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COMPARATIVE ANNOYANCE FROM RAILWAY NOISE AND BUILDING VIBRATION

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INTRODUCTION

The current outcry over the proposed new Channel Tunnel Link line is not a new phenomenon : the influence of railways on the environment has been commented on adversely since within 25 years of the opening of the first public railway [1]. The first scientific study was reported in 1902 by Mallock [2], investigating building vibration from underground trains in Central London. Since Mallock's [2] work, most studies have been concerned with community response to railway noise, such as Fields and Walker [3].

The social survey in Fields and Walker's [3] study, although primarily concerned with response to noise, included some questions on community response to railway-induced building vibration. Their findings included the conclusion that noise was the most important impact of a railway's presence in a neighbourhood, with building vibration being the most important non-noise impact. Maintenance noise was found to be the most annoying of the various noises associated with the railway - even more annoying than the noise from passing trains.

As part of a field study of community response to railway-induced building vibration, questions were used in a social survey in order to identify those aspects of a railway's presence in a neighbourhood which were considered annoying. Questions were also included to determine the relative annoyance, compared to that from building vibration, of the various sources. The social survey was carried out by the author in Scotland between July and December 1984 and between March and May 1985.

SAMPLE DETAILS

A sample of 720 potential respondents was drawn from the adult population of Scotland living within 100 metres of a railway line. The sampling frame for the multi-stage sampling process was an updated version of the National Railway Cartographic Proximity Survey produced for Fields and Walker [3].

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The sampling process identified 24 sites, each containing 30 neighbouring dwellings. The sample was stratified by distance from the railway resulting in eight sites in each of the strips 0–33 m, 34 –66 m, and 67 – 100 metres from the railway. The 30 neighbouring dwellings at each site were all approximately parallel to the railway and of similar age and construction. Certain types of dwelling eg blocks of flats were excluded during the sampling process.

SURVEY DETAILS

The social survey was carried out by means of interview, carried out by the author, in the respondent's own home. A formal questionnaire was used to determine whether respondents perceived railway-induced building vibration and to investigate their attitudes to the phenomena. Details of the sampling procedure and social survey are summarised in Woodroof and Griffin [4] and given in full in Woodroof [5].

The questionnaire contained questions intended to find out what characteristics of vibration, if any, were perceived by respondents when trains passed their home. Possible stimuli were that they felt the whole building, or things in it, shake; or that what they perceived was audible - such as rattling of windows or ornaments, or was visible – such as swaying of pendant lights or plants.

Respondents who perceived some aspect of building vibration were asked, at a later stage in the interview, whether there was anything else about the trains or the railway that annoyed them. If so, they were asked to describe it. If they did not mention noise at this stage, they were specifically asked if they were annoyed by noise from passing trains. Respondents who were annoyed by anything related to the railway were asked to state whether the vibration form the trains annoyed them more, or whether the other railway-related aspect they had mentioned annoyed them more, or whether there was no difference in the annoyance caused.

RESPONSE RATES

Interviews were obtained from 459 of the 720 potential respondents (response rate =64%). Non-response rates were split between refusals by potential respondents (17%) and failure to contact a suitable respondent after at least two call-backs (19%).

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RESULTS AND DISCUSSION

Of the 459 interviewees, 160 (35%), perceived railway-induced building vibration. Their distribution, together with response rates at each site, and the approximate distance of the site from the railway, are shown in Table 1.

SITE	APPROX. DISTANCE FROM RAILWAY (metres)	RESPONSE RATE %	PERCEIVED RAILWAY-INDUCED BUILDING VIBRATION %
KINGSDDIE	0 - 33	77	17
CARNOUSTIE	0 - 33	70	66
BURNTISLAND	67 - 100	67	23
TULLOCH, PERTH	34 - 66	57	59
KIRKCALDY	34 - 66	43	38
RENTON	34 - 66	47	50
NEWTON	34 - 66	63	96
MARYHILL	67 - 100	53	5
BISHOPBRIGGS	34 - 66	63	53
SHETTLESTON	0 - 33	50	6
WESTERTON	34 - 66	60	11
JORDANHILL	0 - 33	73	87
WILLIAMWOOD	34 - 66	67	5
KIRKHILL	34 - 66	73	9
LANGSIDE	0 - 33	87	42
STEWARTON	67 - 100	60	0
LINLITHGOW	0 - 33	73	68
COATBRIDGE	67 - 100	60	6
SHOTTS	0 - 33	77	83
ABBEYHILL	67 - 100	60	6
MAYFIELD	67 - 100	67	0
SLATEFORD	67 - 100	47	21
PRESTWICK	67 - 100	43	77
LOCKERBIE	0 - 33	73	18

TABLE 1 : Site details, response rates to interview, and proportion of respondents perceiving railway-induced building vibration.

It had been expected that either nearly every one at a site, or virtually no one, would perceive vibration. However, the distribution of percentage values in the final column of Table 1 show that this is not so; at nine of the 30 sites between 25% and 75% of respondents perceived vibration. There is a significant relationship between distance from the railway and proportion noticing vibration, (Kendall's tau = 0.23, z = 1.92 ,p < 0.06 1-tail). However the low value of the correlation coefficient, although significant, shows that it is not possible to predict the proportion noticing vibration just from a knowledge of the distance between the dwelling and the railway. An extreme example is that 77% of respondents at one site (Prestwick) perceived vibration, despite it being amongst the sites furthest from the railway. In contrast, only 6% perceived vibration at a site (Shettleston) less than 33 metres from the line. The consequence of such variation is that it is not possible to predict what proportion of residents at a site will perceive vibration from a knowledge of distance from the railway .

The response to the questions about the comparative annoyance of building vibration and other aspects of the railway's presence in the neighbourhood are shown in Table 2.

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OTHER SOURCE OF ANNOYANCE	NUMBER OF RESPONDENTS MENTIONING OTHER SOURCE	COMPARATIVE ANNOYANCE OF VIBRATION AND OTHER SOURCE NUMBER OF RESPONDENTS :			
		MORE ANNOYED BY : VIBRATION	OTHER SOURCE	NO DIFFERENCE BETWEEN TWO SOURCES OF ANNOYANCE	NO DATA
NOISE FROM PASSING TRAINS*	41	6	24	10	1
MAINTENANCE WORK	23	2	17	3	1
CONDITION OF BOUNDARY FENCES	8	1	7	0	0
NOISE FROM STATIONARY ENGINES	5	0	5	0	0
UNTIDYNESS	5	0	3	2	0
LACK OF PRIVACY	4	0	4	0	0
NINE OTHER VARIOUS	17	3	8	5	1
TOTAL	103	12	68	20	3

* Includes 16 who mentioned noise spontaneously and 25 who replied "yes" to a specific question.

TABLE 2 : Comparative annoyance of railway-induced building vibration and various other sources of annoyance related to the railway.

The data in Table 2 show that noise was the most frequently mentioned source of annoyance, with maintenance work also a prominent source. The data on the comparative annoyance of vibration and the other sources of annoyance show that, where another source of annoyance

exists, it was considered to be more annoying than the vibration by the majority of those who mentioned the other source. This shows that vibration is amongst the least annoying aspects of a railway's presence in a neighbourhood.

CONCLUSIONS

It is concluded that railway-induced building vibration is perceived by the residents of a significant proportion of the dwellings within 100 metres of railway lines. However the proportion of residents at any particular site cannot be predicted by simple measures of distance from the railway. Furthermore it is not usual to find either that everyone in a neighbourhood perceives the vibration or that no one feels it.

A finding of the present study agreed with that of Fields and Walker [3] - that noise, and particularly maintenance noise, is the most important impact of a railway on a residential neighbourhood. However the results of the present study did not support their finding that vibration was the most important non-noise impact. The findings of the present study suggest that vibration is amongst the least important of the annoying aspects of a railway's presence in a neighbourhood.

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