NOISE IN SHEFFIELD CITY CENTRE 1991 - 2001

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1. INTRODUCTION

Sheffield City Centre has undergone considerable regeneration in the last ten years. This has been very welcome in the city area as some predominantly industrial parts of the city centre had deteriorated significantly since the nineteen sixties. In some cases large areas of the city centre had became considerably rundown and an eyesore in recent years. Similar regeneration programmes have also been undertaken in other cities in the United Kingdom and the findings reported here may be of interest and applicable in these other locations as well.

The regeneration of Sheffield City Centre has led to many exciting new commercial and recreational developments in the city centre and many of a type not found in the past. This has however led to findings of new noise problems such as higher noise levels and for longer hours of the day and in some cases occuring in the late night and early morning hours. It is also found that there are now more people living in the city centre than previously. This has led to an increased incidence of noise complaints by people living in the vicinity of the noises. The impact of the noise is greater where previously there was quiet or when the offices and shops emptied after the usual working day comes to an end.

The study is based on archiving and analysing detailed environmental noise studies undertaken by students studying for the Acoustics units in the final year of their Engineering degree of the University as well as by those studying for the IOA Diploma in Acoustics and Noise Control and other research students since 1986. In 1990 the environmental noise measurements were extended and carried out to include the construction work of the World Student Games to be held in Sheffield. Since 1994 the study was further extended to look at the city wide construction works of the Sheffield Supertram rail network and in 1998 it was extended to include noise studies around some of the new city centre residential developments. These included some city centre student residences being built to house the increasing number of students coming to study at the two Sheffield Universities.

This paper looks at the ten year period from 1991 to 2001 and is centred on the area around Sheffield City centre near the Sheffield Hallam University (Figure 1). It looks at a selection of 10 of these city centre locations and compares typical noise levels measured in 1991 and those obtained ten years later in 2001. It is found that noise levels had increased dramatically in several areas although in some other areas there have also been important overall reductions.

CITY CENTRE DEVELOPMENTS

One of the earliest developments in this vicinity in recent years is that now known as the Cultural Industries Quarter (Figure 2). This began with the construction of the Red Tape Recording Studios on the site of the old Kennings motor showroom between Brown Street and Shoreham Street [1]. Other early developments in this area included the Ponds Forge Sports facilities built for the World Student Games hosted by Sheffield in 1991 as well as developments due to the gradual expansion of Sheffield Hallam University facilities on Pond Street and the former Sheaf Valley Baths.

Other major developments in the city centre around this time included the closing of the major city centre roundabout known famously as the Hole in the Ground and the downgrading and reduction of road traffic on the dual carriageway on Arundel Gate leading to it. This has reduced access to the city centre considerably but has been found to have also resulted in a significant reduction of daytime noise levels in this area. This development was followed by the citywide road surface tram network, the Sheffield or South Yorkshire Supertram [2], construction works which occupied many of the major city centre roads for months causing much difficulties to local businesses. Apart from the construction noise during this time, daytime road traffic noise was again significantly reduced during this time. Previous fears of aircraft noise from the new Sheffield Airport [3] were unfounded and scheduled flights do not fly over the city centre. This has been further reduced by recent major cutbacks in the number of aircraft flights here although a slight increase in the number of helicopter flights have been recorded.

At present the city centre development projects include several involving new commercial and recreational premises as well as private housing provisions. The latter residential developments are of concern together with that already mentioned for student housing from the point of residential noise requirements. Construction is also under way for developments including housing on the former Royal Hospital site on West Street, Devonshire Green, extensive refurbishment for new housing near the Peace Gardens, housing fronting the Sheaf River, housing developments in and around St Mary's Church and on Bramall Lane beside the grounds of Sheffield United Football Club. Apart from the construction noise currently being experienced, the impact of noise on these and other residential developments are being considered.

NOISE PROBLEMS

As discussed previously the regeneration of Sheffield City Centre is highly desirable and has led to many worthwhile benefits to the area. However it has been found that the resulting noise levels has been gradually creeping up in recent years. In one of the developments mentioned previously on West Street there is some potential concern regarding the noise from road traffic including cars, buses and HGV which all run on the same stretch of road together with the Sheffield Supertram. A further concern is that whilst these quieten down after daytime hours, the other developments like the public houses and restaurants go on into the evenings. This has associated with it the effect of noise from the public who use the establishment around it and entering and leaving from it at closing time.

There are also several nightclubs in the city centre such as those on Eyre Street, London Road, Division Street, Leadmill Street and on Arundel Street. High internal sound levels and insufficient attention to noise insulation often result in noise annoyance to their neighbours and residents. Some also have very long hours of opening often extending into the early hours of the morning (Figure 3).

It has been noted that several new residential developments have taken place near some locations where previously were only offices and commercial properties and disused factory

spaces such as Castle Square and the Truro Works. Other developments include one on a busy main road near one of the major local football grounds and another near a delivery road where early morning deliveries could cause major noise problems.

Noise prediction software can provide guidance to the general background noise levels in a particular locality (Figure 4). Although the predicted noise levels are not exact it is found that with a set of reasonably accurate input parameters they can provide a good estimate of the actual measured levels. Proposed property developers and planners can make use of these as a guide to the expected background noise levels in the locality in a preliminary noise estimate before embarking on a full scale development.

METHODOLOGY

The method used in this study follows that given under the guidance of BS 7445 - Description and measurement of Environmental Noise, using a Type 1 precision integrating sound level meter and other associated instrumentation. The measurements were taken at the various locations specified previously in the Sheffield City Centre. In some locations measurements were taken in in private as well as in student residences where secure facilities were available for long duration unattended measurements. Day, evening and night, manual as well as automatic measurements were taken and DAT recordings were made where appropriate. This was found to be useful as an additional check on the types of sounds being measured.

The LAeq unit is used throughout. LAmax, LAmin and LAE levels were also determined and will be used elsewhere in another paper to look at the correlation of the annoyance aspects of these noise parameters. Here the day-time period is taken as the twelve hours from 0700 to 1900 hours, evening period the three hours from 1900 to 2200, and night-time period the nine hours from 2200 to 0700 hours.

Measurements were taken wherever appropriate for the accurate and representative assessment of prevailing noise levels and with due consideration to safety constraints and security of the instrumentation. Measurements were taken at ground level 1.2m above ground and at least 1m from the kerb and 1m from the facade of the nearest building. In other cases measurements were taken at various building floor levels outside livingroom or bedroom window where available 1m from the building facade using an extension microphone cable.

LOCATIONS SELECTED

In this paper the results obtained from 10 Sheffield City Centre locations were studied and analysed. The locations chosen are as follows.

Three are located along Sheaf Street:
(A) near the Sheaf Square roundabout
(B) in front of the Sheaf Engineering Building, and
(C) halfway towards Park Square where the Sheaf Valley Baths used to be,
and three along Pond Street:
(D) in front of the Adsetts Library
(E) halfway up Flat Street
(F) beside Halfords House,
two along High Street:
(G) High Street beside Kings Chambers

(H) Church Street on the Cathedral Forecourt
and two along Shoreham Street:
(I) St Mary's Road, Matilda Street and Fornham Street beside Truro Works
(J) near Leadmill Street beside Cambridge Court

RESULTS

The typical variation of measured noise levels between some of the various locations in the city centre area as well as the variation according to the time classified as day, evening or night over the ten year period studied is shown below:

Table 1. Noise Levels in 2000

Sound Pressure Level LAeq for typical locations in city centre	Day	Evening	Night
A	75.8	62.4	58.3
B	79.7	66.4	54.2
C	79.1	65.8	52.7
D	70.2	65.7	44.2
E	76.1	68.7	44.5
F	75.3	68.3	45.1
G	73.5	66.2	46.2
H	70.4	64.1	46.1
I	71.6	65.2	52.7
J	71.3	69.4	55.5

To compare with the noise levels in Table 1 above, the noise levels found ten years previously in the same general locations can be compared in Table 2 giving the typical average measurements obtained in 1990.

Table 2. Noise Levels in 1990

Sound Pressure Level LAeq for typical locations in city centre	Day	Evening	Night
A	73.1	63.9	41.8
B	77.2	65.2	44.5
C	78.3	64.8	45.3
D	73.5	67.5	42.2
E	75.9	69.2	41.4
F	74.3	67.3	42.3
G	75.5	67.2	43.2
H	73.6	63.6	42.2
I	67.6	61.6	43.7
J	69.1	62.9	46.8

Table 3. Noise parameters - Typical variation in noise parameters at Truro Works

		Location 1	Location 2
$L_{A\ max}$ (A))	(dB	82,4	84,7
$L_{A\ min}$ (A))	(dB	60,3	59,2
$L_{A\ E}$	(dB (A))	88,7	90,9
$L_{A\ eq}$	(dB (A))	71,0	73,1

DISCUSSION

One of the areas looked at in the city centre is that known as the Cultural Industries Quarter and is now densely built up, housing a mix of offices, shops, restaurants and several recording studios and the new premise of BBC Radio Sheffield. It is a generally busy area with heavy road traffic including a high content of buses and heavy goods vehicles during the daytime hours (Figure 2). It is on the main arterial route of the A61 passing through Sheffield City Centre leading to the A57 and the M1 and is located near both the bus as well as the railway stations. In the eighties it was predominantly a block of disused buildings housing the former Kennings motor showroom between Brown Street and Shoreham Street which has been converted to form the Red Tape Studios [1].

The general noise levels in the city centre is understandable high. In some areas the daily variation of noise levels in general at the various locations in the city centre is also found to be large. This is usually due to high levels of road traffic noise as well as noise from users of the city centre during the day-time and which falls off at night-time. There is also considerable variation in the noise levels between the various locations observed.

In the ten years studied there has been an ever increasing demand for residential accommodation in the city centres. Traditionally the city centre had not been considered a desirable location which is even considered. The new trend is for sophisticated city centre living in high density high rise luxury developments. The noise problems associated with high density living had already been studied previously [4]. The trend seems to be for people mostly used to living in the quieter suburbs to move into these new apartments seemingly unaware of the likely problems associated with the move.

In recent years there has also been a steady increase in the student population in the Universities in Sheffield. At the same time there have been opportunities for student residence developments between the Universities and partnerships with private landlords which have led to a massive increase of student housing in the city centre. This has provided an opportunity for

noise studies without much of the access and security problems often encountered with such long term daily evaluations. Recent developments in Sheffield include Bramall Court on Bramall Lane, with 262 students, Truro Court and Truro Works on Fornham Street housing 245 students, Phoenix Court on West Street, with 203 students, and smaller developments and refurbishments, for around 50 students each, including Cavendish House on West Street, Halford House on Sheaf Street, Kings Chambers near Castle House, the developments on London Road, and the Old Bank on Ecclesall Road.

New themed public houses, coffee houses, restaurants, health clubs and recreational centres are gradually taking over many redundant city centre shops and banks. Many have long opening hours sometimes into the late evenings. In some cases this has led to more noise complaints from residential areas in the city centres.

The usual sources of daytime noise include the noise of people using the city centre workers as well as shoppers and road traffic noise increase as the working day starts. This followed by a gradual increase in number of cars coming into city centre for the morning shopping. A notable result of city centre development is the source of noise complaints coming from early morning noise from street cleaning and noise from deliveries to commercial facilities and supermarkets in the area. This was found to be attributed to either a new resident in the area, a new facility or an existing facility that has expended due to city centre regeneration. Higher noise levels were also found due to the new facilities provided by the regeneration. It was found that this was not generally considered to be a source of annoyance as the facility was enjoyed and the noise was generally masked by the higher day-time noise levels.

It was found that the night-time noise of the same level was not tolerated to the same extent due to the lower background noise levels which allowed the intrusion to be more evident as it is not masked out to the same extent. Also there was the general expectation of lower night-time noise levels which led to such as the 10 dB weighting of the Lden unit.

The city centre generally has very high levels of day-time road traffic noise and very much less traffic at night. This leads to a much quieter background noise levels due to lack of road traffic noise at night-time compared to day-time. This difference is often noticed by newer city centre residents who often complain of night-time noise. This often occurs at pub closing time and when windows are opened when the weather turns warmer. Night-time noise from restaurants, clubs and public houses were found to affect many residents living around, or in the case of some developments, directly above them.

In some locations studied, the hourly noise levels measured do not fall off as in other similar city centre locations but remains high as it is replaced by other sources of noise due to the new establishments and facilities brought into the city centre by the regeneration programmes. Another major source of noise complaints is that from noise from late night revellers and from the night clubs mentioned previously (Figure 3).

A good acoustic environment in city areas would be where the noise level is not to exceed Lden 45. A level of Lden 55 corresponds to a situation where 5% of the population is highly annoyed by noise. Average levels found at present in Sheffield City centre are around Lden 65 and higher in some of the locations studied.

It is evident that guidance on noise limits must be a major residential requirements due to the background noise levels residents expect. This must take account of day-time, evening or night-time hours. One approach is to specify satisfactory internal noise levels to ensure residents enjoy the quiet use of their homes and to produce sleep criteria.

In Sheffield this is achieved by the adoption of a design criteria standard based on the World Health Organisation Standard for sleep disturbance. The developer is required to submit planning application which includes a noise survey and a scheme of works which will ensure an internal noise level of 35 dBA Leq 2300 - 0700 hours. However in some cases such as in warm weather measures provided like double glazed windows would not give the acoustic insulation claimed. It may be preferable to aim at environmental noise levels as well. For example for areas where quiet is necessary such as hospitals or convalescent homes, guidance should be given such as day-time noise levels should not exceed 50 dB LAeq and night-time noise levels not to exceed 40 dB LAeq. Special treatment should be put in place where day-time levels exceed 60 dB LAeq and night-time levels exceed 50 dB LAeq.

CONCLUSION

The present work has included measurements and preliminary views of the users and residents in city centre developments. This has indicated problems which are generally to be expected as well as indicative of some new ones. The present paper has reported on some of the present noise levels found at present and those obtained ten years previously. This has been found to agree with a general increase of noise related problem complaints to the authorities in recent years.

City centre regeneration has been much valued but has led to a gradual deterioration of the noise climate in the area over recent years. Further work will be necessary to look at additional planning guidance for future city centre developers to ensure the much needed regeneration without further loss of the quality of the environment in the city centre. At the same time additional assistance will be obtained such as provided from noise predictions determined from techniques such as noise mapping software.

ACKNOWLEDGEMENTS

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Figure 1. Sheffield City Centre

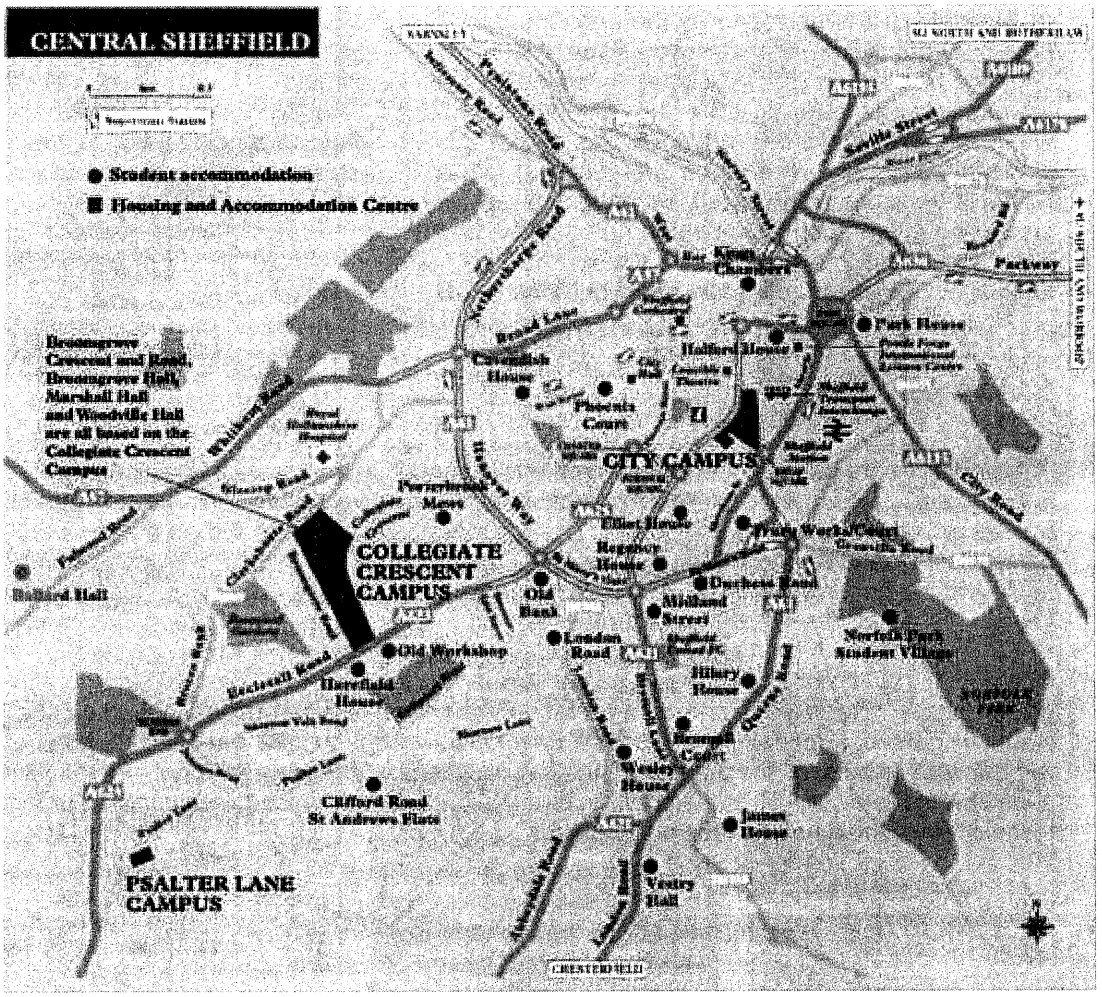


Figure 2. Traffic and construction on Shoreham Street

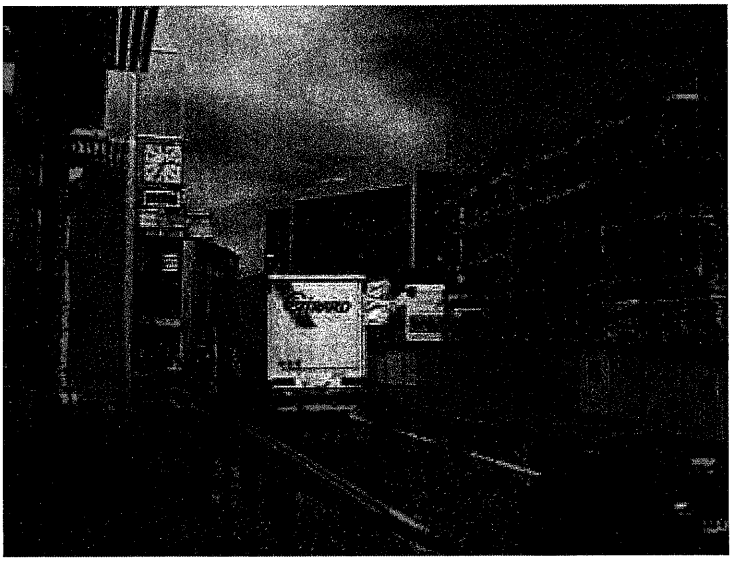
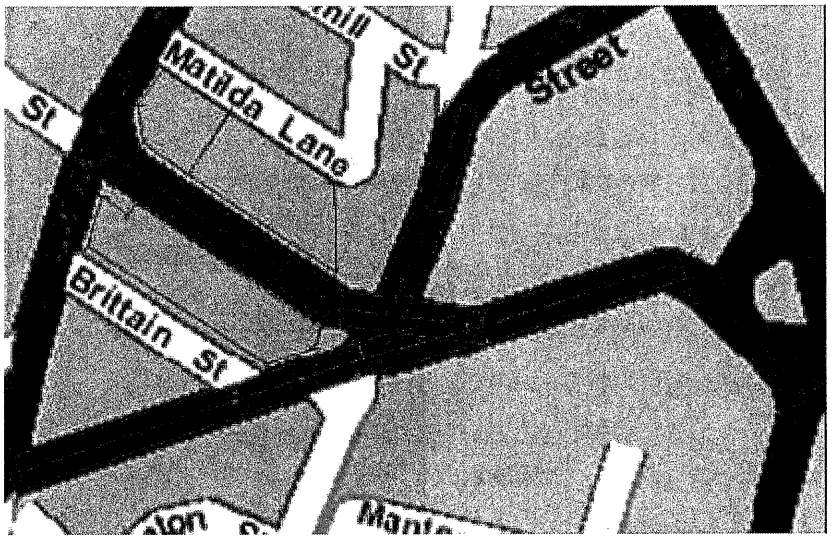


Figure 3. Late night noise from clubs.

Figure 4. Noise prediction on St Marys Road.


Matilda Lane
Brittain St
Street