

**inter.noise 2000**

*The 29th International Congress and Exhibition on Noise Control Engineering  
27-30 August 2000, Nice, FRANCE*

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I-INCE Classification: 3.3

## RESIDENTIAL INSULATION SCHEME AROUND SYDNEY AIRPORT

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**Keywords:**

AIRCRAFT NOISE, HOUSE INSULATION, SYDNEY AIRPORT

**ABSTRACT**

The Sydney Airport Noise Amelioration Program was implemented in 1994 and instigated by the construction of a new parallel runway. The Airport is surrounded by suburban areas on three sides with a bay on the fourth side. Residences within ANEF 40 (approx  $L_{DN}$  75) were acquired and the land converted to a park. A sound insulation scheme is applicable for residences within the ANEF 30 boundary (approx  $L_{DN}$  65) – this includes around 4,200 houses. This paper summarises the implementation of the residential insulation scheme including the aspects designed to allow for user preference and the monitoring and improvement, the noise reductions achieved and the home owner satisfaction. The effects of the scheme on the community and the local building industry will also be discussed.

**1 - INTRODUCTION**

The airport for Sydney is surrounded by suburban areas on three sides with a bay on the fourth side. The Sydney Airport Noise Amelioration Program was implemented in 1994 and instigated by the construction of a new parallel runway. Costs for the program are recovered via a levy on aircraft landings. The program involved

- voluntary acquisition of residential properties and a church within the 40 Australian Noise Exposure Forecast (ANEF) contour (approx  $L_{DN}$  75)
- assistance for the insulation of residences within the 30 ANEF contour (approx  $L_{DN}$  65)
- insulation of public buildings (ie schools, hospitals churches etc within the 25 ANEF contour (approx  $L_{DN}$  60)

The voluntary property acquisition was commenced in 1994 and by 1997 all but 5 of the 161 eligible homeowners had accepted the Federal Government's offer. The land which has been acquired has been transferred to the local council along with a grant to assist with its conversion to a park and a replacement facility has been constructed for the church.

For the 85 public buildings inside the 25 ANEF, the aim of the insulation program was to insulate all the noise sensitive areas of the relevant facility to achieve as close as possible to the internal design noise levels recommended in AS 2021 [1], having regard to architectural, functional and heritage constraints. As the construction of each public building was quite different, an acoustic consultant was involved to undertake a careful investigation and to recommend a cost effective solution to achieve the required noise reduction.

Eligibility for the residential insulation program included some 4,200 houses and a sound insulation packaged based on a menu of options for treatment was selected as an effective approach. The goal

of the package was to provide a cost-effective solution, allowing maximum choice by the home owners without compromising the acoustic performance or the "liveability" of the home.

## **2 - BASIS OF THE NOISE INSULATION PROGRAM**

Various insulation techniques were trialed on a group of 18 houses, as reported by Narang and Butler [2]. Then a package was developed which was based on a menu of options for treatment. In summary, the steps for the work on each residence are:

- the external aircraft noise level for each house is determined with reference to the tables in AS 2021 [1] and is based on the information on the flight paths, aircraft types etc;
- each home owner is provided with an information package which includes a video;
- the 'scoper' from the Project inspects each house and uses the appropriate parts from the Menu of Approved Treatments for the external aircraft noise level to determine the extent of the work to be done;
- the home owner chooses decorator items such as window style;
- taking into consideration the home owner choice and the standard specifications, the scoper prepares the Scope of Works;
- three quotations for the work are obtained by the home owner;
- the lowest quote from an acceptable builder up to a defined limit is accepted by the Project and the work is undertaken – there have been increases from the initial limit of A\$45,000 up to A\$50,000 based on movements in costs;
- inspections are undertaken by staff from the Project mid way through the work, at the end of the work and, in some cases after 3 months; and
- for up to 20% of the houses, noise level measurements are made before and after the work to determine the noise reduction achieved in three rooms.

The essence of the program is the use of the Menu of Approved Treatments rather than a consideration of the noise reduction required for each room. Once the external noise level has been defined, the Menu lists the treatments that are considered applicable. The aim is to provide adequate insulation around the perimeter of the residence even though this may provide higher noise reduction than may be necessary in general areas such as corridors etc. This "perimeter insulation approach" was adopted because the use of substantial internal doors between the rooms was considered unacceptable by the home owners in the pilot study. The work undertaken as part of the Menu includes provision of ducted air conditioning plus measures to improve the attenuation of:

- external doors by replacement and/or seals;
- external walls by blocking vents and openings;
- windows by replacement and/or secondary glazing;
- roof/ceiling by soft fibre insulation and loaded vinyl;

## **3 - MANAGEMENT OF THE NOISE INSULATION PROGRAM**

The Federal Government is responsible for the overall administration of the program and employs a contracted service provider to deliver the program. Insulation work is undertaken by a panel of accredited builders.

Since the announcement of the scheme in 1995 there have been changes in the location of the boundaries due to changes in operating procedures at the airport. To date, approximately 70% of the currently eligible homes have been treated and the total expenditure has been A\$317 million with an estimated final cost of around A\$400 million. The aircraft noise levy has been payable on all landings of jet aircraft at Sydney Airport since October 1995. The levy charge is based on the noise characteristics of each aircraft and applies irrespective of whether the aircraft is operating on national or international routes or is carrying passengers. Most airlines have chosen to apply a charge of A\$3.40 per passenger. The levy will continue to apply until the costs associated with the program have been fully recovered.

#### 4 - OUTCOMES OF THE NOISE INSULATION PROGRAM

AS2021 [1] is primarily designed for new house construction outside the 30 ANEF contour and sets design targets of 50 dB(A) in the bedroom and 60 dB(A) in the other living areas of the house, excluding bathrooms, laundries etc. The program applies to the insulation of existing properties and so these targets do not strictly apply. The pilot study identified the practical limits for noise reduction and the formal announcement of the scheme did not set a target for noise reduction in the homes. Based on the "before" and "after" measurements in around 20% of the houses, an average improvement in noise reduction of 10 dB(A) has been achieved in the bedrooms of brick houses; this has raised the average noise reduction to 38 dB(A). For 94% of the brick houses both a noise reduction greater than 34 dB(A) and an improvement of greater than 4 dB(A) has been achieved. For the houses of lightweight construction, the improved treatment to the walls has led to an average improvement in noise reduction of 8 dB(A) for the bedrooms. Homeowner surveys have shown that overall 88% are positive about the benefits of the program. Of these 64% are entirely happy with the improvement and 24% are positive but with some complaints. Around 60% rate the noise reduction as very good or excellent.

A particular challenge has been the application of the package to houses that are of timber or other lightweight construction. In these cases, the noise reduction of the walls may not be much greater than for the windows. The package has been expanded to allow for treatment of the walls of these houses either by working from the outside or from the inside. Additional funds of up to A\$15,000 per house have been allowed to enable the installation of a selected range of wall insulation in houses where light weight construction comprises 80% or more of the external walls

One beneficial outcome of the project has been the impact on the building industry. The fiscal incentive to remain on the listing of "acceptable" builders has meant that builders have been forced to appreciate the acoustic implications of various aspects of the trades involved. Attention to detail, such as the correct installation of seals around doors, windows and joints, is vitally important in order to achieve the potential noise reduction. The careful checking during the inspection process, which is an essential part of the package, and the acoustic testing of 20% of the houses have reinforced this message to the builders.

The 'scopers', who investigate each house and develop the scope of works from the menu of approved treatments are an important part of the implementation of the package. The pre-requisites for a 'scoper' are experience with the building industry but not necessarily any experience with acoustics in particular. Their ability to apply the menu of treatments after short periods of on-the-job training has shown the benefits of this approach. Feedback from regular group meetings has also improved their knowledge and understanding of the acoustic principles involved.

The requirement for sound insulation data on window and door systems prior to their inclusion in the list, has led manufacturers to improve their product range and technical data. The products developed for this project are now widely promoted. Some manufacturers have tackled the obvious disadvantage of double windows and achieved an equivalent performance from a single window system with a carefully designed frame and sealing mechanism. These have proved to be very popular with residents.

However the experiences with one house did indicate the limitations of this simple menu approach. A detailed investigation was undertaken following complaints about aircraft noise intrusion after the completion of the work. It was discovered that the owner had undertaken some work, such as double glazing, prior to the work undertaken as part of the project. The effective sealing of the room was then reduced when the ducted air conditioning was installed. His claim was that the noise intrusion had been increased by the work as the sound from aircraft could just be perceived – it could not be measured – when the air conditioning was not operating. Ultimately a baffle was installed in the air conditioning duct. More careful attention to the implications of the work that had been done by the home owner, at the scoping stage, may have minimised this problem.

#### 5 - CONCLUSION

The Sydney Airport Noise Amelioration Program for residences has been a major and a costly undertaking but the benefits have included improved noise reduction for those houses affected by aircraft noise and improved products and building techniques. The use of a menu of approved treatments has been shown to be an effective means for implementing the project.

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