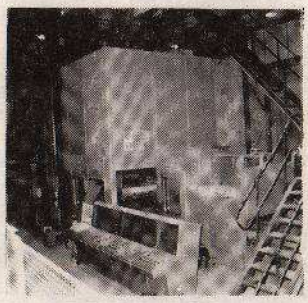

FIG 3. ACOUSTIC PANEL ENCLOSURE

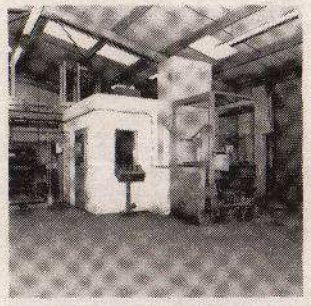

FIG 4. CONCRETE BLOCK ENCLOSURE

FIG 5. ABSORBENT TUNNEL AT BLOCK EXIT OPENING

FIG 6. ABSORBENT TUNNEL AT MATERIAL IN FLOW

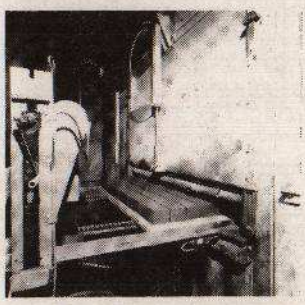

FIG 7. INTERLOCKED BLOCK EXIT SHUTTER DOOR

FIG 8. PLANT OPERATORS CONTROL ROOM