

Design for Educationally Appropriate Acoustic Characteristics in Open Plan Schools

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Acknowledgements

This research could not have been carried out without the co-operation of the head teachers, staff and pupils of three primary schools, one in East Lothian, one in Edinburgh and one in Perthshire. The Charlton Smith Partnership, on behalf of the Project Steering Group and the Scottish Executive accordingly wish to use this opportunity to offer considerable thanks for this co-operation.

The research was predicated upon the assumption that to obtain the co-operation of participating schools it would be necessary to report any data relating to them so that they would not be identifiable. This would enable them to be open in their responses to questionnaires and avoid any unnecessary negative comment about the schools as a result of the report. For this reason plans of the schools, insofar as they are shown in the report, are stylised to attempt to retain this anonymity.

Nevertheless, it was thought that there might be aspects of the findings which could be of interest to the schools and an undertaking was given to each of them that a summary of findings would be made available upon completion of the research. In this way the schools could benefit from the research with information on issues which might assist in the development of each of the school's facilities.

Thanks are also due to the members of the Scottish Executive's project steering group, which has provided ideas and suggestions to help refine the methodology of this research. This steering group comprised members of Architectural Policy, Building Standards and Schools and Buildings Divisions.

Author's Views

The opinions expressed in this report are entirely those of the authors, formed on the basis of the research and the findings of the surveys. These views and opinions may not represent the views, opinions or policies of the Scottish Executive nor of the other participants in the research.

Overview and Summary

This provides a brief account of the Research and the contents of the main report so that the 'casual' reader can examine the broad findings of the Report without the need to read the detailed account which is the purpose of Sections 1 to 6. However, summarised findings and conclusions given in the Overview (Section 6) are often qualified in the text of the main report and the reader is recommended to review this in relation to specific practical issues before considering any further application of them.

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Foreword and Introduction

1.0

- 1.01** The research, which is the subject of this report, was stimulated by consideration of the impact of current guidance on the design of schools, and in particular the approaches adopted for the definition and control of standards, particularly those for acoustics and noise control.
- 1.02** Whilst there has been considerable development of what can be simply termed “open plan¹” schools since the 1960’s little UK guidance has been offered on how to design these schools to optimise acoustic conditions. Building Bulletin 51² offered some guidance on the implications of open plan design but did not provide any guidance on the noise levels typically generated within such teaching and activity areas. A subsequent Bulletin omitted any detailed guidance on open plan school acoustics and the recently published Building Bulletin 93 (BB93)³ permits the use of open plan designs only if they are shown to meet specific criteria for communication conditions. However, the Bulletin fails to provide any useful data on the noise levels typically generated within open plan schools to aid design to meet the required criteria and the Bulletin guides designers towards the use of cellular accommodation. Nonetheless the latest Bulletin provides detailed standards to be met in a finalised design and designs are required to meet these standards under England and Wales Building Regulations.
- 1.03** There are, however, other reasons than communication and privacy for considering the use of “open plan” forms of school accommodation not least of which are flexibility of use of accommodation; easier oversight of pupils (and staff); maximisation of the use of space (particularly circulation space, which is otherwise little used during the majority of the teaching day) and integration of pupils across the ages cohorts helping generate a sense of the school as a community.
- 1.04** It was also felt that guidance on the acoustics of schools, as set out in BB93, is geared to the detailed development of a design rather than providing designers with strategic guidance. Accordingly it was felt that there is a need for some information on the basic advantages / disadvantages and acoustic implications of open plan and cellular plan primary schools so that clients and designers could make appropriate choices at early project inception stages.
- 1.05** One of the issues that was a determinant of the guidance in BB93 was that of providing appropriate learning conditions for those whose hearing is impaired, an issue which will clearly need to be considered in the Scottish context of new schools development. The Report therefore comments on these issues and suggests possible strategies for consideration.
- 1.06** The Research was therefore conceived as a scoping study which would examine some of the principal issues in ‘open-plan’ versus ‘cellular’ designs of school teaching / learning space with a view to establishing factors which ought to be taken into account in strategic decision making. If possible the research would establish some of the fundamental implications of choices of plan form and means of acoustic control and suggest guidance

¹ ‘Open plan’ is used in the sense that classrooms and activity areas / circulation spaces are linked for flexible use; semi-open plan is a better, but more clumsy, descriptor thus, for convenience, the term open plan is used in this report.

² Building Bulletin 51, DES, 1975

³ Building Bulletin 93, published by the DfES, sets performance standards for the acoustics of new buildings and describes the normal means of demonstrating compliance with the Building Regulations for England and Wales.

on some aspects and, perhaps, the need for guidance on others.

- 1.07** Underlying the work was the need to be able to provide advice for decision makers on the fundamental implications of plan-form in terms of advantages and disadvantages of each and the implications that each would make on the fabric and systems which would be required as a consequence of those choices if adequate communication conditions are to be provided in new schools.

Background

2.0

2.01 Introduction

A literature search did not form a significant part of the research programme. However, to establish the context for the work commissioned and carried out a resumé of some background material is presented here.

2.02 Implications of Building Bulletin 93

One of the assumptions in Building Bulletin 93 was that internal activity noise will be dealt with by sound insulation between rooms and therefore does not include contributions of activity noise in the assessment of classroom ambient noise levels limit of 35dB $L_{Aeq, 30mins}$. This presents a number of possible problems, not least that educators and designers are still looking to open-plan designs to offer economy and flexibility of space use, amongst other benefits. The result is that there may not be the necessary sound insulation between rooms that the Bulletin assumes where cellular accommodation is provided and this can impact upon listening and communication conditions. The Building Bulletin discourages the use of open plan teaching spaces and calls for detailed acoustic modelling. However, this is hampered by the lack of information in the Bulletin relating to the performance of such spaces, the levels of noise generated by open school activities and so on.

Some, unpublished research¹ was carried out some 30 years ago (1969 – 1972) into aspects of the acoustics of open plan schools (in the UK) at about the time that open plan schools were first introduced in significant numbers into middle school secondary education. At that time the acoustics of open plan schools were not considered by the Department of Education and Science and the BRE to present any significant problems in terms of communication and comfort and for this reason there was no imperative to publish the results of the research even though it was clear that the information revealed could be useful to designers. This research provides the only work known to the authors containing detailed information on the levels of noise generated in open plan schools and the responses of users to the acoustics of such schools.

2.03 Open Plan Schools: Background Research

In the late 60's and early 70's of the last century a range of open plan schools were built to meet the needs of new teaching methods, notably "integrated day" teaching and to maximise flexibility of the use of space. It should also be noted that a significant driver towards open planning was the benefit of using what had formerly been corridor spaces between rooms as general activity / wet areas, in other words, using them for teaching rather than merely for movement. This was particularly important where elements of school accommodation was rated and based upon specific pupil numbers.

Many open plan schools were designed for primary teaching but later a number of schools, notably in the (then) West Riding of Yorkshire, were built for use as Middle Schools. The first of these was the Delf Hill Middle School in Bradford which is described in some detail in Building Bulletin 35 (1966), as it was a DES Design Unit project. The plan of this school is shown in Figure 2.1 below.

¹ 'Some Acoustic Problems of Open Plan Schools' N C Smith, University of Nottingham, 1974

This school was used as a pilot for the research study referred to above which then studied Grimethorpe Middle School, the first of a series of 8 open plan middle schools built in the 70's in the West Riding.

The open plan forms of these schools were similar, indeed they were all variations on the Delf Hill theme. However, the detailed planning of the two schools was significantly different with Grimethorpe School (see Figure 2.2 below) having sliding partitions to close off teaching spaces from general activity areas whilst Delf Hill School employed much wider use of carpet on teaching space floors (not in activity areas). In addition Delf Hill Middle School was in an urban location and was exposed to some intrusive road traffic noise, whilst Grimethorpe Middle School was in a rural location with little road traffic close to it.

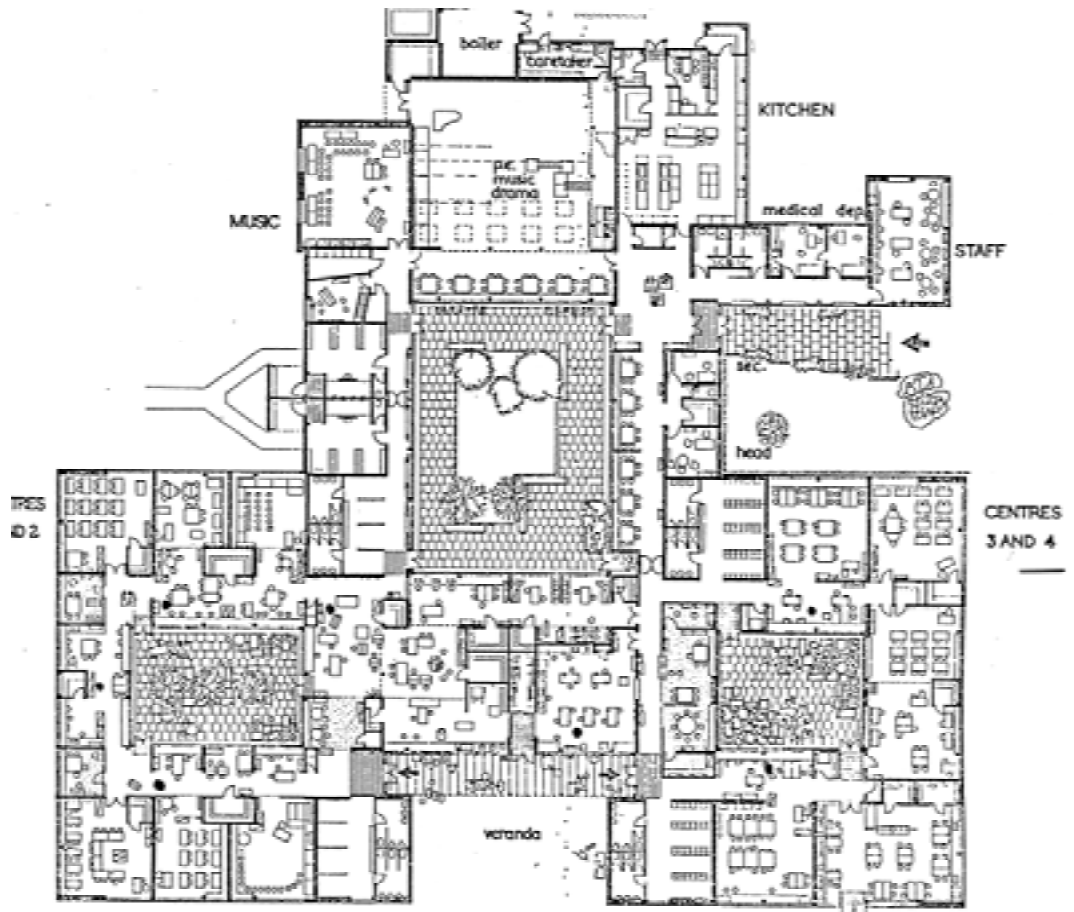


Figure 2.1: Plan of Delf Hill Middle School

2.04 The Research Results - in Brief

The two schools were studied in some detail to establish internal sound levels in a range of spaces and covering various uses / activities and to derive 'reliable' descriptors of internal sound levels and other measurements to inform design. Questionnaires were also administered to school children and teaching staff to establish basic responses and attitudes to acoustic environment.

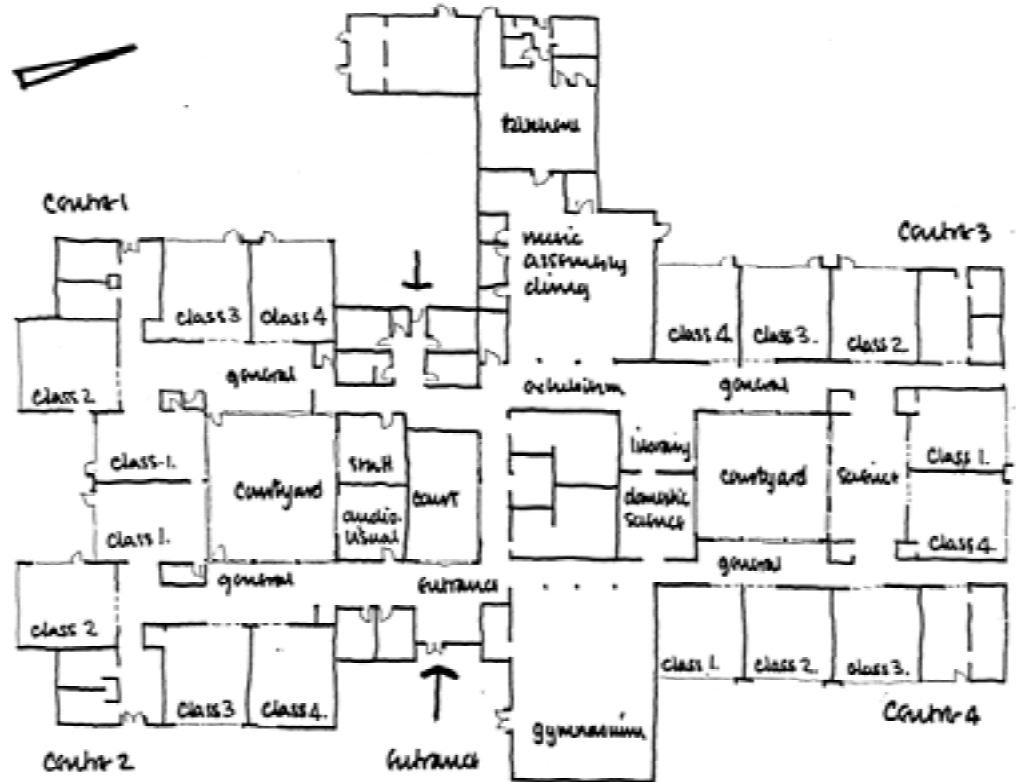


Figure 2.2: Plan of Grimethorpe MS

After completion of the field-work laboratory analogue tape recordings were analysed to establish:

- Modal levels (most frequently occurring levels)
- L₁₀ and L₉₀ levels and
- Sound spectra

for occupied and unoccupied spaces. Sound spectra were then used, together with the values obtained for modal, L₁₀ and L₉₀ levels to establish the Articulation Index and related communication rating for each condition. [Note: L_{eq} was not at this time a descriptor in general use.]

Detailed statistical analysis of the cumulative data provided mean values, standard error values and from these the 95% and 99% confidence levels. For the Delf Hill School with data analysed at a 10% sample rate.

Noise Generation		dB(A) - occupied	dB(A) - unoccupied	Articulation Index (occ)	Communication Rating (occ)
	Modal levels	57.8	N/a	0.38	Fair
	L ₁₀ levels	64.9	N/a	0.09	Minimal
	L ₉₀ levels	53.1	N/a	0.52	Good
Attenuation (Lin)	13dB / doubling of distance over approximately 30 metres				
Mean Reverberation Times (Lin)				Occupied	Unoccupied
	Open plan Classrooms			0.42 secs	0.61 secs
	General activity areas			0.46 secs	0.61 secs

Table 2.1: Data from Delf Hill Middle School

Confidence levels for the noise generation data were of the order of:

	95%	99%
Modal:	±0.36dB(A)	±0.54dB(A)
L₁₀:	±0.46dB(A)	±0.69dB(A)
L₉₀:	±0.46dB(A)	±0.69dB(A)

Noise Generation		dB(A) - occupied	dB (A) - unoccupied	Articulation Index (occ)	Communication Rating (occ)
	Modal levels	61.4	50.9	0.25	Poor
	L ₁₀ levels	68.8	56.9	0.03	Nil
	L ₉₀ levels	56.2	48.7	0.43	Fair
Attenuation (Lin)	3dB / doubling of distance over approximately 10 metres				
Mean Reverberation Times (Lin)				Occupied	Unoccupied
	Open plan Classrooms			0.5secs	0.5secs
	General activity areas			0.47secs	0.62secs

Table 2.2: Data from Grimethorpe Middle School

Confidence levels for the noise generation data were of the order of:

	95%	99%
Modal:	±0.42dB(A)	±0.63dB(A)
L₁₀:	±0.48dB(A)	±0.72dB(A)
L₉₀:	±0.32dB(A)	±0.48dB(A)

2.05 Subjective Responses

		Year 1	Year 2	Year 3	Year 4	Overall
QUESTION 1: Adjectival check list yes no responses Do you think this word describes your school?						
Quiet	Yes %	53.6	40.7	41.9	31.9	42.4
	No %	46.4	59.3	58.1	68.1	57.6
Noisy	Yes %	46.4	69.5	46.5	51.1	54.1
	No %	53.6	30.5	53.5	48.9	45.9
QUESTION 4: Is your school generally ? If it could be changed would you like it to be?						
School generally	Noisy %	39.3	54.2	41.9	42.6	4.9
	Quiet %	60.7	45.8	58.1	55.3	54.6
If changed	Noisier %	0	0	2.3	2.1	1.0
	Quieter %	55.4	44.1	37.2	38.3	44.4
	Same%	44.6	55.9	60.5	57.4	54.1
QUESTION 5: Is your classroom generally ? If it could be changed would you like it to be?						
Classroom generally	Noisy %	50	78.0	58.1	42.6	58.0
	Quiet %	50	22.0	41.9	57.4	42.0
If changed	Noisier %	1.8	0	2.3	2.1	1.5
	Quieter %	62.5	62.7	44.2	38.3	53.2
	Same%	35.7	37.3	53.5	59.6	45.0

QUESTION 6: Is your activity area generally ? If it could be changed would you like it to be?						
General area	Noisy %	39.3	47.5	32.6	38.3	40
	Quiet %	60.7	52.5	67.4	61.7	60
If changed	Noisier %	1.8	0	2.3	2.1	1.5
	Quieter %	48.2	52.5	32.6	36.2	43.4
	Same%	50.0	47.5	65.1	61.7	55.1
QUESTION 7: How do you react to noise when working?						
Dislike noise when working	%	89.3	94.9	95.3	95.7	93.6
Like noise when Working	%	10.7	5.1	4.7	4.3	5.9

Table 2.3: Subjective Responses of Pupils at Milefield Middle School

2.06 Conclusions from the Delf Hill MS / Milefield MS studies

The results of the studies demonstrated that communication conditions in general activity areas were not satisfactory and subjective responses showed that classrooms conditions were even worse. There were fairly serious problems to be dealt with in the design of open plan schools if this plan form were to be used in future school design. The conclusions were that designers should give further attention to a range of issues in developing school provision. The study identified some issues which would help provide significant reductions in ambient levels during school activities. These included:

Communication Standard	Sound levels in dB(A)	
	L ₁₀	Modal
Maximum (for communication)	66	58
Mean	62	54
Minimum (for privacy)	58	50

Suggested design options included:

- Reduction in occupancy levels / more area per pupil (c.f. open-plan office design)
- Increased distances between noise producing area
- Increased use of absorbent surfaces (Grimethorpe MS had limited carpet provision) in floors, ceilings and partitions - focusing on 1000 to 4000 Hertz absorption)
- Reductions in reflective surfaces especially glazing (at this time schools were designed to a 2% daylight factor which produce very large areas of glazing)
- Isolation of very noisy areas e.g. music rooms, gymnasias, halls, etc
- Reduction of noise intrusion from road traffic et alia.

It was acknowledged that some of these solutions would impact upon project budgets.

2.07 Updating work

Involvement of the research consultants in recent school design work provided a limited opportunity to check generated internal levels (quick samples over half-day visits) in two schools.

Abernethy Primary School, nr Perth: Levels in the general activity areas close to open teaching areas, separated by partial height partitions which extend to 1 metre (approximately) below ceiling level are given in Table 2.3 below. Floors are carpeted and ceilings consist of perforated metal with absorptive linings but there is no specific vertical provision of absorption.

Location	Area 1	Area 2	Area 3	Mean values / Differentials
L ₁₀	62.3dB(A)	60.8dB(A)	58.3dB(A)	60.5dB(A)
				2.7dB(A)
L _{eq}	59.8dB(A)	58.3dB(A)	55.2dB(A)	57.8dB(A)
				2.6dB(A)
L ₅₀	57.3dB(A)	55.6dB(A)	52.6dB(A)	55.2dB(A)
				4.5dB(A)
L ₉₀	53.0dB(A)	50.8dB(A)	48.3dB(A)	50.7dB(A)

Table 2.4: Sound levels measured within general activity areas at Abernethy

Auchterarder Primary School, Perthshire: Levels in the general activity areas close to open teaching areas, separated by partitions which extend to ceiling level (but holes in roof beams permit some sound transfer). Floors are carpeted and ceilings have absorptive linings. There is no specific vertical provision of absorption.

Location	Area 1	Area 2	Area 3	Area 3	Area 3	Mean values / Differentials
L ₁₀	50.6 dB(A)	74.1 dB(A)	67.3 dB(A)	66.1 dB(A)	63.2 dB(A)	64.3 dB(A)
						2.8 dB(A)
L _{eq}	47.9 dB(A)	70.9 dB(A)	64.9 dB(A)	63.3 dB(A)	60.3 dB(A)	61.5 dB(A)
						2.3 dB(A)
L ₅₀	44.7 dB(A)	68.9 dB(A)	62.6 dB(A)	61.6 dB(A)	58.0 dB(A)	59.2 dB(A)
						4.3 dB(A)
L ₉₀	41.2 dB(A)	63.1 dB(A)	58.3 dB(A)	57.7 dB(A)	53.9 dB(A)	54.8 dB(A)

Table 4: Sound levels measured within general activity areas at Auchterarder

Approximations of L_{eq} values at Grimethorpe and Delf Hill Data were obtained by applying the differentials derived from the above data. Accordingly it was tentatively suggested that L_{eq} levels will be some 3dB(A) above the L₅₀ levels obtained in the surveys at Delf Hill and Grimethorpe.

For modelling sound distributions in open plan schools this suggests that communication standards should relate to:

Communication Standard	Sound levels in dB(A)	
	L ₁₀	L _{eq}
Maximum (for communication)	66	61
Mean	62	57
Minimum (for privacy)	58	53

This is, of course, based on the use of the “Articulation Index” – which remains a simple tool for design purposes.

2.08 Miscellaneous

- ▶ **New Zealand Research:** Recent research into Classroom Acoustics in New Zealand (Oticon Foundation 2000/ 2001, Wellington info@oticon.org.nz) was concerned with improvement of communication conditions in classrooms and investigated a number of issues including speech perception with simulated background noise conditions.

Whilst the classrooms were cellular, surveys indicated that noise generated within classrooms was a problem (for 71% of teachers surveyed) and vocal effort was also a significant issue. Many teachers commented that noise is at a level that significantly increases stress and irritability for teachers. 35% of the teachers complained that the level that they needed to speak at strained their voice.

61 % of teachers reported that most or all of the noise created inside the classroom is student generated. Computers were the most commonly identified other source of noise generated within the classroom. 86% of the teachers surveyed have problems with noise generated outside the classroom eg. from nearby classrooms, corridors, decks, sports fields, lawnmowers, and road traffic noise. Rain noise, and toilets and hand dryers from cloakrooms, were commonly noted in the “other” noise source category.

The combined effects of New Zealand’s interactive teaching style and reliance on opening windows for ventilation, result in high noise levels in the classroom. This results in difficult listening conditions for all children but especially disadvantages hearing impaired children.

Measurement of reverberation periods for classrooms showed that classrooms rated ‘good’ in teacher surveys typically had a mid-frequency (average of 500 Hz & 1kHz) reverberation time (Rt) of 0.4 seconds whilst the mid-frequency reverberation time in “poor rooms” ranged from 0.53 to 0.63 seconds, with an average value of 0.57 seconds.

Previous NZ research has shown that unoccupied classroom noise levels range from 28-60dBA. In occupied classrooms the signal-noise-ratios are constantly fluctuating throughout the day and single figures do not give an indication of the range a child encounters. New Zealand classrooms differ from North American and European schools. In overseas schools excessive reverberation (from predominantly hard surfaces), and high background noise levels from heating/air-conditioning/mechanical ventilation are the main problems. New Zealand classrooms, being carpeted, typically have lower levels of reverberation than many overseas classrooms, but have high levels of student generated noise, and high levels of intrusive external noise due to open windows.

Speech Testing: The results of the speech perception tests for normal hearing children did not differ significantly between the good and poor rooms. Using recorded background noise the speech score results were relatively consistent with the majority of scores falling in the range 80-100%. However, when live noise sources were assessed the scores fluctuate widely, ranging from 0 – 98%, with more than 40% of the scores falling below 50% correct. These results reflect the poor signal-to-noise ratio and show a clear difference between speech testing carried out in controlled conditions and speech testing carried out in a real room situation.

- ▶ **Hearing Impaired Subjects:** The best performance by hearing-impaired children was obtained by those using FM systems, despite these being the children with the greatest degree of hearing loss. Children with degrees of hearing loss regarded as minor to moderate, fitted with normal hearing aids, performed very poorly in the speech testing, with the majority of scores ranging between 0-50%. Half of these children scored less than 20%.

Children with severe hearing loss who were fitted with FM radio hearing aids in addition to their normal hearing aids performed quite well, with the majority of scores ranging between 50-90%.

- ▶ Such systems (radio microphone systems) are available in the UK through the Royal National Institute for the Deaf (RNID) and will assist those with moderate to severe hearing loss, dependant upon the type used. (Costs are currently £455 to £479 excluding Vat.)

- ▶ **Summary/Recommendations:**
 - High levels of student generated noise and intrusive external noise are problems for the majority of teachers surveyed.
 - The predominant teaching methods of primary school teachers are group work and mat work.
 - For this style of teaching an absorptive ceiling (moderate broad-band absorption to central ceiling) is strongly preferred. A low reverberation time in occupied classrooms of 0.4 seconds or less is recommended.
 - In the siting of classrooms / school design, consideration should be given to outside noise sources, both within and outside of the school e.g. proximity to the bus stop, main roads, school hall, playing fields etc.
 - Noisy activities such as lawn-mowing should be rescheduled to occur outside of school hours.
 - External decks need to be supported independently from classroom structure.
 - Carpet over underlay is the recommended floor covering to reduce noise from footfall and furniture movement.
 - A more solid floor construction is recommended to reduce the drumming associated with particleboard floors - perhaps two layers of particleboard instead of one.
 - FM technology is recommended for hearing impaired children.

- ▶ **The Report also commented on other research and studies:** Of particular relevance to the current study were comments relating to two pieces of work the first, research by Bradley / Bistafa² on theoretical values for speech metrics for a 300cu.m. classroom, which suggest that for very quiet classrooms (signal-to-noise ratio 20-30 dB) a reverberation time of 0.1-0.3s maximises speech intelligibility metrics, but 100% speech intelligibility is still possible with a reverberation time of 0.4-0.5s, and this is the range recommended by them. For noisier classrooms with a signal-to-noise ratio of 10 dB, speech metrics drop off below reverberation times of 0.3-0.4 seconds.

The second relates to work carried out by researchers from Heriot-Watt University, Scotland³ who carried out a study of the acoustics of primary school classrooms in the United Kingdom. A reverberation time design guideline of 0.4 seconds was derived for classrooms that were acoustically treated. It was considered that useful sound would not carry well enough in the classroom environment if the room were to be made "too dead". This study also established that average levels within a range of classrooms, where children were working in groups, was some 77.3 decibels and even where classes were 'quietened down' with absorbent surfaces, levels would typically be of the order of 56dB which required teachers to use raised voices to make themselves understood. 68.5% of 126 teachers surveyed indicated that they suffered voice and throat problems.

² Bistafa S. R. & Bradley J. (1999) Reverberation time and maximum background-noise level for classrooms from a comparative study of speech intelligibility metrics. Institute for Research in Construction–Acoustics National Research Council–Canada.

³ MacKenzie, D.J. Speech Intelligibility in Classrooms. Lecture presented to NZ Acoustical Society, March 1999.

- ▶ **The Business Academy at Bexley:** Recent comments on the performance of this RIBA Stirling Prize finalist indicate that the open plan nature of this secondary establishment has contributed significantly to its success as a learning environment – running counter to the guidance in BB93.

Whilst the required teaching conditions in this academy will no doubt be different from those required for primary teaching anecdotal comment indicates that noise is an issue in the performance of the academy but that this is balanced by the other advantages of the open plan form. Investigation of the performance of this provision might well yield useful post occupancy evaluation data that could be valuable in considering open-plan issues across differing types of school provision.

- ▶ **Kingsmead Primary School, Cheshire:** This award winning school (view at <www.kingsmead-school.co.uk>) has been designed to have a cellular plan form but nevertheless makes provision for the hearing impaired by use of a sound-field system – a provision which is applied across Cheshire County Council schools. This consists of a teacher based roving (lapel) microphone, an amplifier and a number of small loudspeakers distributed around each classroom. When a teacher judges that additional sound signal is needed by any hearing impaired pupil in the classroom the amplifier is adjusted accordingly.
- ▶ **Noise Induced Hearing Loss:** A concern of the Project Steering Group that childrens' hearing might be affected by the levels of noise in schools more so than the hearing of adults (thus implying a need for different noise exposure criteria to be applied) has been checked with Professor Mark Lutman at the Institute of Sound and Vibration at Southampton University (referred by the RNID). The advice is that there is no evidence to support that thesis and that noise exposure criteria to be applied are the same for children and adults.

Scope and Methodology

3.0

3.01 Project Scope

Initial discussions on the scope of the research were based upon the following:

- a. Select three schools for study (different parts of Scotland, different concepts);
- b. Arrange with schools to attend and survey the generated and background sound levels and specific acoustic parameters over 2 full teaching days each, carrying out short questionnaire surveys with teachers and samples of pupils during these attendance periods;
- c. Analyse data in terms of (simple) communication and privacy criteria and establish a series of basic design guidelines;
- d. Prepare short report on the study and findings and draft Guidelines Document / "Practice Note" for designers.

Subsequent discussions resulted in the following research brief (based on the contract documentation):

3.02 Research Outline

- ▶ **Introduction:** The School Premises (General Requirements and Standards) Scotland Regulations 1967 sets out in very broad terms the general standards for school building, e.g. site areas, overall accommodation areas etc. Regulation 25 covers "Acoustic Conditions" and all that it says is "*Every part of the school building shall have acoustic conditions and insulation against disturbance by noise appropriate to the use for which the part of the building is designed.*" Regulation E4 of The Building Regulations 2000 in England and Wales covers acoustic conditions in schools. This is supported by Approved Document E, "Resistance to the Passage of Sound" and Section 8.1 of 'AD: E' provides guidance on complying with regulation E4, which calls up the document, Building Bulletin 93: "The Acoustic Design for Schools".

Good acoustic design is one aspect of a sustainable approach to achieving excellence in new school buildings. The extensive programme of new build schools in Scotland together with the modernisation of the Building Standards system provide a good opportunity to undertake research in this area with an aim to deliver new guidance to key stakeholders.

- ▶ **Background:** Section 1.1 of DB93: Acoustic Design for Schools recommends performance standards for the following areas
 - Indoor sound insulation between spaces
 - Airborne sound insulation between circulation spaces and other spaces used by pupils
 - Impact of sound insulation of floors
 - Reverberation in teaching and study spaces
 - Sound absorption in corridors, entrance hallways and stairways
 - Speech intelligibility in open plan spaces

The document provides a useful reference point but is not mandatory in Scotland. Section 7 lists case studies on various aspects of acoustics in schools, 7.2 is an investigation into three primary schools, and case study 7.10 covers open plan learning spaces in a secondary school. The conclusions from the case studies are similar:

'...it is difficult to justify the use of open plan areas in schools in terms of their acoustic environment.' and

'In many open plan teaching spaces it is difficult to achieve clear communication of speech between teacher and student and between students. For this reason careful consideration should be given as to whether to include open plan teaching spaces in (schools). If open plan areas are required then rigorous acoustic design is necessary to meet the required performance standards in Section 1.'

None of the four schools in these case studies met the recommendations for sound insulation between classrooms contained in BB 93.

- ▶ **Aim:** The aim of this project is to gather evidence that will be used to produce a scoping study or platform for a second larger piece of work. This second piece of work is entirely separate from this contract and is the preparation of a "Good Practice Guidance Note" for designers and local authorities that will provide guidance on design for acoustic characteristics of schools with a particular focus on primary schools.
- ▶ **Objective:** The objective of the research is to use the methodology suggested below to obtain data that will allow an assessment of the benefits / dis-benefits of new or recently constructed schools from an acoustic perspective. From this, recommendations should be made that will assist the development of the Guidance Note.
- ▶ **Scope:** The scope for this project was limited to primary schools, with at least one to be taken from an urban and one from a rural environment. If possible the cases would contain one with a dynamic approach to the use of internal space, one open plan and one with fixed classroom partitions.
- ▶ **Methodology Outline:** Five case studies were to be identified from which the steering group would select three which demonstrate different tactics in school design. Each school would then be surveyed over two full teaching days, to obtain technical measurements of sound levels, recording of architectural / constructional features, and structured interviews with teachers and pupils. The purpose of the surveys was to comment on aspects of acoustic performance of spaces in relation to education needs such as clear communication and concentration.

3.02 Detailed Methodology:

The subsequently agreed project methodology was as follows:

- Final selection of schools for study
- Correspondence with Head Teachers and Local Authorities to formalise visits
- Obtain plans and sections of schools selected
- Visit each school to discuss and agree study dates and survey locations with Head Teachers
- Visit each school for two days to establish:
 - Acoustics of studied spaces measured using the same parameters as those detailed in BB93, [e.g. $L_{Aeq,30mins}$; $L_{A1, 30mins}$; $Rt(\text{mean})$]
 - Interview (using questionnaire format) the head teacher and teachers on use of spaces, acoustics / noise issues, advantages, disadvantages etc.
- Measure statistical parameters of internal sound fields for occupied and unoccupied spaces over 2 days including parameters used in BB93
- Interview (using questionnaire format) sample of pupils in areas studied to establish responses to acoustics / noise issues
- Measure reverberation periods for studied spaces
- Sample measure Sound Transmission Indices (using STIPA based equipment) in studied spaces

- Analyse data and questionnaire responses
- Compile overall results and
- Report on Findings

▶ **Note:** STIPA was used in preference to full STI or RASTI measurements as this measure was considered viable within the timescale constraints of the surveys whereas RASTI, an even shorter survey method is less accurate, whilst full STI was considered too time consuming. This assessment was based on papers by Ole-Herman Bjor¹ and Mapp², reported in the 'Proceedings of the Institute of Acoustics' in 2003.

¹ STIPA – The Golden Mean between full STI and RASTI. Vol 25, Pt 7, Proceedings of the IoA, 2003.

² Speech Intelligibility Measurement – The current state of the Art, Vol 25, Pt 7, Proceedings of the IoA, 2003.

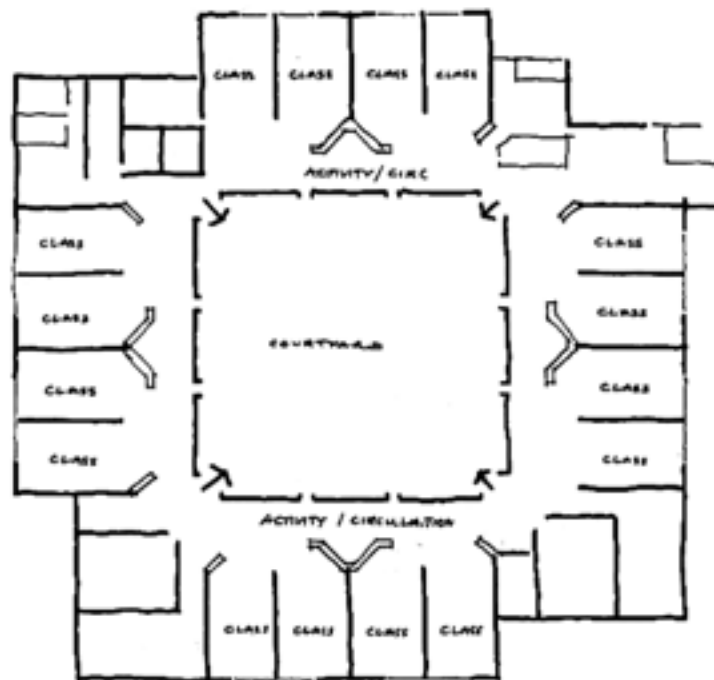
Surveys and Findings

4.0

4.01 Selection of Schools

Three schools were selected for study each representing different phases and types of provision.

- ▶ **School A:** The first of the schools selected for study had a substantial area of replacement accommodation with generous open plan 'activity / circulation' spaces fully open to the teaching base areas. Sixteen teaching areas are distributed around a courtyard with an area of general activity space between courtyard wall and teaching areas. In each corner are specialist accommodation, cloakrooms et alia and to each group of four teaching spaces is a wet/ resource provision. The screens between the teaching spaces are full height (although with some gaps at high level between structural beams and ceiling linings) and the roofs are pitched to rise to a maximum at the change point between classrooms and general activity areas where clerestory ridge lighting is provided. The wall to the courtyard is substantially glazed as are the external facades to each teaching space.



Plan of School A:

The teaching spaces are carpeted to a substrate of concrete, whilst the general activity / circulation areas are covered with a vinyl type flooring. Ceilings to the teaching areas (sloping up towards the activity areas) are of plasterboard with applied timber decorative strips; walls are essentially plasterboard above 2 metres height with fibreboard below (display boarding). The general arrangements can be seen in the photographs, below.

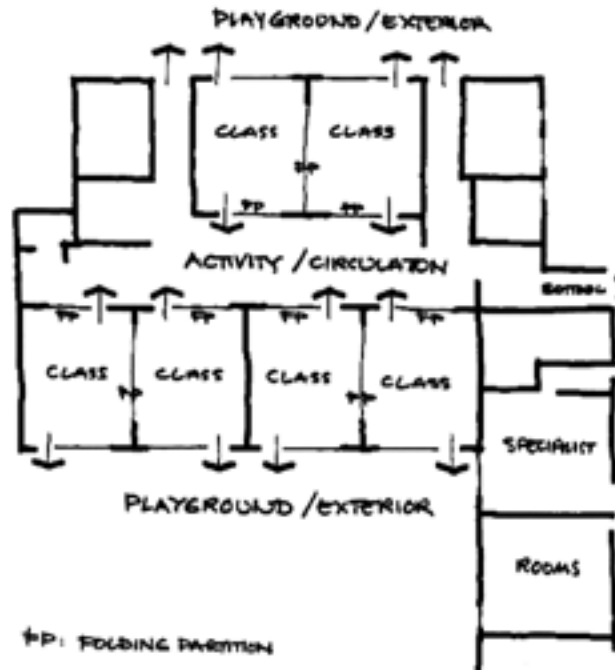


School A: View along general activity / circulation area into teaching spaces



School A: View towards corner specialist provision

- ▶ **School B:** The second school is one of a series of schools built by a local authority based on one particular plan-form. This provides atrium 'activity / circulation' spaces opening onto which are class bases – each having a sliding / folding screen with integral doorway between classroom and atrium. In addition pairs of classrooms can be opened up using sliding / folding screens. Doors to the classrooms were observed often to be left open (to aid supervision of any pupils using the general activity area). However, the class bases were used as cellular accommodation with the atrium area observed to be relatively little used.



School B: View along atrium general activity / circulation space (folding partitions seen in dark blue to each side)

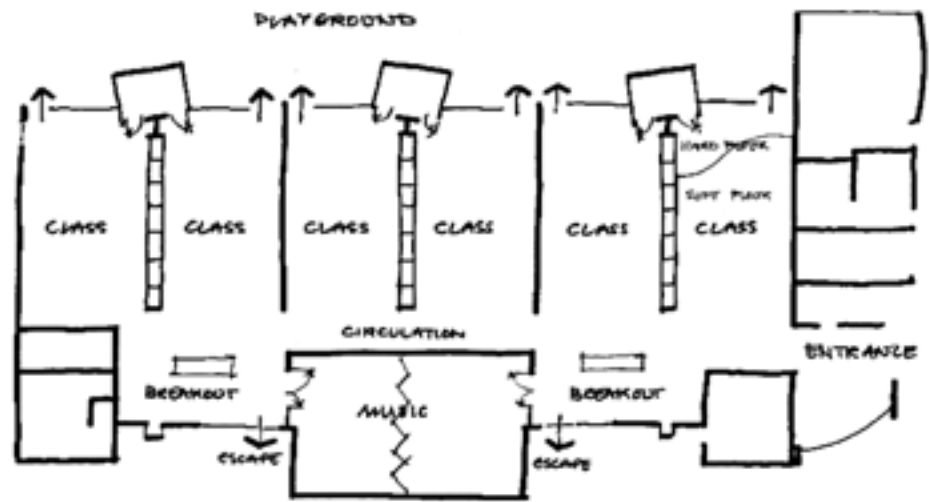
The class bases are fully carpeted (loop type) whilst ceilings are of Korrugal type perforated ribbed / acoustically absorbent metal. Walls are plasterboard or sliding / folding partitions and the external facade is of glass and painted blockwork. The atrium has vinyl sheet flooring on a concrete / screeded substrate, walls are plasterboard or folding /sliding screens and the ceiling is of Korrugal type perforated ribbed / acoustically absorbent metal. The general arrangements can be seen in the photographs above and below.



School B: View into classroom through open door (folding partition seen at lhs)

- ▶ **School C:** The third school selected for study has a series of teaching spaces opening directly onto a circulation area with breakout areas and specialist rooms. The breakout areas and circulation are modest in area and provide limited space for pupil activity in the upper primary area. In the lower primary classes a ramp access to a higher level (the section is on two levels to take account of a sloping site) provides significantly more circulation space. Breakout areas are however of similar size to the upper primary provision. Each class space is provided with an integral wet area and access to a small, enclosed 'retreat' room that is shared between pairs of rooms. Ceilings to the class areas slope upwards to a maximum at the junction between class space and circulation / breakout space.

Ceilings are lined with acoustically absorbent material; walls are plasterboard with applied pin-boarding (1200mm high) or storage walls with approximately 50% timber doors and plasterboard walls. At high level dividers between class spaces are glazed and the steel roof beams perforated with circular holes. Floors are of needle-cord or vinyl on a screeded substrate. The vinyl area to each class base is associated with the wet area and in-out areas to playground.



Plan of School C:



School C: View along / circulation area



School C: View into class spaces

4.02 Observations:

- ▶ **School A:** The flexible teaching spaces and activity areas are used extensively and provide for easy movement around these parts of the building. Space standards appear to be higher than some later primary school provision (particularly in relation to School C).
- ▶ **School B:** This school has the capability of opening up spaces to make the atrium space part of ongoing teaching / activity areas and also to enable two classes to operate in one space. Neither of these capabilities is exploited and to all intents and purposes the school is operated as a cellular school. The atrium space is used for limited activities and as a suitable space to locate pupils who 'need' a period of quieter circumstances or for small groups / individual learning support work. Doors to class bases appear often to be left open to the atrium to enable some, visually limited, supervision of those who are sent to it to work etc.
- ▶ **School C:** This school is physically 'open plan' but offers little flexibility of additional activity space and is not used in the manner that was perhaps envisaged. The breakout areas are delineated from the teaching areas by medium height storage / locker units which result in areas which cannot readily be supervised from the teaching areas. The conclusion was that the open plan general / breakout area is not much more than a corridor with lockers and storage.

It was also noted that teachers were using the base areas indifferent ways – particularly with respect to the 'formal' desk location. It was noted that when located along the long side of a class base the teacher had to continually turn to face the window and corridor ends of that space to be able to see the seated pupils. One teacher had the desk at the centre of the junction with the open plan breakout / circulation space so easing the view of the pupils. However, the lack of vertical surface immediately behind reduced available reflected sound into the classroom. Distraction would also be a probable consequence if movement occurred behind the teacher during more formal sessions.

4.03 The Surveys:

Equipment: The sound level surveys were carried out using a Norsonic 118 Real Time Analyser together with ancillary tripods and calibrator, which provided the capability of measuring and recording period statistics, reverberation times using an impulse source (0.33 starter pistol) and STIPA values using an appropriate sound source (CD, player and high quality loudspeaker). The analyser was operated in accordance with manufacturers instructions and calibrated before and after each session of measurements. Recordings of ambient levels in class bases and activity areas were taken with the microphone mounted at 1200mm above floor level (equivalent to seated teacher head height).

Period Recordings: Locations and measurement periods were established on the basis of each school plan form, timetable and use patterns. Sample periods were typically of 30 minutes with repeat measurements providing a total of:

- 7 hours measurement in 6 locations in School A
- 4.5 hrs measurement in 3 locations in School B and
- 6.0 hrs measurement in 6 locations in School C

Survey locations in each school included class bases and activity / circulation areas and the analyser was set up to provide L_{Aeq} , L_1 , L_{50} and L_{90} levels for the 30 minute sample periods together with 5 minute L_{Aeq} levels. Period analyses of octave band spectra were also obtained.

Survey locations were chosen to provide representative levels within the selected spaces. As the basic geometry of class bases in each school were replicated throughout the space provision sample locations were also chosen to measure within areas affected by differing age ranges so that conditions for young primary children were measured as well as those created and experienced by older primary school children.

Reverberation times: These were measured with the spaces essentially empty (during lunch periods). Typically six measurements were made in each space (typical class base and typical activity areas) and the mean of 500Hz, 1kHz and 2kHz values were derived from these.

STIPA: The STIPA values were measured in empty classrooms but with activity at near normal levels in adjacent areas to provide typical background conditions. Measurements were taken with the source at the typical teacher position in the class base and a series of measurements taken at pupil locations around the class base / activity area ensuring that peripheral locations were tested.

Following the empty space tests typical L_{Aeq} levels of generated noise (derived from the period recordings, see above) were applied to the STIPA results to obtain the STIPA values under higher noise level conditions.

Questionnaires: Two questionnaires were developed to elicit pupil and teacher views on the acoustic conditions in each school. The draft questionnaires were reviewed by the Project Steering Group and adjustments made to reflect a range of concerns. It was recognised that the small samples in each school would preclude full statistical analysis of the questionnaires data but that the basic trends and variations in views and attitudes should be capable of being drawn out of the results. See Appendix A for the full text of the questionnaires.

Pupil Questionnaires: These were administered to a whole class group by the researcher who was introduced by the class teacher, gave a short introduction and then read out each question in turn saying how answers were to be recorded. Emphasis was placed on the need for the answers to be the views of each individual, that there were no right or wrong answers and that their views would contribute to a better understanding of the needs of pupils in schools.

Teacher Questionnaires: These were handed out in the staff room at break time and a short explanation of the purpose of the research given. Questionnaires were collected from teachers over the subsequent visit period and an addressed envelope left with the school secretary with a request to forward any late submissions at a later date. A subsequent reminder elicited these returns.

4.03 The Survey Results:

The principal data from the surveys is given in full in the Appendices, with Appendices B, C and D providing the acoustic surveys data for each school and Appendices E, F and G the questionnaire results. Summary information drawn from those results is the subject of the next section and the springboard for the discussions within it.

Summary and Discussions 5.0

5.01 Pupil Survey Responses

▶ Question 1:		School A	School B	School C
		% of pupils selecting descriptors (high proportions only)		
	Comfortable	58	64	71
	Colourful	72	56	72
	Interesting	66	28	63
	Noisy	65	64	72
	Hot	55	71	51
	Bright	67	57	81
	Pleasant	45	26	56
	Cool	37	31	48
Spacious	39	30	49	
▶ Question 2:		School A	School B	School C
	School is mostly noisy	73	74	86
	Would like it quieter	66	66	59
▶ Question 3:		School A	School B	School C
	Classroom is mostly noisy		56	57
	Classroom is mostly quiet	62		
	Would like it quieter	47	62	48
Would like it to stay the same	51		42	
▶ Question 4:		School A	School B	School C
	Activity area is mostly noisy	58	59	
	Activity area is mostly quiet			52
	Would like it quieter	58	57	
Would like it to stay the same			54	
▶ Question 5:		School A	School B	School C
	Pupils disliking noise when working	81	80	77
▶ Question 6: Does noise / is noise		School A	School B	School C
	Make you feel good - no	72	74	80
	Distracting - yes	85	82	72
	Annoying - yes	61	66	63
	Not fun	65	52	68
	Stops concentration - yes	78	80	77

Makes work more difficult - yes	67	67	66
Help work better - no	82	80	85
Cover up distractions - yes	64	39	58

Question 7: Noise prevents easy hearing of teacher	School A	School B	School C
Sometimes	68	51	49
Often	11	16	19
Most of the time	20	33	32

Question 8: Noise prevents teacher hearing pupil easily	School A	School B	School C
Sometimes	47	48	62
Often	26	23	22
Most of the time	28	31	16

Data for oldest cohort	(P7)		(P7)
Sometimes	38	n/a	64
Often	38	n/a	32
Most of the time	23	n/a	4

Data for youngest cohort	(P4)		(P3)
Sometimes	48	n/a	76
Often	17	n/a	21
Most of the time	35	n/a	3

5.02 Surveys and Statistical Analyses

The surveys results have not been subjected to detailed statistical analysis as samples in some of the surveys are small and the scope of the research precluded that level of detailed review. Rather the intention is that analysis of the returns should be used as indicators of opinions and perceptions which could be used to derive the basis for further detailed study, if considered appropriate, or to demonstrate that particular issues need to be taken into account in brief formation and design. For this reason only substantial variations in results are taken as indications of variations in views and where perceptions relating to noise are broadly similar these are taken as indications that views and perceptions are similar. In this sense the evidence should be seen as essentially anecdotal but with a substantial underpinning of user responses.

The responses from teachers in each school were high as a proportion of the teaching staff in each but nevertheless provided only small sample sizes. The percentage responses can only therefore be indicative of the possible importance of issues and point to the need for follow up surveys of much larger numbers of teachers to establish, for instance, general ranking of factors which contribute to improved reaching conditions.

To aid understanding of the relevance of comments the three schools are referred to in the following commentaries with a simple descriptor of their spatial / use character so that:

- School A is referred to as 'very open plan school'
- School B as 'cellular-use school' and
- School C as the 'limited open plan school'

These descriptions relate to the detailed reviews of the selected schools given in Section 4 above.

5.03 Pupil Surveys Commentary

- ▶ **Q1:** All responses indicated that schools are perceived as 'noisy' but the 'limited open plan school' was perceived to be noisy by more of its pupils than the other two. The difference between the 'very open plan school' responses and those relating to the 'cellular use school' seem small despite the fundamental differences in the way in which sound is controlled in each.

The low response to the 'interesting' descriptor for the 'cellular use school' might suggest that variations in visual stimuli of open plan arrangements could be a factor in responses to school environment.

- ▶ **Q2:** At a more detailed level the perception that the 'limited open plan school' is judged by more pupils to be 'mostly noisy' is confirmed as is are the levels of perception for the other two schools despite their different plan / use conditions.

The responses to the 'change easily' question indicate that all pupils would like their schools to be quieter. Whether this is a genuine user preference or relates to the fact that they are perhaps being asked to be quieter on a regular basis cannot be judged from this data.

- ▶ **Q3:** The question relating to perceptions of classroom noise, as opposed to school noise in the previous question, reveals a different balance with the 'very open plan school' responses giving a high response to 'mostly quiet' whilst the other two schools show similar levels of mostly noisy. This may suggest that noise control by teachers / social means are broadly judged to be effective in the 'very open plan school' and perhaps relates to questions about 'discussion' and 'arrangements' about noise issues covered in the teacher questionnaire below. The corollary, in relation to the other schools, could be that in one (the cellular use school) it is not considered as necessary to liaise on noise matters, and in the other that it is not as necessary or not as effective. What is clear is that similar ratings are provided in relation to very different plan / use types.

The responses to the 'change easily' question indicate that pupils in the 'noisy' classrooms would like them to be quieter whilst those in the 'mostly quiet' classrooms would like them to 'stay the same' or be 'quieter' in broadly equal measure. This does perhaps suggest that a substantial number in the 'very open plan school' perceive that the classrooms are quiet enough.

- ▶ **Q4:** The activity areas in the 'limited open plan school' are perceived to be mostly quiet – perhaps reflecting that they are used only for quiet activities and can only be used by small numbers of people, whereas in the other two schools, which have generous (and reverberant) activity areas levels are judged to be 'mostly noisy'.
- ▶ **Q5:** Levels of dislike of noise when working across the three schools are consistently high and at very similar levels of response. This suggests that the variations in responses given above are not related to population cohort variables but are responses to experienced environments.

- ▶ **Q6:** These responses are very similar across the school cohorts and reinforce the suggestion made in the last paragraph. The significant variation in responses from pupils in the 'cellular use school' in relation to 'covering up distractions' should perhaps be examined in relation to ambient levels and the source of those ambient levels (being predominantly from within classrooms as opposed to a general transferred background from other areas which would apply in the other two schools).
- ▶ **Q7:** The rates of 'sometime' and 'most of the time' responses are consistently different for the 'very open plan school' as compared with the other two, which are broadly similar. These responses echo those to Question 3 above and reinforce the suggestion that teaching management and liaison enables an adequate acoustic environment to be created in the 'very open plan school'. However this raises the question as to why this issue is not as effectively resolved in the 'limited open plan school' and why, with teaching areas insulated from intrusive sound there should be a problem of this sort in the 'cellular-use school'
- ▶ **Q8:** The 'very open plan' and 'cellular-use' schools seem to be fundamentally more difficult environments for pupils to make themselves heard in than the 'limited open plan school' and the data indicates that the situation is probably worse for younger pupils whose voices are often much lower in output than those of older children. What is not clear is why the 'limited open plan school' should be perceived as better for pupil communication given that responses already commented upon indicate that this is generally perceived as a noisier environment. The answers may relate to sound reflection / reverberance as well as to general signal-to-noise ratio issues (background noise / pupil output levels). It is noted in para 5.06 below that reverberant conditions in School A are much less suitable for speech than in the other two schools and even though noise levels are controlled in School A they are higher than in the other schools which would, of course, impact upon communication standards.

5.04 Teacher Surveys Responses

Question 1:	School A	School B	School C
	% of teachers selecting descriptors (high proportions only)		
Comfortable	55	33	45
Limiting	9	67	64
Quiet	0	0	9
Noisy	100	0	73
Pleasant	36	33	27
Flexible	18	0	18

Question 2: Ranking of factors	School A	School B	School C	Overall
Low background noise levels	1	2	1	1
Flexibility of spaces	5=	4=	3	4=
Ease of use of linked spaces	8=	9	8	9
Ease of seeing pupils in teaching and related spaces	2=	3	2	2
Having activity areas linked to teaching spaces	6	8	7	7
Fresh and cool air	3	4=	5	4=
Quiet / private space for 1-to-1/small groups, nearby	8=	7	9=	8
Lots of wall display space	7	6	6	6

Lots of natural lighting	4	1	4	3
Carpeted floors in teaching areas	10	10	9=	10

Question 3: Background Conditions – predominant views	School A	School B	School C
Very noisy	sometimes	sometimes	sometimes
Rather noisy	usually	sometimes	usually
Slightly noisy	sometimes	never	sometimes
Very quiet	sometimes	sometimes	sometimes
Rather quiet	sometimes	sometimes	usually
Slightly quiet	sometimes	sometimes	sometimes

Question 4: Preference for change to teaching area	School A	School B	School C
Noisier	0%	0%	0%
Quieter	91%	44%	82%
Stay the same	9%	56%	18%

Question 5:	School A	School B	School C
Would you feel the same if quieter conditions could only be achieved by closing off spaces, reducing flexibility and reducing available teaching / activity areas			
Yes	56%	60%	91
No	44%	40%	9%

▶ **Explanations of choices:**

“Need an ability to close off spaces as quiet is essential for some teaching; must be able to hear; do not use activity areas a lot due to trying to be quiet for other areas; closed off spaces better for infant concentration; flexible fourth wall to pull across to create quieter space; noise makes quiet instructions difficult to hear and for children to hear each other; teachers co-operate with others to create quiet times but having to co-ordinate quiet times, limits flexibility; quieter allows more flexibility. Necessary to accept other noise; need flexibility of space; noisy when music on next door to cellular classrooms (through dividing screen); rather than have a little noise than sacrifice space”.

Question 6:	School A	School B	School															
How much does noise in your normal teaching environment affect your ability to hear what your pupils are saying to you? Scale: a lot ---- not at all																		
	1	9	0	1	0	0	0	0	1	1	4	3	4	4	3	1	0	0

▶ **Comments:** “Miss what child is saying; need to ask to repeat; have to use hand signals; noise is a distraction; children miss instructions; children switch off; have to raise voice; problem for children with hearing difficulties; often cannot hear in group discussions; a lot of children do not have loud enough voices to be heard. Difficult to hear pupils reading; difficult to hear pupils in group work; sometimes have to repeat for children at outer edges of teaching area; children cannot hear others at opposite end of room; teaching loses

pace; conditions vary over depth of classroom; to be heard need to be halfway down room – impacts on control pupils who do not wish to ‘engage’.”

Question 7:	School A	School B	School
How much does background noise in your normal teaching environment affect how easily your pupils can hear you? Scale: a lot ---- not at all	1 4 3 1 1 0	0 0 1 3 4 1	1 1 5 3 0 0

▶ **Comments:** “Constant distractions from open area; battling to be heard; background noise very high at times; affects reading to class; distraction of noise and (visual) movements; children have to repeat; can’t always see / tell who is talking; difficult for group reading sessions; teacher needs to raise voice in group work; noise and distraction come together – not a major problem.”

Question 8:	School A	School B	School
Do you have to raise your voice to overcome background noise from outwith your class to make yourself heard? Scale: a lot ---- not at all	3 6 0 0 1 1	0 0 0 3 3 3	2 3 5 1 0 0

Question 9a:	School A	School B	School
Do you discuss noise levels with other teachers?			
Yes	91%	33%	100%
No	9%	66%	0%

Question 9b:	School A	School B	School
Do you make arrangements to limit noise at certain times?			
Yes	82%	56%	73%
No	18%	44%	27%

▶ **What Arrangements?** “Try to timetable noisy lessons at same time; designate quiet times especially for maths and languages; use drama space for noisier activities; avoid having too many in wet area at same time; avoid music etc when nursery next door on story time; timetable quiet work times and play areas outside classrooms; more useable doors to activity area would be better (re cellular arrangement in School B); Plan for ‘golden time’; awareness of times for National Tests; forewarning of noisy activities; agreement not to have noisy activities without consulting next door classes.”

Question 10a:	School A	School B	School
Do you think that open plan spaces have advantages for teaching?			
Yes	90%	67%	45%
No	10%	33%	55%

▶ **10b: What advantages?** “Staff team working; awareness of other classes; awareness of school as a whole; collaborative working and liaison easier; supervision by sight easier; more space; ‘company’ for teacher; eases asking for advice / resources; ‘emergency’ support readily available; displays visible to all; children learn to focus; teacher not isolated; sharing resources involves interaction with other classes; flexibility and openness; allows choice for children whilst allowing supervision; flexibility of space use; permits different environmental dynamics; needs-time tabling for quiet times; pupils able to mix; access to other adults; more freedom for children; building responsibility towards others and social awareness; eases movement of pupils; ‘easier policing at intervals; overview of teachers and children, by management; children protected by knowledge of being seen by others; more contact between classes and stages; more staff interaction.”

Question 10c:	School A	School B	School
Do you think that open plan spaces have disadvantages for teaching?			
Yes	30%	100%	100%
No	70%	0%	0%

- ▶ **10d: What disadvantages?** “Noise from other areas, very noisy sometimes; interruptions; disruptions; distractions from people passing by; difficulties watching TV / listening to radio – need to use other quieter space; difficult teaching sensitive subjects (e.g. sex ed); difficult for those with hearing difficulties; difficulty hearing in group discussions; difficult for some children to concentrate with lots of background noise; requires different teaching methods that may not suit all teachers; children need coaching in use of open spaces; difficult supervision to ensure safety in block with ramp (blind spots in school C); noise affects lesson/teaching plans; difficult supervision in nursery classes with noise; limits class activities (keeping them quiet); reduces spontaneity; conscious of making too much noise; difficult to achieve atmosphere for concentration; feeling unable to let class make what is probably normal noise levels; limiting when positioning groups.”

Question 11:	School A	School B	School
If you had to choose between the following teaching areas which would you select?			
a. Cellular classroom with integral wet area and door leading from a corridor	30%	100%	91%
b. Open plan / semi-open plan teaching space with associated activity areas combined with access routes	70%	0%	9%

▶ **Explanations of choices:**

a. “Children contained; less visual distractions and interruptions; teacher in control of noise levels; no timetable planning restrictions; able to watch TV / radio in teaching area (not having to go to another area);

Open plan seriously and negatively affects quality of learning and teaching; do not have to collaborate on what and when for noisy / quiet activities.

Keeps children focused; minimises distractions; calm working environment; open plan facilitates different kinds of teaching but on balance individual classrooms more conducive to this; ease of supervision of activities areas linked to teaching areas; can set own noise levels and plan more freely without interruptions; open plan noisy and distracting; open plan requires extra planning; difficult to have own quiet times; own place needed to be with children – quiet and safe plus concentration; many children like being away from distractions of other classes; some children need to be in an environment where focus and concentration can be optimized.”

“Little advantage in working in current space (School C) - additional areas do not allow adequate supervision from class; closed doors help concentration; less distraction; easier to be more creative in teaching; easier to have group discussions; freedom to teach without restrictions (not limited by other / adjacent class activities); concentration levels higher = attainment levels are higher(?); more freedom in planning activities; would like a partition to enclose at times - would provide aid to concentration; happy to teach with open door but like to be able to close off when needed; children more focused in enclosed classrooms.”

b. "Light and open feel; teacher gets to know lots of other children, good for progression; cellular classroom makes staff and children too isolated; enjoy working in open plan classroom but would be wonderful if there was a means of closing off for quiet activities; have worked in both types and prefer open plan but need to limit noise levels more; more support for teacher in open plan; easier for moving pupils into sets; advantages outweigh disadvantages even though noise is important but need to be able to limit noise more."

5.05 Teacher Survey Commentary

- ▶ **Q1:** Despite the flexible partitions between classrooms and activity areas in School B, 'the cellular-use school', this school is rated the least flexible by teachers and this and the 'limited open plan school' are judged similarly 'limiting'. The two open plan schools are judged noisy by many of their teachers. Teacher views on noise are very different from pupil views for the 'cellular use school' but similar to those for the other two schools.
- ▶ **Q2:** This ranking of factors which may relate to improved teaching conditions is a very useful indicator of teacher concerns and preferences with 'low background noise levels' being the most important factor. This may have been influenced by the nature of the survey and therefore suggests that a broad based survey across teachers in a number of schools might be helpful to establish a reliable ranking of factors – which might also cover issues revealed by other aspects of this survey (see later). However, the second ranked factor – ease of seeing pupils in teaching and related spaces - is also an issue that relates to plan form, materials (glazing) and therefore acoustic design and background noise levels. The third and fourth factors (Lots of natural lighting and fresh and cool air) will often relate to each other and in urban locations and in turn relate to achievement of satisfactory control of external noise. The second fourth(=) ranked factor (Flexibility of spaces) clearly also relates to the issue of open planning and the first and second ranked factors. All in all these responses provide very useful indicators of the issues which need to be refined in developing guidance on the priorities which clients and designers should be considering in project briefing and development.
- ▶ **Q3:** Responses indicate that teachers in the open plan schools each see their background conditions as usually 'rather noisy' whilst those using the cellular classrooms of School B see conditions as sometimes 'rather noisy'.
- ▶ **Q4:** These responses indicate that most teachers in the two open plan schools would prefer to have quieter spaces whilst a little less than half of those in the cellular use school would want this.
- ▶ **Q5:** The substantial response to this question by the teachers in the 'limited open plan school' perhaps indicates that they do not see any significant benefits from the current plan form organisation whereas teachers in the other two plan forms are, as a whole, more ambivalent about the advantages / disadvantages of their existing spatial environments. Perhaps this is because the advantages and disadvantages of each option are in some sort of balance with neither dominating the other.

Explanations of choices show that ability to close off spaces is thought important as is flexibility of space. The opposite side of the coin is however the recognition that whilst liaising to ensure quiet times limits flexibility extra space is nonetheless important even if noise is a consequence of having it.

- ▶ **Q6:** The ability to hear pupils is clearly worst in the 'very open plan school' and best in the 'cellular-use school'. This accords with findings from the pupil surveys (see 5.3 Q8 above) but the teacher response to conditions in the 'limited open plan school' differ from those of

pupils. Pupils may think they cannot be heard when in fact they can or perhaps it is that teachers are not aware that they have not heard! The latter seems more, probable. If nothing else this reinforces the value of asking for user responses from pupils.

Comments: These include the need for teachers to repeat themselves, to use hand signals, to use raised voice and indicate that conditions across teaching spaces vary, with those at the extremities being worst. These factors also impact on control issues and ability to effectively engage pupils in activities.

- ▶ **Q7:** Background noise effects on pupils' abilities to hear teachers are marginally worse in the very 'open plan school' than in the 'limited open plan school'. Teachers rate background noise effects least in the 'cellular-use school'. This is at variance with the responses of pupils who rate the 'very open plan school' better for hearing teachers than the other two, which are rated broadly on a par. This time it is perhaps that teachers may think they cannot be heard when in fact they can or perhaps it is that pupils are not aware that they have not heard! The latter seems more probable. Once again this reinforces the value of asking for user responses from pupils and teachers.
- ▶ **Q8:** The responses to effects of noise from outwith the teaching areas are that teachers have to raise their voices noticeably a lot more in the open plan schools as opposed to where cellular use is adopted.
- ▶ **Q9:** It is clear that teachers in open plan schools discuss noise levels with others and that they require arrangements to be made to limit noise at certain times. Although discussed less in the 'cellular-use school' arrangements are still made by about half of respondents despite there being substantial separation between classrooms and activity spaces (although there was comment that sound from next door music / singing could be heard through partitions).

Arrangements include: Designate quiet times; arrange noisy lessons at the same time; use other cellular spaces for noisy activities; avoid noisy activities at story times; plan times for national tests; agreements with neighbouring class teachers re noisy activities and quiet times; control numbers in activity areas.

- ▶ **Q10a:** The responses to the question on advantages of open plan spaces for teaching show that those using the 'very open plan' spaces see significant advantages and indicate less concern with disadvantages. The perhaps unexpected responses are from those using the 'limited open plan' spaces of School C. These may indicate that there are insufficient advantages from this particular provision to outweigh, or at least balance, the disadvantages that are experienced. One teacher response to School A reinforces this suggestion, by commenting: "Advantages outweigh disadvantages even though noise is important - but need to be able to limit noise more". It is surprising that those in the 'cellular-use school' rate open plan spaces higher in terms of advantages than those in the 'limited open plan school'. This may indicate that the advantages of open plan teaching areas have to be clearly understood and properly implemented in projects so that an effective balance is struck between advantages and disadvantages. The comments on this in Q10c below are also relevant to this consideration.

Q10b: Advantages of open plan spaces for teaching: These have been grouped to show how these relate to differing educational interests and perspectives:

Staff / Teaching Management: Open plan spaces can encourage / allow:

- Staff team working; easier collaborative working and liaison; more staff interaction; 'company' for teachers; access to other adults; easier asking for advice / resources; 'emergency' support readily available; teacher not isolated.

Pupil development: Open plan spaces can encourage:

- Interactions with other classes through sharing resources; awareness of other classes; more contact between classes and stages; awareness of school as a whole; children learning to focus; mixing pupils; more freedom for children; responsibility towards others and social awareness.

Supervision / Health and Safety: Open plan spaces can encourage / allow:

- Easier supervision by sight; easier policing at intervals / breaks; overview of teachers and children by management; activity / environment choice for children whilst allowing supervision;
- Children protected by knowledge of being seen by others.

Space and Use of facilities: Open plan spaces can encourage / allow:

- More space by integration of circulation space into activity areas; displays visible to all; openness; flexibility of space use; different environmental dynamics; easier movement of pupils.

▶ **Q10c:** All teachers of Schools B and C were of the opinion that open plan arrangements had disadvantages for teaching, compared with only about a third of those from School A, the 'very open plan school'. This reinforces the tentative conclusions drawn in the commentary to Q10a above. One teacher commented that there is "Little advantage in working in current space (School C) - additional areas do not allow adequate supervision from class" perhaps suggesting how one high ranking factor can influence attitudes to a whole style of provision. It may also be that the high score of the 'limiting' descriptor in Q1 above has a bearing on this.

▶ **Q10d: Disadvantages of open plan spaces for teaching:** These have been grouped to show how these relate to differing educational interests and perspectives:

Noise and Distraction: Noise from other areas can lead to:

- High background noise levels and difficulties with communication; interruptions; disruptions; difficulties watching TV / listening to radio – need to use other quieter space; difficulties for those with hearing impairments; difficulties with concentration;
- Distractions from people passing by; difficulty hearing in group discussions;
- Difficulties with teaching sensitive subjects (e.g. sex education);

Noise Impact on others: Noise from teaching areas to neighbouring spaces can lead to:

- Consciousness of making too much noise; feeling unable to let class make what are probably 'normal' noise levels;
- Difficulties watching TV / listening to radio – need to use other quieter space;

Timetabling:

- Timetabling and liaison needed for quiet times and for noisy times – limits choices etc;

Teaching methods / activities:

- Requires different teaching methods that may not suit all teachers; children need coaching in use of open spaces; noise affects lesson / teaching plans; limits class activities (keeping them quiet); reduces spontaneity; difficult to achieve atmosphere for concentration; limiting when positioning groups.

▶ **Q11:** The preferences expressed between open plan and cellular teaching areas reinforce the previous responses to advantages and disadvantages of open plan spaces. Of particular interest however is the fact that School C wet areas are integrated into each classroom area and are not in the 'general activity areas' as in the other two schools. Thus their choice of cellular space does not reflect as complete a change as might have been expected had this open plan school conformed to more typical patterns of open planning.

- ▶ **11a: Advantages of Cellular Option:** reasons given (without repeating those listed in Q10b above) included:

Learning Environment:

- Less visual distractions and interruptions; calm working environment; keeps children focused; children contained; teacher in control of noise levels; can set own noise levels and plan more freely without interruptions;
- Own place to be with children – quiet and safe, aiding concentration; concentration levels higher = higher attainment levels (?); children more focused in enclosed classrooms.

Timetabling:

- Do not have to collaborate on ‘what and when’ for noisy / quiet activities; able to watch TV / radio in teaching area (not having to go to another area); freedom to teach without restrictions (not limited by other / adjacent class activities).

Teaching Methods / Activities:

- Reduced need for planning with other classes; not difficult to have own quiet times; many children like being away from distractions of other classes; some children need to be in an environment where focus and concentration can be optimised; easier to be more creative in teaching / planning activities; easier to have group discussions.

- ▶ **11b: Advantages of Open Plan Option:** reasons given (without repeating those listed in Q10a above) included:

Learning Environment:

- Light and open feel; teacher gets to know lots of other children, good for progression; cellular classroom makes staff and children too isolated; have worked in both types and prefer open plan but need to limit noise levels more;

Teaching Methods / Activities:

- Open plan facilitates different kinds of teaching; enjoy working in open plan classroom but would be wonderful if there was a means of closing off for quiet activities;
- Ease of supervision of activities areas linked to teaching areas; more support for teacher in open plan; easier for moving pupils into sets.

5.06 Acoustics Data

- ▶ **Reverberation Times:**

	School A	School B	School C
Classroom	1.05 secs	0.42 secs	0.63 – 0.72 secs
Activity Area	0.77 secs	0.91 secs	0.70 secs

Criteria

	BB93 (500, 1k,2kHz mean)	New Zealand: good (500,1kHz mean) / Heriot Watt Report	New Zealand: poor
Classroom	less than 0.6 secs	0.4 secs	0.5 – 0.6 secs
Activity Area	less than 0.8 secs		

► **Communication:**

	School A	School B	School C
Classroom	0.51 - fair	0.66 - good	0.64 - good
Activity Area	0.41 - poor	0.37 - poor	n/a

► **Period Levels:**

	School A		School B		School C	
	Within tchng area	Edge of tchng area	Within tchng area	Edge of tchng area	Within tchng area	Edge of tchng area
L_{Aeq}	64 - 69	57 - 66	63	69	60 - 68	66 - 68
L_{A1}	75 - 77	67 - 74	73	73	70 - 78	74 - 76
L_{A10}	68 - 72	58 - 69	66	63	62 - 72	68 - 71
L_{A50}	55 - 65	51 - 63	56	54	56 - 65	63 - 65
L_{A90}	46 - 58	46 - 56	45	46	51 - 58	54 - 57
Mean levels						
L_{Aeq}	66	61	63	69	64	67
L_{A1}	76	70	73	73	74	75
L_{A10}	70	64	66	63	67	70
L_{A50}	60	57	56	54	61	64
L_{A90}	52	51	45	46	54	56

Indicative Criteria from previous studies:

	Delf Hill / Milefield MS		Abernethy	Auchterarder
	Maximum	Mean	Mean	Mean
L_{Aeq}	61	57	58	62
L_{A10}	66	62	61	64
L_{A50}	58	54	55	59
L_{A90}			51	55

5.07 Acoustic Data Commentary

- **Reverberation Times:** The implications of the reverberant conditions in the three schools are given below with a summary of the probable reasons for the conditions.

School A: Reverberation times are long by comparison with BB93 criteria and excessively so in comparison with the Heriot Watt and New Zealand criteria. The resultant effects will be to increase ambient sound levels within the open plan spaces as a result of noise generated within teaching areas and activity areas. This will reduce signal-to-noise ratios for speech communications and the longer decay time for sound will also reduce speech clarity.

It was noted in Section 4.01 above that whilst the teaching spaces are carpeted the general activity / circulation areas are covered with a vinyl type flooring, ceilings to the teaching areas are of plasterboard and dividing walls are essentially plasterboard above fibre-board display areas. To the exterior walls there is substantial glazing as there is to the apex of the roof structure. The volume of the teaching and activity spaces is also high. These will all contribute to the long reverberation times recorded.

School B: Reverberation times for cellular space classrooms are satisfactory by comparison with BB93, the Heriot Watt and New Zealand criteria. However, the reverberant conditions within the atrium spaces are excessively long, making speech communication more difficult and contributing to higher than necessary reverberant levels as a result of occupant generated noise. This could result in higher intrusive levels within the classrooms, dependant upon the insulative performance of the flexible partitions between the two spaces.

Whilst the cellular classroom spaces are generally absorptive, giving the low reverberation conditions recorded, the atrium has vinyl sheet flooring on a concrete substrate, walls are of plasterboard or folding / sliding screens and the ceiling is of a perforated ribbed / acoustically absorbent metal structure. There is however a significant area of glazing at high level and the proportion of absorptive surface is small in relation to the whole. This combines with a high volume to the atrium to result in long reverberation times.

School C: Reverberation times are a little longer than BB93 criteria but considerably longer than the Heriot Watt and New Zealand criteria. The resultant effects will be to increase ambient sound levels within the open plan spaces as a result of noise generated within teaching areas and activity areas. This will reduce signal-to-noise ratios for speech communications and the longer decay time for sound will also reduce speech clarity.

Volumes are high (although not as high as School A) and ceilings are lined with acoustically absorbent material; walls are of plasterboard with applied pin-boarding (1200mm high) or storage walls with approximately 50% timber doors and 50% plasterboard walls. At high level the dividers between class spaces are glazed and there are steel roof beams perforated with circular holes. Floors are of needle-cord or vinyl on a screeded substrate but part of the floor consists of a vinyl covered area associated with the wet area and in-out areas to playground. These will all contribute to the reverberation times recorded.

- ▶ **Communication:** Each of the schools with significant activity areas showed poor communication conditions within these spaces and only 'fair' to 'good' conditions within unoccupied teaching spaces. Assessments of communication conditions in Schools A and C using typical sound spectra for L_{eq} period levels (60dB L_{Aeq}) gave 'bad' communication conditions in the teaching spaces and activity areas. This level is at the lower end of the range typically experienced over extended periods in each of the schools. The BB93 criterion for STI values is 'not less than 0.6' for unoccupied spaces only.

It is clear that in terms of this criterion and its equivalents in terms of RASTI and STIPA the schools do provide acceptable or near acceptable conditions – but these do not relate to occupied conditions and associated communication performances. The responses to pupil and teacher surveys make clear that there are communication problems in all of the Schools for both pupils and teachers whether considering cellular use spaces or open plan spaces. Differences between male and female voice ranges for differing age groups should perhaps be considered in relation to speech communication criteria and background noise levels. (Note: Standard tests for STI, RASTI and STIPA do not take account of voice differences and are standardized for a male voice source whose range and output is very different from that of a young child.) The surveys have not considered the conditions for the hearing impaired which can be expected to present problems (or challenges) in all of the schools.

Consideration should also be given to the comments made in the New Zealand studies, cited in Section 2, which related to speech testing: *“Using recorded background noise the speech score results were relatively consistent with the majority of scores falling in the range 80-100%. However, when live noise sources were assessed the scores fluctuate widely, ranging from 0 – 98%, with more than 40% of the scores falling below 50% correct. These results reflect the poor signal-to-noise ratio and show a clear difference between speech testing carried out in controlled conditions and speech testing carried out in a real room situation”*. It might therefore be judged that ‘unoccupied’ communication testing is of little relevance to ‘use’ conditions and that reliance on basic space performance criteria and options for noise control could be more useful and appropriate.

- ▶ **Hearing Impaired:** With regard to hearing impaired subjects the New Zealand studies indicated that the best performance by hearing-impaired children was obtained by those using FM systems, despite these being the children with the greatest degree of hearing loss. Children with degrees of hearing loss regarded as ‘minor’ to ‘moderate’, fitted with normal hearing aids, performed very poorly in the speech testing, with the majority of scores ranging between 0-50%. Half of these children scored less than 20%. Children with severe hearing loss who were fitted with FM radio hearing aids in addition to their normal hearing aids performed quite well, with the majority of scores ranging between 50-90%.

Taken together with the comments above on the value of communication testing and the prevalent conditions in, and user responses to, each of the schools surveyed then hearing impaired communication conditions might be better resolved through similar or related methods. (c.f. also the Cheshire County Council provision of sound-field systems in schools).

- ▶ **Period Levels:** Examining the period levels in relation to the earlier studies of open plan schools indicate that the sound levels, in dB(A) relating to communication standards should be no more than:

	L ₁₀	L _{eq}	L ₅₀
Maximum (for communication)	66	61	58
Mean	62	57	54

School A: Mean recorded levels all exceed the (mean) criteria by 6 to 9dB(A); the range of levels experienced (L₁₀ – L₉₀) is of the order of 10 to 26dB(A) and the variation in L_{Aeq} levels is of the order of 12dB(A).

School B: Mean recorded levels all exceed criteria by 2 to 6dB(A); the range of experienced levels (L₁₀ – L₉₀) is of the order of 21dBA) and the variation in L_{Aeq} levels is of the order of 6dB(A).

School C: Mean recorded levels all exceed criteria by 5 to 7dB(A); the range of experienced levels (L₁₀ – L₉₀) is of the order of 4 to 21dBA) and the variation in L_{Aeq} levels is of the order of 8dB(A).

- ▶ **Implications:** One simple implication would appear to be that users of School A and School C should be indicating that noise is a significant communication issue with these schools recording the highest levels of concern. However, this is not consistently indicated in the pupil user responses given above where School C is rated the noisiest by pupils and teaching areas to Schools B and C are judged ‘mostly noisy’ in broadly equal measure whilst School A is judged ‘mostly quiet’. Noise preventing pupils hearing teachers is also judged to be less of a problem in School A, whilst in Schools A and B pupils judge that noise prevents them being heard by teachers more than in School C. This latter perception is perhaps the least subjective of the responses as it will relate to pupil experience of not being heard whereas the response to noise preventing teachers being heard may also relate to what pupils are told by teachers (and the measure of control over noise levels exercised by teachers).

However, the teachers surveys indicate that Schools A and C are noisy; that School A is worse than School C in terms of noise preventing them hearing pupils a lot and similarly of them being heard by pupils. The need for teachers to raise their voices is greatest in School A, a little less in School C and considerably less in School B. This pattern confirms the broad implications of the period levels data and related criteria and indicates that the differences between ranges in period levels and criteria may be more significant than mean values and that levels at the edges of teaching areas could also be indicators of subjective responses. (Where mean levels in School A and C are similar, subjective judgements may relate to larger differences in edge of space values – c.f. L_{Aeq} , L_{A10} and L_{A50} values.)

Common sense suggests that more difficulties with hearing and being heard will occur if levels at the edges of teaching spaces are higher than in the main teaching areas. The findings support this view. It should also be noted that in School C these ‘edge of area’ values are consistently higher than the main teaching area values as opposed to those in School A which are consistently lower. These levels can be expected to reflect the impact of noise from areas outwith the main teaching areas i.e. general background / school noisiness. There are indications therefore that this sound distribution issue needs to be considered in design development as does the general lowering of period levels by controlling (reducing) reverberant levels.

► **Impact of Spatial / Material factors on Sound Fields / Period levels:** The period levels at the edges of open plan spaces (or deeper within them if the overall space performs as a single volume) will be influenced by reverberant conditions and by strong reflections of sound. In School A the sloping reflective ceilings above each teaching space will project sound outwards into the activity areas whose walls and ceilings will in turn reflect sound into adjacent spaces. However, as each side of the courtyard arrangement consists of essentially one volume with four teaching ‘areas’ within it there is likely to be a relatively homogeneous dispersion of sound within the space. This will also result from the broadly uniform distribution of absorption / reflective surfaces in the space resulting in balanced horizontal and vertical components of sound decay.

In School C the ceilings are substantially absorptive resulting in lower projection / reflections of sound into the activity / common space. However, it should be noted that the high level glazed (and steel) areas and substantially reflective walls etc., will provide strong lateral reflections of sound (especially at high level) which will result in the build up of strong ‘horizontal reflections’ and lower decay rates for such elements. This could result in sound transfer from teaching spaces into the adjacent open areas and by reflection from vertical elements (walls, windows, storage units, etc) project sound into adjacent teaching areas, so contributing to the overall higher edge of space ambient levels despite their being substantial acoustical absorption in the spaces.

The implications of this are that spatial organisation and materials selection and location in open plan schools should take account not only of reverberant decay requirements (reverberation time) but be so organised that sound is not preferentially reflected / projected into adjacent spaces. Reverberation time alone will not be an adequate criterion for spatial acoustics but will need to be kept to an optimally low level to minimise the contributions of reverberant sound to background noise levels within open plan spaces and the control of sound transfer should be seen as a primary design issue as will be the location and distribution of absorptive surfaces.

Conclusions

6.0

6.01 Broad Conclusions:

- ▶ Noise is a significant issue in the use of all the schools studied, is thought to be effectively controlled in the 'very open plan school' but a cause of concern in the 'limited open plan school'. All schools would prefer lower noise levels and where it is not available the ability to close off spaces to create quieter conditions, is considered important.
- ▶ Noise levels and Reverberation times in the activity spaces in the three schools and the teaching areas in schools A and C all exceed criteria and result in poor communication conditions where teachers have difficulty hearing pupils and vice-versa for significant periods of time. By-and-large pupil views of hearing / listening conditions are that they are worse than their teachers assess and youngest pupils seem to have more difficulty making themselves heard than older ones.
- ▶ Communication conditions in the 'cellular-use school' are considered worse by pupils than teachers. Noise prevents easy hearing of teachers most of the time for a substantial proportion of users despite the supposed advantages of cellular forms for noise control.
- ▶ Conditions vary within teaching spaces and at the edge of these spaces communication conditions may be noticeably worse than in the main part of the teaching space.
- ▶ Tests of communication standards based on unoccupied spaces do not relate to the general teaching conditions and may be of questionable value. If utilised they should be adjusted to take account of female and young pupil voices as signal sources.
- ▶ Hearing impaired pupils will be disadvantaged even more than normal hearing pupils in all of the tested schools given the responses to assessments of communication conditions, recorded period levels and reverberation times. This suggests that consideration should be given to methods of improving received signals for the hearing impaired including FM and sound-field / speech reinforcement systems.
- ▶ Teacher rankings of factors which could contribute to improved teaching conditions highlight two issues which relate to the choice of open-plan / cellular plan formats – *the need for low background noise levels* and the *need to be able to see pupils in teaching and related spaces*. The third and fourth ranked factors relate to natural lighting and ventilation and also tie in with noise control issues (internal reflective surfaces, insulation from external noise) whilst the other fourth (equal) rated factor relates to flexibility of spaces.
- ▶ Advantages and disadvantages of Cellular and Open Plan arrangements need to be understood and appropriate techniques for management and operation implemented. Some teachers are prepared to trade-off some advantages for some disadvantages to achieve better overall facilities provision.

- ▶ The control of sound transfer including room shape, sectional form and distribution of absorptive materials should be considered in design development together with reverberation criteria which should be optimally low to minimise the contributions of reverberant sound to background noise levels and communication standards.

- ▶ The over-riding conclusions would seem to be that:
 - The school that has substantial open-plan spaces and has wholeheartedly adopted the operational strategies and tactics of open planning sees the benefits and dis-benefits and prefers the open plan option.
 - The school that has the option to be flexible and open plan has only operated in a cellular manner, prefers this to 'open plan' and is unlikely to experiment with open planning. It could be argued that the expenditure on flexible partitions between classrooms and between classrooms and activity areas / atrium spaces is perhaps a wasted resource in this case. However, flexibility is available if staff choose, or are encouraged by school management, to use it.
 - The plan form of the limited open plan school does not offer significant levels of flexibility, has problems with visual supervision of pupils in the 'activity/ resource' areas and receives high levels of background noise as a result of the open plan. Staff see little advantage in open planning and would prefer cellular classrooms.

- ▶ The acoustic design of schools, to create appropriate conditions for hearing and privacy – for communication, needs to be balanced with other educational needs and priorities. The research indicates that there are no absolutes in terms of open-plan or cellular plan forms – each offers advantages and disadvantages which need to be understood and weighed and the project implemented on that basis so that the one set balances the other. If the flexibility and visual supervision advantages which open planning should offer are not realised then some disadvantages may dominate user views. Equally if teachers' needs are understood and met by a design then some of the main disadvantages identified in the report - especially with regard to not having readily available 'quiet' spaces in open plan buildings – may be effectively eliminated. Resources will then be applied effectively and with economy.

6.02 Advantages of Open Plan Spaces for teaching:

The advantages and disadvantages of open plan or cellular school plans, grouped to show how these relate to differing educational interests and perspectives, include the following:

Staff / Teaching Management: Open plan spaces can encourage / allow:

- Staff team working; easier collaborative working and liaison; more staff interaction 'company' for teacher; access to other adults; eases asking for advice / resources; 'emergency' support readily available; teacher not isolated.

Teaching Methods / Activities:

- Facilitates different kinds of teaching;
- Eases of supervision of activities areas linked to teaching areas; more support for teachers available in open plan areas; easier for moving pupils into sets.

Supervision / Health and Safety: Open plan spaces can encourage / allow:

- Easier supervision by sight; easier policing at intervals / breaks; overview of teachers and children by management; activity / environment choice for children whilst allowing supervision;
- Children protected by knowledge of being seen by others.

Learning Environment:

- Light and open feel; teacher gets to know lots of other children, good for progression; cellular classroom makes staff and children too isolated; have worked in both types and prefer open plan but need to limit noise levels more.

Pupil development: Open plan spaces can encourage / allow:

- Interactions with other classes through sharing resources; awareness of other classes; more contact between classes and stages; awareness of school as a whole; children learning to focus; mixing pupils; more freedom for children; responsibility towards others and social awareness.

Space and Use of facilities: Open plan spaces can encourage / allow:

- More space by integration of circulation space into activity areas; displays visible to all; openness; flexibility of space use; different environmental dynamics; easier movement of pupils.

6.03 Disadvantages of Open Plan Spaces for teaching:

Noise and Distraction: Noise from other areas can lead to:

- High background noise levels and difficulties with communication; interruptions; disruptions; difficulties watching TV / listening to radio – need to use other quieter space; difficult for those with hearing difficulties; difficult for some children to concentrate with lots of background noise; means of closing off for quiet activities needed;
- Visual and aural distractions from people passing by; difficulty hearing in group discussions;
- Difficulties teaching sensitive subjects (e.g. sex education);

Noise Impact on others: Noise from teaching areas to neighbouring spaces areas can lead to:

- Consciousness of making too much noise; feeling unable to let class make what are probably 'normal' noise levels.
- Difficulties watching TV / listening to radio – need to use other quieter space;

Timetabling: Can limit flexibility:-

- Timetabling and liaison needed for quiet times and for noisy times; Designate quiet times; arrange noisy lessons at the same time; use other cellular spaces for noisy activities; avoid noisy activities at story times; plan times for national tests;
- Agreements with neighbouring class teachers re noisy activities and quiet times; control numbers in activity areas;

Teaching methods / activities:

- Requires different teaching methods that may not suit all teachers; children need coaching in use of open spaces; noise affects lesson / teaching plans; limits class activities (keeping them quiet); reduces spontaneity; difficult to achieve atmosphere for concentration; limiting when positioning groups.

6.04 Advantages of Cellular Planning:

Learning Environment:

- Less visual distractions and interruptions; calm working environment; keeps children focused; children contained; teacher in control of noise levels; can set own noise levels and plan more freely without interruptions;
- Own place to be with children – quiet and safe, aiding concentration; higher concentration levels could lead to higher attainment levels; children more focused in enclosed classrooms;

Timetabling:

- Do not have to collaborate on what and when for noisy / quiet activities; able to watch TV / radio in teaching area (not having to go to another area); freedom to teach without restrictions (not limited by other / adjacent class activities);

Teaching Methods / Activities:

- Open plan requires extra planning; difficult to have own quiet times; many children like being away from distractions of other classes; easier to be more creative in teaching / planning activities; easier to have group discussions;

6.05 Development of Design Guidance:

The intention of any such design guidance should be, in the first instance, to enable those involved in early stage project development to understand the essential implications of plan form choices and the impact of noise control and communication requirements on project design and development. In making choices on plan and organisation it should be clear what the consequential implementation requirements would then be so that the potential of the project can be realised and so that it can provide optimal teaching / learning conditions.

The design guidance should also offer designers simple methods for taking into account noise control and communication issues with regard to whichever plan form is selected, so that the earliest design concept decisions are responsive to those requirements.

Design guidance dealing with acoustics in primary schools would need to cover the following issues:

- Teacher priorities
- Advantages and disadvantages of open plan and cellular school forms
- Operational noise levels in teaching and activity areas
- Communication and privacy requirements
- Decay of sound and distribution of materials
- Plan form, and room shape factors
- Hearing Impairment Issues
- Sound insulation, natural lighting, ventilation and thermal performance / sustainability issues

Some of these elements have been established in this survey and report, others have been alluded to and others have not been considered at all (as they did not form part of the research brief). The following notes indicate the status of information required for each element.

▶ A: Teacher Priorities

The ranking produced in this Report provides the basis for development of guidance on teacher priorities. However, as the surveys involved only relatively small numbers of teachers it would be wise to carry out a more substantive study to establish a higher level of confidence in this critical guidance matter. Such a study would need to ensure that the teachers selected for survey work in differing plan forms so that any experience skew is appropriately balanced

The opportunity could also be taken to establish the importance of a number of other factors, alluded to in this research report, which could contribute to improved teaching conditions. These could include for example: space orientation; room shape; space needs and quiet space requirements.

▶ **B: Advantages and Disadvantages of Open Plan and Cellular School Forms**

The report establishes a substantial list of advantages and disadvantages and relates these to aspects of differing educational interests and perspectives. It might well be appropriate to further examine these in a more substantial study of teacher attitudes and perceptions and, in particular, to establish some ranking of importance of principal factors. However, it might be advantageous to carry out this work as a subset or extension of the teacher priority survey referred to in the last paragraph so that the rankings are seen in relation to educational / teaching priorities rather than plan form or noise control. Such a survey would need to be kept short and might need to be carefully followed up to obtain a satisfactory sample response.

▶ **C: Noise Levels in Teaching and Activity Areas**

In our view there is sufficient data from these studies and previous studies to be able to assess typical operational noise levels within teaching and activity spaces and to provide typical sound spectra in relation to these. Such spectra could be helpful when selecting materials (for noise control, decay control) and for partition insulation design.

▶ **D: Privacy & Communication**

The reasons given for quiet spaces to be readily available include the need to provide appropriate conditions for story telling, small group work, watching television / listening to audio, calming and disciplining. The ability to close off a space easily yet open it up to other spaces and permit easy visual supervision suggest that the solutions adopted in some of the very earliest open plan schools – the use of a glazed sliding screen across a substantial opening to the teaching area - could be an effective option. Alternatively provision of small cellular spaces, sufficient for use by a class, or a substantial part of it, might be viable. Feedback from a further 'Teacher Priorities' survey, referred to above, could provide further guidance on this.

Reduction of general noise levels, whether in cellular or open plan forms, is essential for the creation of good communication conditions. Measures to reduce ambient noise levels – using insulation, separation by distance, low reverberation times, deployment of absorbent surfaces and avoidance of reflective ones in critical locations will all be required and such considerations will be as essential to the provision of communication conditions in schools as water-proofed structures are to swimming pools. Appropriate acoustic finishes in schools cannot be considered an optional extra but must form an integral part of the provision.

▶ **E: Decay Characteristics, Materials Selection and Deployment**

All the evidence suggests that reverberation times need to be low and of the order of 0.4 seconds across the frequency range of 500hz to 2kHz. However, it is also necessary to consider the horizontal and vertical components of sound decay so that the decay characteristics of each are roughly similar.

It should also be noted that speech communication can be enhanced by the provision of early reflected sound from walls or ceilings in rooms and that highly absorptive ceilings, whilst reducing reverberation times can also preclude helpful reflections of sound to aid teachers in hearing pupils and vice versa. Design guidance should be provided on such matters, based upon well understood acoustic design principles.

► **F: Plan Form and Room Shape Factors**

Intelligibility of sound from a speaking person takes the form of a directional equal intelligibility contour and the quieter the voice or the lower the signal to noise ratio the more important this directionality of the voice becomes. Similarly it is well understood that distance affects audibility and the higher the background level in a space the more important it is for listeners to be close to speakers. Guidance based on these principles could be developed to influence the shape of classrooms and the basic orientations of teacher pupil interfaces, in particular to try to reduce the effects of the 'edges of spaces' in communication problems.

To enable good supervision (and health and safety etc) formal teaching positions in teaching areas should provide an easy overview of the whole teaching area and the related activity area without significant blind spots. Equally, where possible, pupils should be orientated away from sources of distraction. Developed guidance on these interactions could be helpful and will be critical if partial closure of teaching spaces is to be provided.

There can also be advantages in using distance attenuation to keep noise sources (outwith teaching areas) as far as possible from listeners in each space. These issues could influence basic plan layout and the principles should therefore be included in design guidance.

The larger the opening between a teaching area and an open plan activity area the more the potential for sound to transfer between the two. Guidance on sectional principals, to reduce sound transfer, would be helpful as would related and linked comment on the need to ensure that reflective surfaces are not so positioned that they focus, or project, sound into adjacent spaces. Careful positioning of absorbent surfaces can reduce transfer from space to space (relates also to the previous paragraph on sound decay and the distribution of materials).

► **G: Hearing Impairment Issues**

This aspect of schools design is clearly a matter of increasing importance and consideration should be given to the evaluation of different systems for enhancing speech signals for the hearing impaired. Whilst this study has not examined these issues in any detail it would appear that with generally high ambient levels within teaching and related spaces some problems exist for those with normal hearing. Problems for those with hearing impairments would therefore appear to be more likely and need to be addressed.

In the first instance it is suggested that an assessment of existing solutions and policies be carried out in conjunction with those who have experience and responsibility for dealing with the hearing impaired. We are aware of two possible systems for enhancing speech signals and there may well be others that should be evaluated. What does appear to be clear is that measures to reduce background noise levels in schools to cater for the hearing impaired do not seem to offer an effective aid to communication – given the experience in New Zealand and the period levels recorded in this and other studies. In our view cost effective solutions need to be examined in a holistic way and in relation to the overall objectives of school design. It may also be that one or more of the electronically based systems could provide benefits to their hearing impaired users in other aspects of their lives.

► **H: External Skin Issues: Sound Insulation, Ventilation, Daylight, Thermal Performance and Sustainability**

Skin and Partition Insulation: Guidance on building envelope performance in relation to the control of external noise as well as standards for control of internal noise using partitions and walls etc., will be required. Whilst there is substantial and useful material for this purpose in BB93 the low background levels sought in that document, to deal with the hearing impaired, may not be appropriate if Scottish policy moves in a different direction (see previous paragraph). Equally more detailed knowledge of typical internal period levels could provide information with which to check the effectiveness of current insulation standards for classrooms.

Plant Noise et alia: Consideration should also be given to the impact of ventilation provision on noise control again bearing in mind the general sustainability thrust to minimise incidental ventilation related thermal losses in buildings. Guidance on whole building ventilation, passive stack systems, natural ventilation, trickle vents and the like should perhaps be considered so that noise control requirements are compatible with available and desirable systems and are in balance with them.

Daylight: The provision of daylight in schools through windows, roof-lights, clerestory lights et alia can also have an impact upon skin insulation, which could be significant on tight urban sites. The glass associated with this also has an impact upon internal sound reflection and decay. Some strategic consideration of daylight provision in relation to thermal performance and noise control standards would, in our view, be helpful - again so that design issues are seen holistically and requirements or standards balanced one with another.

6.06 In Conclusion

- ▶ The foregoing summarises the results of the research programme and the essential findings from it. The research, we believe, demonstrates that the selection of open plan or cellular plan forms of primary school buildings is dependant upon much broader educational / teaching objectives than just good communication standards and noise control. Indeed the study demonstrates that these standards have not been uniformly provided in any of the schools studied and that management and teaching method is required to balanced out the advantages and disadvantages of plan forms to provide adequate communication conditions and exploit (or not, as the case may be) the physical provisions of each school to an optimum level.
- ▶ It is very clear that each plan form leads to specific implications in terms of the physical development of the schools and their management and organisation and that these need to be recognized, at the outset of a project, so that budgets and operational patterns are consistent with these strategic decisions.
- ▶ The Report contains a number of indicative findings about school acoustics in relation to plan forms and lists not only teachers' priorities but also their views of the advantages and disadvantages of different ways of organising primary school provision. There is also reference to a number of issues that relate closely to the design of primary schools and which need to be considered in design or need to be investigated further so that comprehensive guidance can be provided.
- ▶ We conclude that the report ought to provide a useful basis for development of guidance on plan forms, school acoustics and related issues to inform the development process.
- ▶ This guidance, especially that relating to rankings of teacher priorities, can also serve as a means of identifying primary briefing and development targets so that the performance requirements of the project can not only be clearly understood by all involved but also so that ongoing assessment of briefing conformance can be carried out.

- ▶ One of the clear messages from the research study would appear to be that post occupancy evaluation of this limited nature has revealed areas where projects may not have met original targets, if indeed targets were set, or may not have delivered what those commissioning had hoped for.
- ▶ Design guidance could also, therefore, be used to establish some of the parameters for post-occupancy evaluation of new projects which, given the importance and costs of new educational provisions, might well be seen as an essential component in securing best value and ensuring that development experience is fed back into the iterative development loop.

Nick Charlton Smith
for
The Charlton Smith Partnership

15th February 2005

Design for Educationally Appropriate Acoustic Characteristics in Open Plan Schools: Overview

**An Overview and Summary of the coverage of the Report and
the Principal Findings and Conclusions**

The Charlton Smith Partnership

Acoustics, Architecture and Town Planning Consultants

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7.01 Background

- ▶ This Research Report was stimulated by consideration of the impact of current guidance on the design of schools, and in particular the approaches adopted for the definition and control of standards, particularly those for acoustics and noise control.
- ▶ Whilst there has been considerable development of what can be simply termed “open plan¹” schools since the 1960’s little UK guidance has been offered on how to design these schools to optimise acoustic conditions.
- ▶ The Research was therefore conceived as a scoping study that would examine some of the principal issues in ‘open-plan’ versus ‘cellular’ designs of school teaching / learning space with a view to establishing factors which ought to be taken into account in strategic decision making. If possible the research would establish some of the fundamental implications of choices of plan form and means of acoustic control and suggest guidance on some aspects and, perhaps, the need for guidance on others.
- ▶ Underlying the work was the need to be able to provide advice for decision makers on the fundamental implications of plan-form in terms of advantages and disadvantages of each and the implications that each would make on the fabric and systems which would be required as a consequence of those choices if adequate communication conditions are to be provided in new schools.
- ▶ The work consisted of measured surveys of acoustic design aspects of three primary schools, in different parts of Scotland each of which represented a different approach to the provision of open plan school space. In addition, in each school questionnaire surveys of pupil and teacher responses to their acoustic environments and other factors were administered so that user responses could be related to the physical parameters.
- ▶ Indicative criteria for primary schools were drawn from examination of work by others including Building Bulletins 93, work by the Otican Foundation in New Zealand, by D J MacKenzie at Heriot Watt University, by Bradley / Bistafa in Canada and previous work by this report’s author, particularly that carried out in relation to open plan middle schools in 1969-72.
- ▶ The schools selected for study each represented different phases and types of provision and information on them was anonymously attributed as Schools A, B and C.
- ▶ **School A:** This school is characterised by a substantial area of replacement accommodation with generous open plan ‘activity / circulation’ spaces fully open to the teaching base areas. Sixteen teaching areas are distributed around a courtyard with an area of general activity space between courtyard wall and teaching areas. In each corner are specialist accommodation, cloakrooms et alia and to each group of four teaching spaces is a wet/ resource provision.

¹ ‘Open plan’ is used in the sense that classrooms and activity areas / circulation spaces are linked to enable ready, flexible use.

The screens between the teaching spaces are full height (although with some gaps at high level between structural beams and ceiling linings) and the roofs are pitched to rise to a maximum at the change point between classrooms and general activity areas where clerestory ridge lighting is provided. The wall to the courtyard is substantially glazed as are the external facades to each teaching space.

- ▶ **School B:** The second school is one of a series of schools built by a local authority based on one particular plan-form. This provides high volume brightly lit atrium 'activity / circulation' spaces opening onto which are class bases – each having a sliding / folding screen with integral doorway between classroom and atrium. In addition pairs of classrooms can be opened up using sliding / folding screens. However, the class bases were used as cellular accommodation with the atrium area observed to be relatively little used.
- ▶ **School C:** The third school has a series of teaching spaces opening directly onto a circulation area with breakout areas and specialist rooms. The breakout areas and circulation are modest in area and provide limited space for pupil activity in the upper primary area. In the lower primary classes a ramp access to a higher level (the section is on two levels to take account of a sloping site) provides significantly more circulation space. Breakout areas are however of similar size to the upper primary provision. Each class space is provided with an integral wet area and access to a small, enclosed 'retreat' room that is shared between pairs of rooms. Ceilings to the class areas slope upwards to a maximum at the junction between class space and circulation / breakout space.
- ▶ To aid understanding of the relevance of comments the three schools are referred to in the report with a simple descriptor of their spatial / use character so that:
 - School A is referred to as 'very open plan school'
 - School B as 'cellular-use school' and
 - School C as the 'limited open plan school'

7.02 Pupil Survey Findings

- ▶ Pupil responses indicated that the schools are all perceived as 'noisy' but the 'limited open plan school' was perceived to be noisy by more of its pupils than the other two. The difference between the 'very open plan school' responses and those relating to the 'cellular use school' seem small despite the fundamental differences in the way in which sound is controlled in each.
- ▶ The low response to the 'interesting' descriptor for the 'cellular use school' suggests that variations in visual stimuli of open plan arrangements could be a factor in responses to school environment.
- ▶ Questions relating to perceptions of classroom noise, as opposed to school noise, reveals a different balance with the 'very open plan school' responses giving a high response to 'mostly quiet' whilst the other two schools show similar levels of mostly noisy. This may suggest that noise control by teachers / social means are broadly judged to be effective in the 'very open plan school' and perhaps relates to questions about 'discussion' and 'arrangements' about noise issues (covered in the teacher questionnaires).
- ▶ The activity areas in the 'limited open plan school' are perceived to be mostly quiet – perhaps reflecting that they are used only for quiet activities and can only be used by small numbers of people, whereas in the other two schools, which have generous (and reverberant) activity areas levels are judged to be 'mostly noisy'.

- ▶ The 'very open plan' and 'cellular-use' schools seem to be fundamentally more difficult environments for pupils to make themselves heard in than the 'limited open plan school' and the data indicates that the situation is probably worse for younger pupils whose voices are often much lower in output than those of older children.

7.03 Teacher Survey Findings

- ▶ Despite the flexible partitions between classrooms and activity areas in School B, 'the cellular-use school', this school is rated the least flexible by teachers and this and the 'limited open plan school' are judged similarly 'limiting'. The two open plan schools are judged noisy by many of their teachers. Teacher views on noise are very different from pupil views for the 'cellular use school' but similar to those for the other two schools.
- ▶ Rankings of factors which may relate to improved teaching conditions is a very useful indicator of teacher concerns and preferences with 'low background noise levels' being the most important factor. This may have been influenced by the nature of the survey and therefore suggests that a broad based survey across teachers in a number of schools might be helpful to establish a reliable ranking of factors – which might also cover issues revealed by other aspects of this survey. However, the second ranked factor – 'ease of seeing pupils in teaching and related spaces' - is also an issue that relates to plan form, materials (glazing) and therefore acoustic design and background noise levels. The third and fourth factors (Lots of natural lighting and fresh and cool air) will often relate to each other and in urban locations and in turn relate to achievement of satisfactory control of external noise. A second fourth (=) ranked factor (Flexibility of spaces) clearly also relates to the issue of open planning and the first and second ranked factors. All in all these responses provide very useful indicators of the issues which need to be refined in developing guidance on the priorities which clients and designers should be considering in project briefing and development.
- ▶ The substantial response to this question by the teachers in the 'limited open plan school' (School C) perhaps indicates that they do not see any significant benefits from the current plan form organisation whereas teachers in the other two plan forms are, as a whole, more ambivalent about the advantages / disadvantages of their existing spatial environments. This may be because the advantages and disadvantages of each option are in some sort of balance with neither dominating the other.
- ▶ Explanations of choices show that an ability to close off spaces is thought important as is flexibility of space. The opposite side of the coin is however the recognition that whilst liaising to ensure quiet times limits flexibility, extra space is nonetheless important even if noise is a consequence of having it.
- ▶ Responses to questions on the advantages of open plan spaces for teaching show that those using the 'very open plan' spaces see significant advantages and indicate less concern with disadvantages. The perhaps unexpected responses are from those using the 'limited open plan' spaces of School C. These seem to indicate that there are insufficient advantages from this particular provision to outweigh, or at least balance, the disadvantages that are experienced. It is also surprising that those in the 'cellular-use school' rate open plan spaces higher in terms of advantages than those in the 'limited open plan school'. This may indicate that the advantages of open plan teaching areas have to be clearly understood and properly implemented in projects so that an effective balance is struck between advantages and disadvantages.
- ▶ **Advantages of open plan spaces for teaching:** These are grouped to show how they relate to differing educational interests and perspectives:

Staff / Teaching Management: Open plan spaces can encourage / allow:

- Staff team working; easier collaborative working and liaison; more staff interaction; 'company' for teachers; access to other adults; easier asking for advice / resources; 'emergency' support readily available; teacher not isolated.

Pupil development: Open plan spaces can encourage:

- Interactions with other classes through sharing resources; awareness of other classes; more contact between classes and stages; awareness of school as a whole; children learning to focus; mixing pupils; more freedom for children; responsibility towards others and social awareness.

Supervision / Health and Safety: Open plan spaces can encourage / allow:

- Easier supervision by sight; easier policing at intervals / breaks; overview of teachers and children by management; activity / environment choice for children whilst allowing supervision;
- Children protected by knowledge of being seen by others.

Space and Use of facilities: Open plan spaces can encourage / allow:

- More space by integration of circulation space into activity areas; displays visible to all; openness; flexibility of space use; different environmental dynamics; easier movement of pupils.

- ▶ All teachers of Schools B and C were of the opinion that open plan arrangements had disadvantages for teaching, compared with only about a third of those from School A, the 'very open plan school'.

- ▶ **Disadvantages of open plan spaces for teaching:** These are grouped to show how they relate to differing educational interests and perspectives:

Noise and Distraction: Noise from other areas can lead to:

- High background noise levels and difficulties with communication; interruptions; disruptions; difficulties watching TV / listening to radio – need to use other quieter space; difficulties for those with hearing impairments; difficulties with concentration;
- Distractions from people passing by; difficulty hearing in group discussions;
- Difficulties with teaching sensitive subjects (e.g. sex education);

Noise Impact on others: Noise from teaching areas to neighbouring spaces can lead to:

- Consciousness of making too much noise; feeling unable to let class make what are probably 'normal' noise levels;
- Difficulties watching TV / listening to radio – need to use other quieter space;

Timetabling:

- Timetabling and liaison needed for quiet times and for noisy times – limits choices etc;

Teaching methods / activities:

- Requires different teaching methods that may not suit all teachers; children need coaching in use of open spaces; noise affects lesson / teaching plans; limits class activities (keeping them quiet); reduces spontaneity; difficult to achieve atmosphere for concentration; limiting when positioning groups.

- ▶ The preferences expressed between open plan and cellular teaching areas reinforce responses to advantages and disadvantages of open plan spaces.

- ▶ **Advantages of Cellular Option:** reasons given (without repeating those listed above) included:

Learning Environment:

- Less visual distractions and interruptions; calm working environment; keeps children focused; children contained; teacher in control of noise levels; can set own noise levels and plan more freely without interruptions;
- Own place to be with children – quiet and safe, aiding concentration; concentration levels higher = higher attainment levels (?); children more focused in enclosed classrooms.

Timetabling:

- Do not have to collaborate on 'what and when' for noisy / quiet activities; able to watch TV / radio in teaching area (not having to go to another area); freedom to teach without restrictions (not limited by other / adjacent class activities).

Teaching Methods / Activities:

- Reduced need for planning with other classes; not difficult to have own quiet times; many children like being away from distractions of other classes; some children need to be in an environment where focus and concentration can be optimised; easier to be more creative in teaching / planning activities; easier to have group discussions.

- ▶ **Advantages of Open Plan Option:** reasons given (without repeating those listed above) included:

Learning Environment:

- Light and open feel; teacher gets to know lots of other children, good for progression; cellular classroom makes staff and children too isolated; have worked in both types and prefer open plan but need to limit noise levels more;

Teaching Methods / Activities:

- Open plan facilitates different kinds of teaching; enjoy working in open plan classroom but would be wonderful if there was a means of closing off for quiet activities;
- Ease of supervision of activities areas linked to teaching areas; more support for teacher in open plan; easier for moving pupils into sets.

7.04 Acoustic Data Findings

- ▶ **Reverberation Times:**

School A: Reverberation times are long by comparison with the various criteria with the resultant effect of increasing ambient sound levels within the open plan spaces as a result of noise generated within teaching areas and activity areas. This will reduce signal-to-noise ratios for speech communications and the longer decay time for sound will also reduce speech clarity.

School B: Reverberation times for cellular space classrooms are satisfactory however, the reverberant conditions within the atrium spaces are excessively long, making speech communication more difficult and contributing to higher than necessary reverberant levels as a result of occupant generated noise. This could result in higher intrusive levels within the classrooms, dependant upon the insulative performance of the flexible partitions between the two spaces.

School C: Reverberation times are a little longer than BB93 criteria but considerably longer than the Heriot Watt and New Zealand criteria. The resultant effects will be to increase ambient sound levels within the open plan spaces as a result of noise generated within teaching areas and activity areas. This will reduce signal-to-noise ratios for speech communications and the longer decay time for sound will also reduce speech clarity.

- ▶ **Communication:** Each of the schools with significant activity areas showed poor communication conditions within these spaces and only 'fair' to 'good' conditions within unoccupied teaching spaces. Assessments of communication conditions in Schools A and C using typical sound spectra for L_{eq} period levels (60dB L_{Aeq}) gave 'bad' communication conditions in the teaching spaces and activity areas.

It is clear that in terms of the BB93 criterion and its equivalents in terms of RASTI and STIPA the schools do provide acceptable or near acceptable conditions – but these do not relate to occupied conditions and associated communication performances. The responses to pupil and teacher surveys make clear that there are communication problems in all of the Schools for both pupils and teachers whether considering cellular use spaces or open plan spaces. Differences between male and female voice ranges for differing age groups should perhaps be considered in relation to speech communication criteria and background noise levels.

- ▶ **Hearing Impaired:** With regard to hearing impaired subjects the New Zealand studies indicated that the best performance by hearing-impaired children was obtained by those using FM systems, despite these being the children with the greatest degree of hearing loss.

Taken together with the comments above on the value of communication testing and the prevalent conditions in, and user responses to, each of the schools surveyed then hearing impaired communication conditions might be better resolved through similar or related methods. (c.f. also the Cheshire County Council provision of sound-field systems in schools).

- ▶ **Period Levels:** Examining the period levels in relation to the earlier studies of open plan schools indicate that the sound levels, in dB(A) relating to communication standards should be no more than:

	L_{10}	L_{eq}	L_{50}
Maximum (for communication)	66	61	58
Mean	62	57	54

- ▶ **Implications:** Recorded data for the individual schools suggests that users of School A and School C should be indicating that noise is a significant communication issue with these schools recording the highest levels of concern. However, this is not consistently indicated in the pupil user responses. School C is rated the noisiest by pupils and teaching areas to Schools B and C are judged 'mostly noisy' in broadly equal measure whilst School A is judged 'mostly quiet'. Noise preventing pupils hearing teachers is also judged to be less of a problem in School A, whilst in Schools A and B pupils judge that noise prevents them being heard by teachers more than in School C. This latter perception is perhaps the least subjective of the responses as it will relate to pupil experience of not being heard whereas the response to noise preventing teachers being heard may also relate to what pupils are told by teachers (and the measure of control over noise levels exercised by teachers).

- ▶ **Impact of Spatial / Material factors on Sound Fields / Period levels:** The implications of the data findings are that spatial organisation and materials selection and location in open plan schools should take account not only of reverberant decay requirements (reverberation time) but be so organised that sound is not preferentially reflected / projected into adjacent spaces. Reverberation time alone will not be an adequate criterion for spatial acoustics but will need to be kept to an optimally low level to minimise the contributions of reverberant sound to background noise levels within open plan spaces and the control of sound transfer should be seen as a primary design issue as will be the location and distribution of absorptive surfaces.

7.05 Broad Conclusions

- ▶ Noise is a significant issue in the use of all the schools studied, is thought to be effectively controlled in the 'very open plan school' but a cause of concern in the 'limited open plan school'. All schools would prefer lower noise levels and where it is not available the ability to close off spaces to create quieter conditions, is considered important.
- ▶ Noise levels and Reverberation times in the activity spaces in the three schools and the teaching areas in schools A and C all exceed criteria and result in poor communication conditions where teachers have difficulty hearing pupils and vice-versa for significant periods of time. By-and-large pupil views of hearing / listening conditions are that they are worse than their teachers assess and youngest pupils seem to have more difficulty making themselves heard than older ones.
- ▶ Communication conditions in the 'cellular-use school' are considered worse by pupils than teachers. Noise prevents easy hearing of teachers most of the time for a substantial proportion of users despite the supposed advantages of cellular forms for noise control.
- ▶ Conditions vary within teaching spaces and at the edge of these spaces communication conditions may be noticeably worse than in the main part of the teaching space.
- ▶ Tests of communication standards based on unoccupied spaces do not relate to the general teaching conditions and may be of questionable value. If utilised they should be adjusted to take account of female and young pupil voices as signal sources.
- ▶ Hearing impaired pupils will be disadvantaged even more than normal hearing pupils in all of the tested schools given the responses to assessments of communication conditions, recorded period levels and reverberation times. This suggests that consideration should be given to methods of improving received signals for the hearing impaired including FM and sound-field / speech reinforcement systems.
- ▶ Teacher rankings of factors which could contribute to improved teaching conditions highlight two issues which relate to the choice of open-plan / cellular plan formats – *the need for low background noise levels* and *the need to be able to see pupils in teaching and related spaces*. The third and fourth ranked factors relate to natural lighting and ventilation and also tie in with noise control issues (internal reflective surfaces, insulation from external noise) whilst the other fourth (equal) rated factor relates to flexibility of spaces.
- ▶ Advantages and disadvantages of Cellular and Open Plan arrangements need to be understood and appropriate techniques for management and operation implemented. Some teachers are prepared to trade-off some advantages for some disadvantages to achieve better overall facilities provision.
- ▶ The control of sound transfer including room shape, sectional form and distribution of absorptive materials should be considered in design development together with reverberation criteria which should be optimally low to minimise the contributions of reverberant sound to background noise levels and communication standards.
- ▶ The over-riding conclusions would seem to be that:
 - The school that has substantial open-plan spaces and has wholeheartedly adopted the operational strategies and tactics of open planning sees the benefits and dis-benefits and prefers the open plan option.

- The school that has the option to be flexible and open plan has only operated in a cellular manner, prefers this to 'open plan' and is unlikely to experiment with open planning. It could be argued that the expenditure on flexible partitions between classrooms and between classrooms and activity areas / atrium spaces is perhaps a wasted resource in this case. However, flexibility is available if staff choose, or are encouraged by school management, to use it.
 - The plan form of the limited open plan school does not offer significant levels of flexibility, has problems with visual supervision of pupils in the 'activity/ resource' areas and receives high levels of background noise as a result of the open plan. Staff see little advantage in open planning and would prefer cellular classrooms.
- ▶ The acoustic design of schools, to create appropriate conditions for hearing and privacy – for communication, needs to be balanced with other educational needs and priorities. The research indicates that there are no absolutes in terms of open-plan or cellular plan forms – each offers advantages and disadvantages which need to be understood and weighed and the project implemented on that basis so that the one set balances the other. If the flexibility and visual supervision advantages which open planning should offer are not realised then some disadvantages may dominate user views. Equally if teachers' needs are understood and met by a design then some of the main disadvantages identified in the report - especially with regard to not having readily available 'quiet' spaces in open plan buildings – may be effectively eliminated. Resources will then be applied effectively and with economy.

7.06 Advantages of Open Plan Spaces for teaching:

- ▶ The advantages of open plan or cellular school plans, grouped to show how these relate to differing educational interests and perspectives, include the following:

Staff / Teaching Management: Open plan spaces can encourage / allow:

- Staff team working; easier collaborative working and liaison; more staff interaction 'company' for teacher; access to other adults; eases asking for advice / resources; 'emergency' support readily available; teacher not isolated.

Teaching Methods / Activities:

- Facilitates different kinds of teaching;
- Eases of supervision of activities areas linked to teaching areas; more support for teachers available in open plan areas; easier for moving pupils into sets.

Supervision / Health and Safety: Open plan spaces can encourage / allow:

- Easier supervision by sight; easier policing at intervals / breaks; overview of teachers and children by management; activity / environment choice for children whilst allowing supervision;
- Children protected by knowledge of being seen by others.

Learning Environment:

- Light and open feel; teacher gets get to know lots of other children, good for progression; cellular classroom makes staff and children too isolated; have worked in both types and prefer open plan but need to limit noise levels more.

Pupil development: Open plan spaces can encourage / allow:

- Interactions with other classes through sharing resources; awareness of other classes; more contact between classes and stages; awareness of school as a whole; children learning to focus; mixing pupils; more freedom for children; responsibility towards others and social awareness.

Space and Use of facilities: Open plan spaces can encourage / allow:

- More space by integration of circulation space into activity areas; displays visible to all; openness; flexibility of space use; different environmental dynamics; easier movement of pupils.

7.07 Disadvantages of Open Plan Spaces for teaching:

- ▶ The disadvantages of open plan or cellular school plans, grouped to show how these relate to differing educational interests and perspectives, include the following:

Noise and Distraction: Noise from other areas can lead to:

- High background noise levels and difficulties with communication; interruptions; disruptions; difficulties watching TV / listening to radio – need to use other quieter space; difficult for those with hearing difficulties; difficult for some children to concentrate with lots of background noise; means of closing off for quiet activities needed;
- Visual and aural distractions from people passing by; difficulty hearing in group discussions;
- Difficulties teaching sensitive subjects (e.g. sex education);

Noise Impact on others: Noise from teaching areas to neighbouring spaces areas can lead to:

- Consciousness of making too much noise; feeling unable to let class make what are probably 'normal' noise levels.
- Difficulties watching TV / listening to radio – need to use other quieter space;

Timetabling: Can limit flexibility:-

- Timetabling and liaison needed for quiet times and for noisy times; Designate quiet times; arrange noisy lessons at the same time; use other cellular spaces for noisy activities; avoid noisy activities at story times; plan times for national tests;
- Agreements with neighbouring class teachers re noisy activities and quiet times; control numbers in activity areas;

Teaching methods / activities:

- Requires different teaching methods that may not suit all teachers; children need coaching in use of open spaces; noise affects lesson / teaching plans; limits class activities (keeping them quiet); reduces spontaneity; difficult to achieve atmosphere for concentration; limiting when positioning groups.

7.08 Advantages of Cellular Planning:

- ▶ **Learning Environment:**
 - Less visual distractions and interruptions; calm working environment; keeps children focused; children contained; teacher in control of noise levels; can set own noise levels and plan more freely without interruptions;
 - Own place to be with children – quiet and safe, aiding concentration; higher concentration levels could lead to higher attainment levels; children more focused in enclosed classrooms;

Timetabling:

- Do not have to collaborate on what and when for noisy / quiet activities; able to watch TV / radio in teaching area (not having to go to another area); freedom to teach without restrictions (not limited by other / adjacent class activities);

Teaching Methods / Activities:

- Open plan requires extra planning; difficult to have own quiet times; many children like being away from distractions of other classes; easier to be more creative in teaching / planning activities; easier to have group discussions;

7.09 Development of Design Guidance:

- ▶ The intention of any such design guidance should be, in the first instance, to enable those involved in early stage project development to understand the essential implications of

plan form choices and the impact of noise control and communication requirements on project design and development. In making choices on plan and organisation it should be clear what the consequential implementation requirements would then be so that the potential of the project can be realized and so that it can provide optimal teaching / learning conditions.

- ▶ The design guidance should also offer designers simple methods for taking into account noise control and communication issues with regard to whichever plan form is selected, so that the earliest design concept decisions are responsive to those requirements.
- ▶ Design guidance dealing with acoustics in primary schools would need to cover the following issues:
 - Teacher priorities
 - Advantages and disadvantages of open plan and cellular school forms
 - Operational noise levels in teaching and activity areas
 - Communication and privacy requirements
 - Decay of sound and distribution of materials
 - Plan form, and room shape factors
 - Hearing Impairment Issues
 - Sound insulation, natural lighting, ventilation and thermal performance / sustainability issues
- ▶ The report indicates the status of information required for each these elements and goes on to outline the limited research work needed to support its development as well as the detailed coverage which each element would entail.

7.10 Conclusions:

- ▶ The research demonstrates that the selection of open plan or cellular plan forms of primary school buildings is dependant upon much broader educational / teaching objectives than just good communication standards and noise control. Indeed the study demonstrates that these standards have not been uniformly provided in any of the schools studied and that management and teaching method is required to balanced out the advantages and disadvantages of plan forms to provide adequate communication conditions and exploit (or not, as the case may be) the physical provisions of each school to an optimum level.
- ▶ It is clear that plan forms lead to specific implications in terms of the physical development of the schools and their management and organisation and that these need to be recognized, at the outset of a project, so that budgets and operational patterns are consistent with these strategic decisions.
- ▶ The Report contains a number of indicative findings about school acoustics in relation to plan forms and lists not only teachers' priorities but also their views of the advantages and disadvantages of different ways of organising primary school provision. There is also reference to a number of issues that relate closely to the design of primary schools and which need to be considered in design or need to be investigated further so that comprehensive guidance can be provided.
- ▶ The report provides a useful basis for development of guidance on plan forms, school acoustics and related issues to inform the development process.

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

- a. mostly noisy?
- b. mostly quiet?

If it could be changed easily, would you like it to be:

- b. noisier?
- c. quieter?
- d. stay the same?

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:

- a. like noise?
- b. dislike noise?

Question 6: Noise affects people in different ways. How does noise in school affect you:

- | | | | |
|------------|----|--------------------|----------|
| Does noise | a. | make you feel good | yes / no |
| Is Noise | b. | distracting | yes / no |
| | c. | annoying | yes / no |
| | d. | fun | yes / no |

- | | | | |
|------------|----|---------------------------------|----------|
| Does noise | a. | stop you concentrating? | yes / no |
| | b. | make work more difficult to do? | yes / no |
| | c. | help you work better? | yes / no |
| | d. | help cover up distractions? | yes / no |

Question 7: Does noise in the classroom stop you hearing your teacher easily?

- a. Sometimes
- b. Often
- c. Most of the time?

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

- a. Sometimes
- b. Often
- c. Most of the time?

Thank you.

Please give this answer sheet to me as I come round the classroom.

This questionnaire is part of a study of some issues that we need to know more about when designing new schools. The research has been commissioned by the Scottish Executive and is supported by your Education Authority.

The purpose of the research is to improve guidance to designers, clients and all those who have an interest in school buildings and help achieve a better understanding of key design issues by relating the views of teachers and pupils to design aspects of the buildings they work in.

Your response is therefore important to the research and we appreciate you sparing time to complete this questionnaire.

Responses are entirely anonymous, apart from the name of school, so we hope that you will feel able to respond openly to the questions.

If you would put the name of your school at the top of this page and then answer the questions in the way indicated we would be very grateful.

Question 1: If you think that any of the following words describe this school put a circle around the letter next to the word or words:

- | | | | |
|---------------------|------------------|------------------|---------------------|
| a. comfortable | b. quiet | c. hot | d. colourful |
| e. limiting (space) | f. uncomfortable | g. pleasant | h. interesting |
| j. spacious | k. noisy | l. fresh | m. bright |
| n. dingy | o. smelly | p. uninteresting | q. flexible (space) |
| r. cool | s. cramped | | |

Question 2: Please rank the importance to you, as a teacher, of the following as factors which are thought to relate to improved teaching conditions (Put '1' against the most important and then rank, as importance reduces, until 10 is against the least important to you. If you think some are of equal importance please put an 'number=' against these):

- | | |
|--|-------|
| Low background noise levels | _____ |
| Flexibility of space for different arrangements | _____ |
| Ease of use of linked spaces | _____ |
| Ease of seeing pupils in teaching and related spaces | _____ |
| Having activity areas linked to teaching spaces | _____ |
| Fresh and cool (not stuffy) air | _____ |
| 'Quiet / private' space (for 1-to-1 / small groups) nearby | _____ |
| Lots of wall display space | _____ |
| Lots of natural lighting | _____ |
| Carpeted floors in teaching areas | _____ |

Question 3: Speaking generally about the space you usually teach / work in how would you describe the 'background' conditions? (Circle one option for each statement)

- | | | |
|-----------------------------|---|----------------|
| Usually / sometimes / never | - | very noisy |
| Usually / sometimes / never | - | rather noisy |
| Usually / sometimes / never | - | slightly noisy |
| Usually / sometimes / never | - | very quiet |
| Usually / sometimes / never | - | rather quiet |
| Usually / sometimes / never | - | just quiet |

Question 10: We would value your views on the following questions

a. **Do you think that 'open plan/ semi-open plan' spaces have advantages for teaching?**
(Please circle) **yes** or **no**

b. **What advantages? Please list any that occur to you**

c. **Do you think that 'open plan / semi open plan' spaces have disadvantages for teaching?**
(Please circle) **yes** or **no**

d. **What disadvantages? Please list any that occur to you**

Question 11: If you had to choose between the following teaching areas which would you select?
(Please circle the letter next to your choice.)

- a. Cellular classroom with an integral wet area and a door leading from a corridor
- b. Open plan / semi open plan teaching spaces with associated activity areas combined with access routes.

Please explain your choice as best you can:

Thank you. Please hand the completed questionnaire to me before I finish my visit or to the school secretary to be sent to me soon.

Nick Charlton Smith

The Charlton Smith Partnership

01241 859495

Appendix B

School A

Reverberation Times				
Location	500Hz	1kHz	2kHz	
Classroom				
1	0.8	2.07	0.66	
2	0.78	1.39	0.94	
3	0.91	0.84	0.84	
4	0.93	0.82	0.77	
5	0.79	0.78	0.75	
6	1.05	3.45	0.88	
7	0.93	0.95	0.93	
Mean values	0.88	1.47	0.82	
Activity Area				
1	0.88	0.83	0.76	
2	0.85	0.8	0.82	
Mean values	0.87	0.82	0.79	

STIPA Results					
Location	Rating	Assessment			
Classroom			With 60LAeq BNL		
1	0.42	Poor	0.11	Bad	
2	0.47	Fair	0.10	Bad	
3	0.54	Fair	0.19	Bad	
4	0.52	Fair	0.13	Bad	
5	0.59	Fair	0.13	Bad	
6	0.54	Fair	0.21	Bad	
Mean	0.51	Fair			
Activity Area					
1	0.40	Poor	0.13	Bad	
2	0.41	Poor	0.07	Bad	
3					
Mean	0.41	Poor			

Period levels						
24th August		LAeq	LA1	LA10	LA50	LA90
0927 - 0957	A	63.6	71.7	67.4	60.7	53.0
0958 - 1028	B	63.9	74.9	67.0	58.1	51.7
1051 - 1121	C	68.0	75.9	71.5	65.6	59.8
1121 - 1151	D	66.4	75.4	69.3	63.0	56.8
1151 - 1221	E	66.3	75.8	69.7	62.8	56.0
1305 - 1335	F	67.0	74.6	70.7	64.8	56.8
1335 - 1405	G	65.4	73.4	68.5	63.1	56.4
1405 - 1428	H	69.7	75.8	72.5	68.7	64.4
1449 - 1519	I	72.5	79.0	73.9	68.6	62.6
1519 - 1530	J	70.8	79.6	74.9	66.1	55.9
Mean level in teaching space		69	77	72	65	58
Mean level at edge of teaching space		66	74	69	63	56

Octave Band Analyses (in Hz)													
8	16	32	64	125	250	500	1k	2k	4k	8k	16k	LIN	Comments
55.3	53.2	52.3	50.2	48.2	58.5	60.3	59.5	56.3	50.1	42.4	33.3		Gen Area
51.7	53.3	52.6	50.0	47.1	58.7	60.3	59.9	56.0	53.5	48.5	40.7	66.4	Gen Area
59.5	49.4	52.7	52.1	55.0	63.6	66.5	63.5	59.4	53.8	45.3	36.0	70.9	Teaching area
64.1	51.6	54.3	54.5	51.3	64.0	65.0	61.6	57.8	53.4	45.6	36.4	70.9	Teaching area
61.9	49.7	53.1	53.0	51.2	61.9	62.8	62.0	59.3	54.3	46.9	37.6	69.5	Teaching area
55.8	58.7	57.9	51.5	51.3	60.6	65.3	62.9	58.8	53.6	44.6	33.5	69.9	Teaching area
51.1	56.0	56.9	50.2	49.2	59.2	62.7	61.5	57.6	53.6	48.7	38.5	68.0	Gen Area
54.8	55.2	55.3	53.6	53.6	62.4	66.9	66.3	61.9	56.2	46.5	37.0	71.6	Gen Area
59.1	53.7	52.0	51.5	54.3	64.4	69.5	69.4	64.2	57.6	48.0	38.4	72.5	Teaching area
60.9	57.9	55.0	54.3	59.6	66.7	68.3	67.1	62.6	57.7	51.1	41.8	73.7	Teaching area
60	54	54	53	54	64	66	64	60	55	47	37	71	Mean level in teaching space
53	54	54	51	50	60	63	62	58	53	47	37	52	Mean level - edge of teaching space

Period levels						
25th August		LAeq	LA1	LA10	LA50	LA90
0920 - 0935	A	41.0	54.0	39.3	29.8	28.5
0936 - 1006	B	61.3	71.3	64.1	57.4	50.7
1006 - 1026	C	62.3	72.1	65.3	58.0	52.0
1058 - 1128	D	61.9	70.6	65.2	59.2	51.5
1128 - 1158	E	65.1	75.0	68.7	59.3	47.3
1158 - 1210	F	63.1	75.5	67.4	50.0	45.5
Mean level in teaching space		64	75	68	55	46
Mean level at edge of teaching space		57	67	58	51	46

Octave Band Analyses (in Hz)													
8	16	32	64	125	250	500	1k	2k	4k	8k	16k	LIN	Comments
44.5	47.5	45.3	41.4	36.4	37.6	39.9	36.3	31.0	27.6	23.3	15.5	52.6	Gen Area
53.8	54.6	51.4	48.3	45.9	57.0	59.4	57.3	52.5	46.9	40.3	31.3	64.8	Gen Area
54.8	52.5	50.4	48.5	46.4	60.5	59.4	57.5	53.6	51.3	48.0	39.3	65.9	Gen Area
54.1	47.7	50.9	48.2	48.1	59.4	60.8	56.7	52.0	48.9	43.3	35.9	65.4	Gen Area
58.9	53.7	52.9	49.8	50.2	60.9	63.1	61.0	56.5	51.9	43.4	34.9	68.4	Teaching area
56.7	49.7	51.5	49.5	50.8	59.6	60.2	58.0	55.3	52.1	51.0	40.9	66.3	Teaching area
58	52	52	50	51	60	62	60	56	52	47	38	67	Mean level in teaching space
52	51	50	47	44	54	55	52	47	44	39	31	62	Mean level at edge of teaching space

5 minute LAeq levels					
	A	30.9	28.7	54.6	
	B	55.6	55.1	61.5	44.5
	C	59.2	58.7	59.1	65.9
	D	46.5	55.7	58.4	69
	E	57.8	59.9	58.6	49
	F	46.3	53.3	61.7	63.5
Overall mean level in teaching space		66	76	70	60
Overall mean level at edge of teaching space		61	70	64	51

Overall Octave band levels	8	16	32	64	125	250	500	1k	2k	4k	8k	16k	LIN
Overall mean level in teaching space	59	53	53	51	52	62	64	62	58	54	47	38	69
Overall mean level at edge of teaching space	53	53	52	49	47	57	59	57	53	49	43	34	57

Appendix C

School B

Reverberation Times				
Location		500Hz	1kHz	2kHz
Classroom				
	1	0.34	0.43	0.46
	2	0.42	0.43	0.44
	3	0.37	0.42	0.43
	4	0.45	0.43	0.44
Mean values		0.40	0.43	0.44
BB93 criteria				
Activity Area				
	5	0.74	0.93	1.05
	6	0.79	0.81	1.06
	7	0.73	0.97	1.09
Mean values		0.75	0.90	1.07
BB93 criteria				

STIPA Results				
Location	Rating	Assessment	Comments	
Classroom				
	1	0.78	Excellent	Adjacent classroom in use - audibly -with adjacent activity area also in occasional use
	2	0.59	Fair	
	3	0.67	Good	
	4	0.63	Good	
	5	0.65	Good	
	6	0.57	Fair	
	7	0.63	Good	
	8	0.75	Good	
Mean	0.66		Good	
Activity Area				
	1	0.36	Poor	Mic at approx 3 metres from source
	2	0.38	Poor	
	3	0.36	Poor	
Mean	0.37		Poor	

Period levels						
		LAeq	LA1	LA10	LA50	LA90
0855 - 0925	A	63	73	65	53	40
0925 - 0955	B	58	69	61	52	42
0955 - 1025	C	62	72	65	55	44
1103 - 1133	D	66	76	69	60	50
1133 - 1203	E	64	74	67	59	48
1203 - 1233	F	68	76	67	57	44
1333 - 1403	G	76	74	62	52	43
1403 - 1433	H	63	73	64	56	49
Mean level in teaching space		63	73	66	56	45
Mean level at edge of teaching space		69	73	63	54	46

Octave Band Analyses (in Hz)													
	8	16	32	64	125	250	#	1k	2k	4k	8k	16k	
	59	54	52	51	56	57	61	58	58	52	45	35	
	54	53	51	50	51	54	57	52	52	45	39	32	
	53	52	52	49	53	57	60	56	54	49	41	34	
	59	53	52	52	56	59	61	63	60	54	45	39	
	56	53	52	52	53	58	62	59	56	50	41	34	
	58	54	53	53	59	63	68	61	57	51	44	39	
	59	55	55	55	50	56	70	72	66	69	42	36	
	61	57	54	54	50	56	61	59	54	50	41	32	
Mean level in teaching space		57	53	52	51	55	58	62	58	56	50	43	36
Mean level at edge of teaching space		60	56	55	55	50	56	66	66	60	60	42	34

5 minute LAeq levels						
A	68	58	55	61	63	63
B	59	54	58	57	58	59
C	62	56	56	57	63	66
D	60	70	64	63	67	67
E	62	64	63	66	62	63
F	70	56	69	61	72	63
G	48	81	80	63	64	64
H	59	62	60	64	62	65

Appendix D

School C

Reverberation Times				
Location		500Hz	1kHz	2kHz
Classroom 1				
Primary 5	1	0.71	0.61	0.63
	2	0.58	0.60	0.61
	3	0.68	0.68	0.66
	4	0.69	0.65	0.59
	5	0.74	0.66	0.68
	6	0.64	0.67	0.61
	7	0.58	0.73	0.68
	8	0.76	0.63	0.6
	9	0.63	0.63	0.62
	10	0.66	0.68	0.63
	11	0.74	0.65	0.64
	12	0.67	0.65	0.62
Mean values		0.67	0.65	0.63
Breakout Area				
	1	0.61	0.65	0.65
	2	0.57	0.62	0.61
Mean values		0.59	0.64	0.63
Classroom 2				
Primary 2	1	0.59	0.61	0.6
	2	0.62	0.70	0.65
	3	0.68	0.68	0.61
	4	0.63	0.69	0.59
	5	0.56	0.65	0.62
	6	0.55	0.67	0.64
	7	0.64	0.64	0.65
	8	0.62	0.69	0.61
Mean values		0.70	0.76	0.71
Breakout Area				
	1	0.71	0.75	0.68
	2	0.71	0.71	0.61
	3	0.71	0.77	0.72
Mean values		0.71	0.74	0.67

STIPA Results				
Location	Rating	Assessment	Comments	
Classroom			With 60LAeq BNL	
	1	0.56	Fair	0.10 Bad
	2	0.69	Good	0.20 Bad
	3	0.63	Good	0.14 Bad
	4	0.57	Fair	0.11 Bad
	5	0.78	Excellent	0.32 Poor
	6	0.59	Fair	0.12 Bad

Period levels							
31st August		LAeq	LA1	LA10	LA50	LA90	
1004 - 1034	A	60.1	68.9	60.4	55.6	51.7	
1104 - 1134	B	60.1	71.2	61.9	55.0	49.7	
1134 - 1204	C	60.1	69.5	62.5	56.8	52.1	
1345 - 1415	D	66.8	75.0	70.5	64.3	56.1	
1415 - 1445	E	67.3	75.4	70.5	65.2	59.7	
1445 - 1515	F	69.1	77.8	71.7	66.2	59.1	
Mean level in teaching space		60	70	62	56	51	
Mean level at edge of teaching space		66	74	68	63	57	

Octave Band Analyses (in Hz)													
8	16	32	64	125	250	500	1k	2k	4k	8k	16k	LIN	Comments
56.8	62.0	61.4	63.4	53.6	57.2	56.4	53.5	53.9	51.3	40.5	32.1	68.8	Gen area (tchng spaces occupied)
69.2	67.4	59.8	64.0	55.8	56.9	57.2	55.7	52.6	48.3	43.2	34.3	72.8	Teaching area near window
59.3	64.2	64.1	66.0	59.4	59.0	58.1	55.0	51.3	46.8	42.0	32.9	71.3	Teaching area near window
52.7	56.6	56.3	58.8	57.0	60.9	64.7	62.8	58.9	52.4	44.5	33.2	69.8	Edge of teaching area
52.6	57.0	55.6	57.9	59.1	61.7	65.2	63.3	59.5	52.7	44.6	34.8	70.3	Edge of teaching area
57.9	58.1	57.0	57.6	60.6	62.5	65.8	64.5	62.3	58.0	46.3	36.0	71.6	Edge of teaching area
64	66	62	65	58	58	58	55	52	48	43	34	72	Mean level in teaching space
55	58	58	59	58	61	63	61	59	54	44	34	70	Mean level at edge of teaching space

5 minute LAeq levels							
Break starts at end of period	A	57.9	57.9	57.5	57.5	59.7	64.6
	B	62.7	60.1	60.4	58.6	60.7	56.0
	C	56.9	59.3	60.4	61.9	60.7	57.6
	D	62.3	64.4	67.5	67.7	68.7	67.4
	E	67.0	67.7	65.1	67.0	68.5	67.9
End of school at end of period	F	69.4	70.1	67.8	71.1	66.3	68.1

Period levels						
1st September		LAeq	LA1	LA10	LA50	LA90
0912 - 0942	A	65.4	74.3	69.1	62.5	53.4
0942 - 1012	B	68.7	76.5	71.9	66.7	61.9
1012 - 1042	C	68.5	77.8	72.5	65.0	46.1
1106 - 1136	D	70.1	79.8	73.5	66.8	59.1
1136 - 1206	E	71.8	81.7	75.3	68.0	59.9
1347 - 1417	F	63.5	72.4	66.5	60.6	54.4
Mean level in teaching space		68	78	72	65	58
Mean level at edge of teaching space		68	76	71	65	54

Octave Band Analyses (in Hz)													
8	16	32	64	125	250	500	1k	2k	4k	8k	16k	LIN	
54.4	52.5	52.4	52.7	50.1	55.5	61.2	62.1	58.6	51.8	42.2	31.1	67.6	Edge of teaching area
54.3	58.1	55.3	53.0	53.1	58.4	64.3	65.5	61.8	55.7	44.9	34.4	70.4	Edge of teaching area
60.3	57.0	55.3	55.0	54.1	56.8	63.1	65.0	62.3	56.9	45.3	35.9	70.7	Edge of teaching area
63.6	63.9	53.0	50.5	51.6	59.9	65.3	66.8	63.3	58.0	47.4	36.5	72.7	In teaching space
69.0	65.3	57.4	52.6	54.6	62.7	68.2	68.0	64.8	60.3	48.6	39.1	75.2	In teaching space
52.3	57.2	54.6	55.6	56.4	60.0	61.9	58.7	55.1	49.6	43.6	34.9	67.5	In teaching space
62	62	55	53	54	61	65	65	61	56	47	37	72	
56	56	54	54	52	57	63	64	61	55	44	34	70	

5 minute LAeq levels							
	A	57.6	60.8	66.0	67.6	67.0	66.5
	B	68.5	67.6	69.8	71.5	66.7	66.1
Overlaps into break period by 15 mins	C	68.2	68.2	72.4	70.8	51.9	54.3
	D	66.5	66.8	68.3	70.8	72.4	72.2
	E	73.7	71.5	70.7	71.1	73.7	69.0
Story time	F	62.0	64.8	63.1	63.6	61.6	64.6

Summary Results					
	LAeq	LA1	LA10	LA50	LA90
Overall mean level in teaching space	64	74	67	61	54
Overall mean level at edge of teaching space	66	75	70	64	56

Octave Band Analyses (in Hz)													
8	16	32	64	125	250	500	1k	2k	4k	8k	16k	LIN	
63	64	58	59	56	59	61	60	57	52	45	35	72	Overall mean level in teaching space
56	57	56	57	55	59	63	63	60	55	44	34	71	Overall mean level at edge of teaching space

Appendix E

School A

Pupil Survey: School: A P4 (23)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	21	b.	quiet	4	c.	hot	9
d.	dingy	0	e.	cool	12	f.	spacious	15
(as in temperature)								
g.	pleasant	19	h.	interesting	22	j.	uncomfortable	1
k.	crowded	2	l.	noisy	8	m.	bright	19
n.	colourful	19	o.	smelly	1	p.	uninteresting	0

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	7
	b.	mostly quiet?	15
If it could be changed easily, would you like it to be:	c.	noisier?	1
	d.	quieter?	13
	e.	stay the same?	9

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	3
	b.	mostly quiet?	22
If it could be changed easily, would you like it to be:	a.	noisier?	0
	b.	quieter?	12
	c.	stay the same?	11

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	8
	b.	mostly quiet?	15
If it could be changed easily, would you like it to be:	c.	noisier?	1
	d.	quieter?	12
	e.	stay the same?	10

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	2
	b.	dislike noise?	20

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 3 / no	20
Is Noise	b.	distracting	yes 18 / no	4
	c.	annoying	yes 18 / no	4
	d.	fun	yes 1 / no	21
Does noise	a.	stop you concentrating?	Yes 20 / no	3
	b.	make work more difficult to do?	yes 19 / no	3
	c.	help you work better?	yes 2 / no	20
	d.	help cover up distractions?	yes 12 / no	11

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	14
b.	Often	5
c.	Most of the time?	4

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	11
b.	Often	4
c.	Most of the time?	8

Pupil Survey: School: A P5 (26)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	9	b.	quiet	2	c.	hot	21
d.	dingy	3	e.	cool	11	f.	spacious	5
				(as in temperature)				
g.	pleasant	7	h.	interesting	8	j.	uncomfortable	6
k.	crowded	14	l.	noisy	21	m.	bright	9
n.	colourful	16	o.	smelly	2	p.	uninteresting	4

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	19
	b.	mostly quiet?	1

If it could be changed easily, would you like it to be:

c.	noisier?	1
d.	quieter?	20
e.	stay the same?	4

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:

a.	mostly noisy?	12
b.	mostly quiet?	14

If it could be changed easily, would you like it to be:

c.	noisier?	0
d.	quieter?	19
e.	stay the same?	7

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

- | | | |
|----|---------------|----|
| a. | mostly noisy? | 19 |
| b. | mostly quiet? | 7 |

If it could be changed easily, would you like it to be:

- | | | |
|----|----------------|----|
| c. | noisier? | 0 |
| d. | quieter? | 21 |
| e. | stay the same? | 5 |

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:

- | | | |
|----|----------------|----|
| a. | like noise? | 3 |
| b. | dislike noise? | 23 |

Question 6: Noise affects people in different ways. How does noise in school affect you:

- | | | | | |
|------------|----|---------------------------------|-------------|----|
| Does noise | a. | make you feel good | yes 1 / no | 21 |
| Is Noise | b. | distracting | yes 18 / no | 6 |
| | c. | annoying | yes 18 / no | 4 |
| | d. | fun | yes 6 / no | 17 |
| Does noise | a. | stop you concentrating? | Yes 22 / no | 5 |
| | b. | make work more difficult to do? | yes 16 / no | 9 |
| | c. | help you work better? | yes 2 / no | 21 |
| | d. | help cover up distractions? | yes 4 / no | 18 |

Question 7: Does noise in the classroom stop you hearing your teacher easily?

- | | | |
|----|-------------------|----|
| a. | Sometimes | 17 |
| b. | Often | 1 |
| c. | Most of the time? | 7 |

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

- | | | |
|----|-------------------|----|
| a. | Sometimes | 12 |
| b. | Often | 4 |
| c. | Most of the time? | 10 |

Pupil Survey:

School: A

P6 (25)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

- | | | | | | | | | |
|---------------------|-------------|----|----|-------------|----|----|---------------|----|
| a. | comfortable | 15 | b. | quiet | 1 | c. | hot | 10 |
| d. | dingy | 0 | e. | cool | 7 | f. | spacious | 10 |
| (as in temperature) | | | | | | | | |
| g. | pleasant | 10 | h. | interesting | 11 | j. | uncomfortable | 3 |
| k. | crowded | 6 | l. | noisy | 15 | m. | bright | 20 |
| n. | colourful | 15 | o. | smelly | 0 | p. | uninteresting | 1 |

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	22
	b.	mostly quiet?	3
If it could be changed easily, would you like it to be:			
	c.	noisier?	0
	d.	quieter?	16
	e.	stay the same?	9

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	7
	b.	mostly quiet?	18
If it could be changed easily, would you like it to be:			
	a.	noisier?	0
	b.	quieter?	5
	c.	stay the same?	20

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	15
	b.	mostly quiet?	10
If it could be changed easily, would you like it to be:			
	c.	noisier?	0
	d.	quieter?	11
	e.	stay the same?	14

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	5
	b.	dislike noise?	21

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 3 / no	20
Is Noise	b.	distracting	yes 22 / no	2
	c.	annoying	yes 10 / no	11
	d.	fun	yes 4 / no	15
Does noise	a.	stop you concentrating?	yes 20 / no	4
	b.	make work more difficult to do?	yes 16 / no	9
	c.	help you work better?	yes 1 / no	22
	d.	help cover up distractions?	yes 3 / no	20

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	19
b.	Often	3
c.	Most of the time?	3

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	14
b.	Often	7
c.	Most of the time?	4

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	13	b.	quiet	2	c.	hot	15
d.	dingy	1	e.	cool	7	f.	spacious	9
(as in temperature)								
g.	pleasant	9	h.	interesting	15	j.	uncomfortable	4
k.	crowded	11	l.	noisy	21	m.	bright	19
n.	colourful	22	o.	smelly	1	p.	uninteresting	1

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	25
	b.	mostly quiet?	1
If it could be changed easily, would you like it to be:	c.	noisier?	1
	d.	quieter?	17
	e.	stay the same?	8

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	18
	b.	mostly quiet?	8
If it could be changed easily, would you like it to be:	c.	noisier?	1
	d.	quieter?	11
	e.	stay the same?	13

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	16
	b.	mostly quiet?	10
If it could be changed easily, would you like it to be:	c.	noisier?	1
	d.	quieter?	14
	e.	stay the same?	11

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	8
	b.	dislike noise?	17

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 15 / no	11
Is Noise	b.	distracting	yes 17 / no	8

	c.	annoying	yes 15 / no	10
	d.	fun	yes 14 / no	12
Does noise	a.	stop you concentrating?	yes 16 / no	7
	b.	make work more difficult to do?	yes 16 / no	8
	c.	help you work better?	yes 6 / no	19
	d.	help cover up distractions?	yes 9 / no	15

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	18
b.	Often	2
c.	Most of the time?	6

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	10
b.	Often	10
c.	Most of the time?	6

Pupil Survey: School: A Summary (100)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	58	b.	quiet	9	c.	hot	55
d.	dingy	4	e.	cool	37	f.	spacious	39
				(as in temperature)				
g.	pleasant	45	h.	interesting	66	j.	uncomfortable	14
k.	crowded	33	l.	noisy	65	m.	bright	67
n.	colourful	72	o.	smelly	4	p.	uninteresting	6

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	73
	b.	mostly quiet?	20

If it could be changed easily, would you like it to be:

a.	noisier?	3
b.	quieter?	66
c.	stay the same?	30

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:

a.	mostly noisy?	40
b.	mostly quiet?	62

If it could be changed easily, would you like it to be:

a.	noisier?	1
b.	quieter?	47
c.	stay the same?	51

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

a.	mostly noisy?	58
----	---------------	----

- b. mostly quiet? 42
- If it could be changed easily, would you like it to be:
- a. noisier? 2
- b. quieter? 58
- c. stay the same? 40

Question 5: (Put a circle around the letter next to your answer)
When you are working in the classroom do you:

- a. like noise? 18
- b. dislike noise? 81

Question 6: Noise affects people in different ways. How does noise in school affect you:

- | | | | | |
|------------|----|---------------------------------|-------------|----|
| Does noise | a. | make you feel good | yes 22 / no | 72 |
| Is Noise | b. | distracting | yes 85 / no | 20 |
| | c. | annoying | yes 61 / no | 29 |
| | d. | fun | yes 25 / no | 65 |
| Does noise | a. | stop you concentrating? | yes 78 / no | 19 |
| | b. | make work more difficult to do? | yes 67 / no | 29 |
| | c. | help you work better? | yes 11 / no | 82 |
| | d. | help cover up distractions? | yes 28 / no | 64 |

Question 7: Does noise in the classroom stop you hearing your teacher easily?

- a. Sometimes 68
- b. Often 11
- c. Most of the time? 20

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

- a. Sometimes 47
- b. Often 26
- c. Most of the time? 28

Teacher Survey: School: A (11)

Question 1: If you think that any of the following words describe this school put a circle around the letter next to the word or words:

- | | | | |
|------------------|--------------|---------------|------------------|
| a. comfortable 6 | b. quiet 0 | c. hot 4 | d. colourful 10 |
| e. limiting 1 | f. uncomf 0 | g. pleasant 4 | h. interesting 6 |
| j. spacious 2 | k. noisy 11 | l. fresh 1 | m. bright 11 |
| n. dingy 0 | o. smelly 1 | p. unint 0 | q. flexible 2 |
| r. cool 1 | s. cramped 0 | | |

Question 2: Please rank the importance to you, as a teacher, of the following as factors which are thought to relate to improved teaching conditions (Put '1' against the most

important and then rank, as importance reduces, until 10 is against the least important to you. If you think some are of equal importance please put an 'number=' against these):

	Mean	rank
Low background noise levels	2.7	1
Flexibility of space for different arrangements	4.7	5
Ease of use of linked spaces	5.4	8=
Ease of seeing pupils in teaching and related spaces	3.5	2
Having activity areas linked to teaching spaces	4.8	6
Fresh and cool (not stuffy) air	4.0	3
'Quiet / private' space (for 1-to-1 / small groups) nearby	5.4	8=
Lots of wall display space	5.3	7
Lots of natural lighting	4.5	4
Carpeted floors in teaching areas	6.5	10

Question 3: Speaking generally about the space you usually teach / work in how would you describe the 'background' conditions? (Circle one option for each statement)

Usually 1 / sometimes 8 / never 1	-	very noisy
Usually 8 / sometimes 0/ never 0	-	rather noisy
Usually 0 / sometimes 4/ never 0	-	slightly noisy
Usually 0 / sometimes 4/ never	-	very quiet
Usually 1 / sometimes 8/ never	-	rather quiet
Usually 0 / sometimes 3/ never	-	just quiet

Question 4: If change could be readily achieved would you like the teaching areas to be (put a circle around the letter next to one of the following):

- a. noisier? b. quieter? 10 c. stay the same? 1

Question 5: Would you feel the same if quieter conditions could only be achieved by closing off spaces, reducing flexibility and reducing the total available teaching and activity areas? (Please circle) **yes** 5 or **no** 4

Please explain your choice:

Ability to close off spaces as quiet essential for some teaching; must be able to hear; do not use activity areas a lot due to trying to be quiet for other areas; these factors important in a large school; need large teaching area.

Question 6: How much does noise in your normal teaching environment affect your ability to hear what your pupils are saying to you? (Please circle your answer on the following scale)

A lot					not at all
5	4	3	2	1	0
1	9	0	1	0	0

Please comment on the extent of any problem of pupils not hearing you:

Miss what child is saying; need to ask to repeat; have to use hand signals; noise is a distraction; children miss instructions (3); children switch off; have to raise my voice; problem for children with hearing difficulties; often cannot hear in group discussions(3).

Question 7: How do you think background noise in your normal teaching environment affects how easily your pupils hear you? (Please circle your answer on the following scale):

A lot						not at all
5	4	3	2	1		0
1	4	3	1	1		0

Please comment on the extent of any problem of you not hearing your pupils:

Battling to be heard; background noise very high at times (3); affects reading to class; distraction of noise and (visual) movements; children have to repeat; can't always see / tell who is talking; minor consideration; a lot of children do not have loud enough voices to be heard.

Question 8: Do you have to raise your voice to overcome background noise from outwith your class to make yourself heard? (Please circle your answer on the following scale):

A lot						not at all
5	4	3	2	1		0
3	6	0	0	1		1

Question 9a: Do you discuss noise levels in the school with other teachers?

(Please circle) **yes 10** or **no 1**

Question 9b: Do you make arrangements with other teachers to limit noise at certain times?

(Please circle) **yes 9** or **no 2**

Please describe briefly any such arrangements

Try to timetable noisy lessons at same time; designate quiet times (3) especially for maths and languages; use drama space for noisier activities (3);

Question 10: We would value your views on the following questions

a. **Do you think that 'open plan/ semi-open plan' spaces have advantages for teaching?** (Please circle) **yes 9** or **no 1**

b. **What advantages? Please list any that occur to you**

Staff team working; awareness of other classes; awareness of school as a whole; collaborative working and liaison easier (60); supervision by sight easier; more space (2); 'company' for teacher; easies asking for advice / resources (2); 'emergency' support readily available; displays visible to all; children learn to focus; teacher not isolated; sharing resources involves interaction with other classes; flexibility and openness.

c. **Do you think that 'open plan / semi open plan' spaces have disadvantages for teaching?** (Please circle) **yes 3** or **no 7**

d. **What disadvantages? Please list any that occur to you**

Noise from other areas (6); very noisy sometimes; interruptions; distractions from people passing by (4); Difficulties watching TV / listening to radio – need to use other quieter space; difficult teaching sensitive subjects (e.g. sex ed); difficult for those with hearing difficulties; group discussions –difficulty hearing.

Question 11: If you had to choose between the following teaching areas which would you select? (Please circle the letter next to your choice.)

- a. Cellular classroom with an integral wet area and a door leading from a corridor 3
- b. Open plan / semi open plan teaching spaces with associated activity areas combined with access routes. 7

Please explain your choice as best you can:

- a. children contained; less visual distractions and interruptions (2); teacher in control of noise levels (2); no timetable planning restrictions (2); able to watch TV / radio in teaching area (not having to go to another area); advantages outweigh disadvantages even though noise is important (2) but need to be able to limit noise more; open plan seriously and negatively affects quality of learning and teaching; do not have to collaborate on what and when for noisy / quiet activities.
- b. Light and open feel; teacher gets to know lots of other children, good for progression; cellular classroom makes staff and children too isolated; enjoy working in open plan classroom but would be wonderful if there was a means of closing off for quiet activities; have worked in both types and prefer open plan but need to limit noise levels more; more support for teacher in open plan; easier for moving pupils into sets;

Appendix F

School B

Pupil Survey:

School: B

P6/7

(20)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	14	b.	quiet	5	c.	hot	10
d.	dingy	0	e.	cool	7	f.	spacious	5
				(as in temperature)				
g.	pleasant	5	h.	interesting	6	j.	uncomfortable	2
k.	crowded	3	l.	noisy	10	m.	bright	10
n.	colourful	8	o.	smelly	0	p.	uninteresting	3

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:

a.	mostly noisy?	14
b.	mostly quiet?	6

If it could be changed easily, would you like it to be:

a.	noisier?	0
b.	quieter?	11
c.	stay the same?	9

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:

a.	mostly noisy?	3
b.	mostly quiet?	17

If it could be changed easily, would you like it to be:

a.	noisier?	2
b.	quieter?	9
c.	stay the same?	9

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

a.	mostly noisy?	11
b.	mostly quiet?	9

If it could be changed easily, would you like it to be:

a.	noisier?	1
b.	quieter?	12
c.	stay the same?	7

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:

a.	like noise?	6
b.	dislike noise?	14

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 5 / no	15
Is Noise	b.	distracting	yes 16 / no	4
	c.	annoying	yes 11 / no	9
	d.	fun	yes 11 / no	8
Does noise	a.	stop you concentrating?	yes 17 / no	3
	b.	make work more difficult to do?	yes 10 / no	8
	c.	help you work better?	yes 2 / no	18
	d.	help cover up distractions?	yes 7 / no	12

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	14
b.	Often	2
c.	Most of the time?	4

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	9
b.	Often	4
c.	Most of the time?	7

Pupil Survey: School: B P6 (21)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	13	b.	quiet	7	c.	hot	17
d.	dingy	1	e.	cool	5	f.	spacious	6
				(as in temperature)				
g.	pleasant	8	h.	interesting	7	j.	uncomfortable	3
k.	crowded	11	l.	noisy	11	m.	bright	14
n.	colourful	16	o.	smelly	0	p.	uninteresting	4

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	15
	b.	mostly quiet?	5

If it could be changed easily, would you like it to be:

a.	noisier?	2
b.	quieter?	16
c.	stay the same?	3

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	1	7
	b.	mostly quiet?	4	

If it could be changed easily, would you like it to be:

c.	noisier?	1
d.	quieter?	17
e.	stay the same?	3

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

- | | | |
|----|---------------|----|
| a. | mostly noisy? | 10 |
| b. | mostly quiet? | 11 |

If it could be changed easily, would you like it to be:

- | | | |
|----|----------------|----|
| c. | noisier? | 2 |
| d. | quieter? | 13 |
| e. | stay the same? | 6 |

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:

- | | | |
|----|----------------|----|
| a. | like noise? | 4 |
| b. | dislike noise? | 16 |

Question 6: Noise affects people in different ways. How does noise in school affect you:

- | | | | | |
|------------|----|---------------------------------|-------------|----|
| Does noise | a. | make you feel good | yes 4 / no | 15 |
| Is Noise | b. | distracting | yes 18 / no | 3 |
| | c. | annoying | yes 16 / no | 6 |
| | d. | fun | yes 10 / no | 10 |
| Does noise | a. | stop you concentrating? | yes 17 / no | 4 |
| | b. | make work more difficult to do? | yes 18 / no | 2 |
| | c. | help you work better? | yes 4 / no | 16 |
| | d. | help cover up distractions? | yes 11 / no | 9 |

Question 7: Does noise in the classroom stop you hearing your teacher easily?

- | | | |
|----|-------------------|----|
| a. | Sometimes | 5 |
| b. | Often | 5 |
| c. | Most of the time? | 11 |

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

- | | | |
|----|-------------------|---|
| a. | Sometimes | 7 |
| b. | Often | 9 |
| c. | Most of the time? | 5 |

Pupil Survey: School: B P7 (20)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

- | | | | | | | | | |
|----|-------------|----|----|---------------------|----|----|---------------|----|
| a. | comfortable | 12 | b. | quiet | 2 | c. | hot | 16 |
| d. | dingy | 0 | e. | cool | 7 | f. | spacious | 7 |
| | | | | (as in temperature) | | | | |
| g. | pleasant | 3 | h. | interesting | 4 | j. | uncomfortable | 3 |
| k. | crowded | 10 | l. | noisy | 18 | m. | bright | 11 |
| n. | colourful | 10 | o. | smelly | 3 | p. | uninteresting | 4 |

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:

- | | | |
|----|---------------|----|
| a. | mostly noisy? | 16 |
| b. | mostly quiet? | 5 |

If it could be changed easily, would you like it to be:

- c. noisier? 2
- d. quieter? 13
- e. stay the same? 6

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:

- a. mostly noisy? 14
- b. mostly quiet? 7

If it could be changed easily, would you like it to be:

- c. noisier? 2
- d. quieter? 12
- e. stay the same? 7

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

- a. mostly noisy? 15
- b. mostly quiet? 6

If it could be changed easily, would you like it to be:

- c. noisier? 2
- d. quieter? 10
- e. stay the same? 9

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:

- a. like noise? 2
- b. dislike noise? 19

Question 6: Noise affects people in different ways. How does noise in school affect you:

- | | | | | |
|------------|----|---------------------------------|-------------|----|
| Does noise | a. | make you feel good | yes 4 / no | 15 |
| Is Noise | b. | distracting | yes 16 / no | 4 |
| | c. | annoying | yes 13 / no | 6 |
| | d. | fun | yes 5 / no | 14 |
| Does noise | a. | stop you concentrating? | yes 15 / no | 4 |
| | b. | make work more difficult to do? | yes 13 / no | 6 |
| | c. | help you work better? | yes 4 / no | 15 |
| | d. | help cover up distractions? | yes 7 / no | 3 |

Question 7: Does noise in the classroom stop you hearing your teacher easily?

- a. Sometimes 12
- b. Often 3
- c. Most of the time? 5

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

- a. Sometimes 13
- b. Often 1
- c. Most of the time? 7

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	39	b.	quiet	14	c.	hot	43
d.	dingy	1	e.	cool	19	f.	spacious	18
				(as in temperature)				
g.	pleasant	16	h.	interesting	17	j.	uncomfortable	8
k.	crowded	24	l.	noisy	39	m.	bright	35
n.	colourful	34	o.	smelly	3	p.	uninteresting	11

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	45
	b.	mostly quiet?	16
If it could be changed easily, would you like it to be:	c.	noisier?	4
	d.	quieter?	40
	e.	stay the same?	18

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	34
	b.	mostly quiet?	28
If it could be changed easily, would you like it to be:	c.	noisier?	5
	d.	quieter?	38
	e.	stay the same?	19

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	36
	b.	mostly quiet?	26
If it could be changed easily, would you like it to be:	c.	noisier?	5
	d.	quieter?	35
	e.	stay the same?	22

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	12
	b.	dislike noise?	49

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 13 / no	45
Is Noise	b.	distracting	yes 50 / no	11
	c.	annoying	yes 40 / no	21
	d.	fun	yes 26 / no	32

Does noise	a.	stop you concentrating?	yes 49 / no	11
	b.	make work more difficult to do?	yes 41 / no	16
	c.	help you work better?	yes 10 / no	49
	d.	help cover up distractions?	yes 25 / no	24

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	31
b.	Often	10
c.	Most of the time?	20

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	29
b.	Often	14
c.	Most of the time?	1

Teacher Survey: School: B (9)

Question 1: If you think that any of the following words describe this school put a circle around the letter next to the word or words:

a.	comfortable	3	b.	quiet	0	c.	hot	3	d.	colourful	0
e.	limiting	6	f.	uncom	0	g.	pleasant	3	h.	interesting	0
j.	spacious	0	k.	noisy	0	l.	fresh	4	m.	bright	1
n.	dingy	0	o.	smelly	0	p.	unint	2	q.	flexible	0
r.	cool	1	s.	cramped	2						

Question 2: Please rank the importance to you, as a teacher, of the following as factors which are thought to relate to improved teaching conditions (Put '1' against the most important and then rank, as importance reduces, until 10 is against the least important to you. If you think some are of equal importance please put an 'number=' against these):

	Mean	rank
Low background noise levels	3.6	2
Flexibility of space for different arrangements	4.4	4=
Ease of use of linked spaces	6.4	9
Ease of seeing pupils in teaching and related spaces	3.9	3
Having activity areas linked to teaching spaces	6.0	8
Fresh and cool (not stuffy) air	4.4	4=
'Quiet / private' space (for 1-to-1 / small groups) nearby	5.6	7
Lots of wall display space	5.3	6
Lots of natural lighting	3.5	1
Carpeted floors in teaching areas	9.3	10

Question 3: Speaking generally about the space you usually teach / work in how would you describe the 'background' conditions? (Circle one option for each statement)

Usually 0/ sometimes 5 / never 4	-	very noisy
Usually 0/ sometimes 9/ never 0	-	rather noisy
Usually 0/ sometimes 1/ never 2	-	slightly noisy

Usually 0 / sometimes 5/ never 2 - very quiet
 Usually 2/ sometimes 6/ never 0 - rather quiet
 Usually 0/ sometimes 3/ never 1 - just quiet

Question 4: If change could be readily achieved would you like the teaching areas to be
 (put a circle around the letter next to one of the following):

a. noisier? 0 b. quieter? 4 c. stay the same? 5

Question 5: Would you feel the same if quieter conditions could only be achieved by closing off spaces, reducing flexibility and reducing the total available teaching and activity areas?
 (Please circle) **yes** 3 or **no** 2

Please explain your choice:

Closed spaces better for infant concentration; necessary to accept other noise; not enough flexibility of space as it is; noisy when music on next door; rather than have a little noise than sacrifice space.

Question 6: How much does noise in your normal teaching environment affect your ability to hear what your pupils are saying to you? (Please circle your answer on the following scale)

A lot						not at all
5	4	3	2	1	0	
0	0	1	1	4	3	

Please comment on the extent of any problem of pupils not hearing you:

Only class noise.

Question 7: How do you think background noise in your normal teaching environment affects how easily your pupils hear you? (Please circle your answer on the following scale):

A lot						not at all
5	4	3	2	1	0	
0	0	1	3	4	1	

Please comment on the extent of any problem of you not hearing your pupils:

Noise and distraction come together – not a major problem

Question 8: Do you have to raise your voice to overcome background noise from outwith your class to make yourself heard? (Please circle your answer on the following scale):

A lot						not at all
5	4	3	2	1	0	
0	0	0	3	3	3	

Question 9a: Do you discuss noise levels in the school with other teachers?
 (Please circle) **yes** 3 or **no** 6

Question 9b: Do you make arrangements with other teachers to limit noise at certain times?
 (Please circle) **yes** 5 or **no** 4

Please describe briefly any such arrangements

Not having too many in wet area at same time; avoid music etc when nursery next door on story time; timetable quiet work times and play areas outside classrooms; more useable doors to activity area would be better

Question 10: We would value your views on the following questions

a. **Do you think that 'open plan/ semi-open plan' spaces have advantages for teaching?** (Please circle) **yes** 6 or **no** 3

d. **What advantages? Please list any that occur to you**

Allows choice for children whilst allowing supervision; flexibility if space use (2); permits different environmental dynamics; needs-time tabling for quiet times; shared resources; pupils able to mix; use space as extension of classroom; use for group work and children's choice.

e. **Do you think that 'open plan / semi open plan' spaces have disadvantages for teaching?** (Please circle) **yes** 9 or **no** 0

d. **What disadvantages? Please list any that occur to you**

Noisy environment (5); difficult for some children to concentrate with lots of background noise; requires different teaching methods that may not suit all teachers; children need coaching in use of open spaces; difficult supervision to ensure safety in block with ramp; noise affects lesson/teaching plans; distraction (2); difficult supervision in nursery classes with noise.

Question 11: If you had to choose between the following teaching areas which would you select? (Please circle the letter next to your choice.)

a. Cellular classroom with an integral wet area and a door leading from a corridor 8

b. Open plan / semi open plan teaching spaces with associated activity areas combined with access routes. 0

Please explain your choice as best you can:

Keeps children focused (2); minimises distractions (2); calm working environment; open plan facilitates different kinds of teaching but on balance individual classrooms more conducive to this; ease of supervision of activities areas linked to teaching areas; can set own noise levels and plan more freely without interruptions; open plan noisy and distracting; open plan requires extra planning; difficult to have own quiet times; own place needed to be with children – quiet and safe plus concentration; many children like being away from distractions of other classes; some children need to be in an environment where focus and concentration can be optimised;

Appendix G

School C

Pupil Survey:

School:

P3 (29)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	23	b.	quiet	11	c.	hot	13
d.	dingy	0	e.	cool	16	f.	spacious	13
				(as in temperature)				
g.	pleasant	19	h.	interesting	22	j.	uncomfortable	1
k.	crowded	8	l.	noisy	17	m.	bright	27
n.	colourful	26	o.	smelly	0	p.	uninteresting	0

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	21
	b.	mostly quiet?	8
If it could be changed easily, would you like it to be:	c.	noisier?	0
	d.	quieter?	14
	e.	stay the same?	15

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	8
	b.	mostly quiet?	20
If it could be changed easily, would you like it to be:	a.	noisier?	5
	b.	quieter?	8
	c.	stay the same?	15

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	8
	b.	mostly quiet?	21
If it could be changed easily, would you like it to be:	c.	noisier?	0
	d.	quieter?	7
	e.	stay the same?	20

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	6
	b.	dislike noise?	23

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 6 / no	23
Is Noise	b.	distracting	yes 20 / no	9
	c.	annoying	yes 19 / no	9
	d.	fun	yes 9 / no	19
Does noise	a.	stop you concentrating?	yes 22 / no	7
	b.	make work more difficult to do?	yes 23 / no	5
	c.	help you work better?	yes 4 / no	23
	d.	help cover up distractions?	yes 7 / no	20

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	9
b.	Often	8
c.	Most of the time?	12

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	22
b.	Often	6
c.	Most of the time?	1

Pupil Survey: School: P5 (25)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	18	b.	quiet	7	c.	hot	18
d.	dingy	1	e.	cool	10	f.	spacious	13
				(as in temperature)				
g.	pleasant	13	h.	interesting	15	j.	uncomfortable	2
k.	crowded	6	l.	noisy	21	m.	bright	21
n.	colourful	14	o.	smelly	6	p.	uninteresting	3

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	22
	b.	mostly quiet?	3

If it could be changed easily, would you like it to be:

c.	noisier?	4
d.	quieter?	12
e.	stay the same?	8

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	21
	b.	mostly quiet?	4

If it could be changed easily, would you like it to be:

c.	noisier?	2
d.	quieter?	18
e.	stay the same?	6

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:

- a. mostly noisy? 18
- b. mostly quiet? 7

If it could be changed easily, would you like it to be:

- c. noisier? 3
- d. quieter? 19
- e. stay the same? 3

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:

- a. like noise? 1
- b. dislike noise? 24

Question 6: Noise affects people in different ways. How does noise in school affect you:

- | | | | | |
|------------------------|----|--------------------|-------------|----|
| Does noise
Is Noise | a. | make you feel good | yes 2 / no | 22 |
| | b. | distracting | yes 21 / no | 4 |
| | c. | annoying | yes 21 / no | 3 |
| | d. | fun | yes 2 / no | 23 |

- | | | | | |
|------------|----|---------------------------------|-------------|----|
| Does noise | a. | stop you concentrating? | yes 23 / no | 2 |
| | b. | make work more difficult to do? | yes 18 / no | 7 |
| | c. | help you work better? | yes 0 / no | 24 |
| | d. | help cover up distractions? | yes 10 / no | 12 |

Question 7: Does noise in the classroom stop you hearing your teacher easily?

- a. Sometimes 10
- b. Often 2
- c. Most of the time? 13

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

- a. Sometimes 11
- b. Often 3
- c. Most of the time? 11

Pupil Survey: School: C P7 (25)

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

- | | | | | | | | | |
|---------------------|-------------|----|----|-------------|----|----|---------------|----|
| a. | comfortable | 15 | b. | quiet | 0 | c. | hot | 9 |
| d. | dingy | 0 | e. | cool | 12 | f. | spacious | 13 |
| (as in temperature) | | | | | | | | |
| g. | pleasant | 12 | h. | interesting | 13 | j. | uncomfortable | 2 |
| k. | crowded | 1 | l. | noisy | 19 | m. | bright | 16 |
| n. | colourful | 17 | o. | smelly | 1 | p. | uninteresting | 1 |

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	25
	b.	mostly quiet?	0
If it could be changed easily, would you like it to be:			
	c.	noisier?	0
	d.	quieter?	21
	e.	stay the same?	4

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	16
	b.	mostly quiet?	9
If it could be changed easily, would you like it to be:			
	c.	noisier?	1
	d.	quieter?	12
	e.	stay the same?	12

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	12
	b.	mostly quiet?	13
If it could be changed easily, would you like it to be:			
	c.	noisier?	0
	d.	quieter?	5
	e.	stay the same?	20

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	11
	b.	dislike noise?	14

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 7 / no	18
Is Noise	b.	distracting	yes 16 / no	9
	c.	annoying	yes 10 / no	15
	d.	fun	yes 12 / no	12
Does noise	a.	stop you concentrating?	yes 16 / no	9
	b.	make work more difficult to do?	yes 11 / no	14
	c.	help you work better?	yes 5 / no	20
	d.	help cover up distractions?	yes 11 / no	14

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	20
b.	Often	5
c.	Most of the time?	0

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	16
b.	Often	8
c.	Most of the time?	1

Question 1: Here are some words. If you think that one or more of them describes your school put a circle around the letters next to the words.

a.	comfortable	56	b.	quiet	18	c.	hot	40
d.	dingy	1	e.	cool	38	f.	spacious	39
				(as in temperature)				
g.	pleasant	44	h.	interesting	50	j.	uncomfortable	5
k.	crowded	15	l.	noisy	57	m.	bright	64
n.	colourful	57	o.	smelly	7	p.	uninteresting	4

Question 2: (Put a circle around the letter next to your answer)

Would you say that your school is:	a.	mostly noisy?	68
	b.	mostly quiet?	11
If it could be changed easily, would you like it to be:	c.	noisier?	4
	d.	quieter?	47
	e.	stay the same?	27

Question 3: (Put a circle around the letter next to your answer)

Would you say that your teaching area / classroom is:	a.	mostly noisy?	45
	b.	mostly quiet?	33
If it could be changed easily, would you like it to be:	c.	noisier?	8
	d.	quieter?	38
	e.	stay the same?	33

Question 4: (Put a circle around the letter next to your answer)

Would you say that your activity area is:	a.	mostly noisy?	38
	b.	mostly quiet?	41
If it could be changed easily, would you like it to be:	a.	noisier?	3
	b.	quieter?	31
	c.	stay the same?	43

Question 5: (Put a circle around the letter next to your answer)

When you are working in the classroom do you:	a.	like noise?	18
	b.	dislike noise?	61

Question 6: Noise affects people in different ways. How does noise in school affect you:

Does noise	a.	make you feel good	yes 15 / no	63
Is Noise	b.	distracting	yes 57 / no	22
	c.	annoying	yes 50 / no	27

	d.	fun	yes 23 / no	54
Does noise	a.	stop you concentrating?	yes 61 / no	18
	b.	make work more difficult to do?	yes 52 / no	26
	c.	help you work better?	yes 9 / no	67
	d.	help cover up distractions?	yes 28 / no	46

Question 7: Does noise in the classroom stop you hearing your teacher easily?

a.	Sometimes	39
b.	Often	15
c.	Most of the time?	25

Question 8: Does noise in the classroom make it difficult for your teacher to hear you?

a.	Sometimes	49
b.	Often	17
c.	Most of the time?	13

Teacher Survey: School: C (11)

Question 1: If you think that any of the following words describe this school put a circle around the letter next to the word or words:

a.	comfortable	5	b.	quiet	1	c.	hot	0	d.	colourful	4
e.	limiting	7	f.	uncom	0	g.	pleasant	3	h.	interesting	6
j.	spacious	3	k.	noisy	8	l.	fresh	4	m.	bright	5
n.	dingy	1	o.	smelly	0	p.	unint	0	q.	flexible	2
r.	cool	3	s.	cramped	1						

Question 2: Please rank the importance to you, as a teacher, of the following as factors which are thought to relate to improved teaching conditions (Put '1' against the most important and then rank, as importance reduces, until 10 is against the least important to you. If you think some are of equal importance please put an 'number=' against these):

	mean	rank
Low background noise levels	2.2	1
Flexibility of space for different arrangements	4.7	3
Ease of use of linked spaces	6.7	8
Ease of seeing pupils in teaching and related spaces	2.3	2
Having activity areas linked to teaching spaces	5.8	7
Fresh and cool (not stuffy) air	5.4	5
'Quiet / private' space (for 1-to-1 / small groups) nearby	6.9	9=
Lots of wall display space	5.5	6
Lots of natural lighting	5.3	4
Carpeted floors in teaching areas	6.9	9=

Question 3: Speaking generally about the space you usually teach / work in how would you describe the 'background' conditions? (Circle one option for each statement)

Usually 0/ sometimes 9/ never 0 - very noisy

Usually 5/ sometimes 4/ never 0	-	rather noisy
Usually 3/ sometimes 7/ never 1	-	slightly noisy
Usually 0/ sometimes 6/ never 5	-	very quiet
Usually 9/ sometimes 7/ never 2	-	rather quiet
Usually 1/ sometimes 6/ never 2	-	just quiet

Question 4: If change could be readily achieved would you like the teaching areas to be
(put a circle around the letter next to one of the following):

a. noisier? 0 b. quieter? 9 c. stay the same? 1

Question 5: Would you feel the same if quieter conditions could only be achieved by closing off spaces, reducing flexibility and reducing the total available teaching and activity areas?
(Please circle) **yes** 10 or **no** 1

Please explain your choice:

Space already limited; flexible 4th wall to pull across; tchrs co-operate with others to create quiet times; noise makes quiet instructions difficult to hear and hear each other; having to co-ord quiet times, limits flexibility; quieter allows more flexibility

Question 6: How much does noise in your normal teaching environment affect your ability to hear what your pupils are saying to you? (Please circle your answer on the following scale)

A lot						not at all
5	4	3	2	1	0	
4	4	3	1	0	0	

Please comment on the extent of any problem of pupils not hearing you:

Constant background noise; difficult for group reading sessions; teacher needs to raise voice in group work; Sometimes have to repeat for children at outer edges of teaching area; children cannot hear others at opposite end of room; teaching loses pace; conditions vary over depth of classroom; to be heard need to be halfway down room – impacts on control pupils who do not wish to ‘engage’.

Question 7: How do you think background noise in your normal teaching environment affects how easily your pupils hear you? (Please circle your answer on the following scale):

A lot						not at all
5	4	3	2	1	0	
1	1	5	3	0	0	

Please comment on the extent of any problem of you not hearing your pupils:

Constant distractions from open area; difficult to hear pupils reading; difficult to hear pupils in group work.

Question 8: Do you have to raise your voice to overcome background noise from outwith your class to make yourself heard? (Please circle your answer on the following scale):

A lot						not at all
5	4	3	2	1	0	
2	3	5	1	0	0	

Question 9a: Do you discuss noise levels in the school with other teachers?
(Please circle) **yes** 11 or **no** 0

Question 9b: Do you make arrangements with other teachers to limit noise at certain times? (Please circle) **yes** 8 or **no** 3

Please describe briefly any such arrangements

Plan for 'golden time'; awareness of times for National tests; forewarning of noisy activities; co-ordinating quiet times (3); agreement not to have noisy activities without consulting next door classes.

Question 10: We would value your views on the following questions

a. **Do you think that 'open plan/ semi-open plan' spaces have advantages for teaching?** (Please circle) **yes** 5 or **no** 6

b. **What advantages? Please list any that occur to you**

Access to other adults; more freedom for children; building responsibility towards others; /social awareness; liaison between staff helped; eases movement of pupils; 'easier policing at intervals; overview of teachers and children; by management; children protected by knowledge of being seen by others; teachers have quieter voices; more contact between classes and stages; flexible use of space; more staff interaction.

c. **Do you think that 'open plan / semi open plan' spaces have disadvantages for teaching?** (Please circle) **yes** 11 or **no** 0

d. **What disadvantages? Please list any that occur to you**

Constant distractions(3); high noise levels most of the time (6); limits class activities (keeping them quiet); reduces spontaneity; conscious of making too much noise; noise and movement distractions (4); disruption; difficult to achieve atmosphere for concentration; feeling unable to let class make what is probably normal noise levels; limiting when positioning groups.

Question 11: If you had to choose between the following teaching areas which would you select? (Please circle the letter next to your choice.)

- a. Cellular classroom with an integral wet area and a door leading from a corridor 10
- b. Open plan / semi open plan teaching spaces with associated activity areas combined with access routes. 1

Please explain your choice as best you can:

Little advantage in working in current space - additional areas do not allow adequate supervision from class; closed doors help concentration; less distraction; easier to be more creative in teaching; easier to have group discussions; freedom to teach without restrictions (not limited by other / adjacent class activities); concentration levels higher = attainment levels are higher(?); more freedom in planning activities; would like a partition to enclose at times would provide aid to concentration; happy to teach with open door but like to be able to close off when needed; children more focused in enclosed classrooms;