Adelaide Airport Noise Insulation Program – Noise Insulation Works At St. George College

Ivailo Dimitrov and Elizabeth Cheng

VIPAC Engineers & Scientists, Adelaide, South Australia

ABSTRACT

The Department of Transport and Regional Services is overseeing a $63 million federally funded sound insulation program for residential and public buildings surrounding the Adelaide Airport. VIPAC was engaged by the project manager (Clifton Coney Stevens) as the acoustic consultant to design the treatments for the buildings, to oversee the installation of the treatments and to verify its performance.

This paper presents a review of the noise insulation treatment works at St. George College. An analysis of the noise reduction gained within the different buildings of the college (based on pre- and post-construction measurements) is presented as well as a comparison with the noise reduction achieved and the noise control treatments utilised in other types of public buildings included in the noise insulation program.

INTRODUCTION

The Department of Transport and Regional Services is overseeing a $63 million federally funded sound insulation program for residential and public buildings surrounding the Adelaide Airport. VIPAC was engaged by the Project Manager (Clifton Coney Group) as the acoustic consultant to design the treatments for the buildings, to oversee the installation of the treatment and verify the performance.

The project involves implementation of noise insulation treatments to about 600 residential dwellings within the 30 and 35 Australian Noise Exposure Concept (ANEC) noise contours as well as 5 selected public buildings within the 25 ANEC noise contours. It is based on aircraft noise level contour data provided by the Federal Airports Corporation and amelioration treatment guidelines developed from the Sydney Airport Noise Insulation Program (SANIP).

BUILDING TYPES

St George College comprises of a number of different buildings. As they were built over an extended period of time (between 1926 and 1983), the building types vary considerably.

Figure 1: The Language School

Figure 2: The Primary School

Figure 3: The Drama Studio

Figure 4: The Gymnasium

Figure 5: The TAFE Building

BUILDING MODELS AND ACHIEVABLE NOISE REDUCTION

To predict the noise reduction and the internal noise level in the St George College buildings (before and after treatment) models representing each of the buildings were developed.

Following completion of building treatment, the developed models for the buildings were verified with pre-and post-treatment aircraft noise measurements, which are discussed below.

Building Elements

There are several buildings with different construction types within the College. Building envelope elements with construction as summarized below were modeled:

Language School

- External walls – solid brick and brick veneer construction.
- Roof – sheet metal pitched and skillion roofs above generally typical flush plasterboard ceiling. Some ceilings consist of plaster acoustic tiles.
- Windows – 3mm thick float glass in timber and aluminium framings.
- Entry doors – timber doors with no seals.

Administration, Primary School

- External walls – brick veneer construction
- Roof – skillion corrugated iron roof with plaster acoustic tiles, flush plasterboard and Woodtex to various areas.
- Windows – 3mm thick float glass in aluminium framing. The northern façade of the Primary School has double glazing of 3mm thick float glass panes.
- Doors – timber doors with no seals.

Activity Room, Drama Studio, Canteen

- External walls – cavity brick construction.
- Roof – sheet metal skillion roof with plaster acoustic tiles, flush plasterboard ceiling to the canteen.
- Windows – 3mm thick float glass.
- External doors – transparent roller doors to the eastern façade.

Gymnasium

- External walls – brick veneer construction, with glass block wall to a portion of the western façade.
- Roof – skillion corrugated iron roof with sisalation underneath.
- Windows – 3mm thick float glass on aluminium framing.
- Doors – timber doors with no seals.

TAFE Building

- External walls – solid brick and cavity brick construction.
- Roof – Pitched tiled roof with flush plasterboard and Woodtex ceilings.
- Windows – 3mm thick float glass on timber and aluminium framing.
- Doors – timber doors with no seals.

Gaps were modeled around the entry doors and the operable windows as well as on the walls and roof to represent the subfloor vents.

External Design Level (EDL)

AS 2021-2000 provides a method for predicting the sound pressure level (in dBA) at a building site resulting from aircraft landings and take-offs based on the distances in metres from the runway centreline and both runway ends.

Based on coordinate information for each of the public buildings, as provided by the Department of the Environment and Heritage, the L_{Amax} for BOEING 737-300 (the aircraft considered as predominant for the Adelaide Airport) was calculated using AS 2021-2000. Measurements of noise resulting from flyovers of different types of aircraft were taken at each of the buildings. The calculated EDL's and measurement results are presented in Table 1:

Table 1. Calculated EDL's and measured external noise levels

	Calculated EDL, dBA	Measured noise level*, dBA
St George College	85	84

* ***Averaged over the pre- construction measurements for various buildings***

Criteria

AS 2021-2000 *"Acoustics – Aircraft Noise Intrusion – Building Siting and Construction"* sets the following recommended indoor design sound levels for determination of aircraft noise reduction for public buildings:

- Libraries, study areas: 50dBA
- Teaching spaces, assembly areas: 55dBA
- Gymnasia: 75dBA

As the St George College gymnasium is also used for assemblies and teaching, a criterion for teaching spaces (55dBA) was applied.

Nose Reduction and Internal Noise Levels

To investigate the options for optimization of the noise insulation treatment and therefore for cost effectiveness, two treatment options were considered:

<u>Optimal treatment:</u>

- Sealing the gaps between the roof and the external walls.
- Either new secondary 6mm thick laminated glass windows offset from the existing windows by 150mm air gap or 10mm thick laminated glass offset from the existing window by 100mm air gap.
- Overlaying the ceiling with 85mm, 20kg/m^3 fibreglass batts and 4kg/m^2 flexible vinyl loaded acoustic barrier (Wavebar).
- Sealing of the wall and subfloor vents.
- Treatment of skylights – installation of secondary glazing and lining of the skylight shaft.
- Replacement of the external door with solid core timber door fitted with seals.

<u>Non-optimal treatment:</u>

The following elements were not acoustically treated:

- Gaps in the roof structure.
- Wall and subfloor vents.
- Replacement of the existing windows glazing with 10mm laminated glass instead of upgrading to double-glazing.

The findings of the analysis of the noise reduction achieved in the different types of residential buildings during the previous stage of the project showed:

- If a building is treated <u>optimally</u> (as detailed above), AS 2021-2000 criteria could be achieved in the areas with solid external walls (solid or double brick or brick veneer) and may not be achieved in rooms with lightweight external walls.
- An average noise reduction improvement higher than 10dB throughout a building could be achieved by applying optimal treatment.
- Even an average noise reduction of about 10dB throughout a residence could be achieved if a house is non-optimally treated, however the AS 2021-2000 criteria could not be met.
- Based on the above findings, the optimal treatment was applied to the buildings.

ASSESSMENT OF THE NOISE REDUCTION GAINED

Measurement Procedure

To assess the effect of the noise insulation treatments, noise measurements were carried out in each of the buildings before any acoustic treatment was applied and then, after the work on the building was completed. The maximum A-weighted sound pressure levels were measured simultaneously outside and inside the buildings. A Larson Davis LD2900 dual channel analyser was used in the measurements. The microphone reading the external noise levels was positioned at approximately 5m away from the facade. The internal sound pressure levels were measured approximately in the middle of the critical spaces of various buildings during five flyovers of representative aircraft (BOEING 737, 747, 767, A320 and A340) for each space.

Results

Pre- and post-construction measurements were carried out in St. George College with the results of the treatment summarised below:

- The average measured improvement in noise reduction was 14dBA
- All criteria in the various rooms were achieved.

Table 2 shows a comparison between the predicted sound pressure levels in each of the buildings with the optimal treatment applied to the models and measured during aircraft flyovers after the optimal treatment was implemented to the buildings.

Table 2. Predicted and measured internal noise levels

St George College	Model (predicted)		Building (measured)	
	SPL, dBA	Overall Reduction, dBA	SPL, dBA	Overall Reduction*, dBA
Language School	48	29	41	36
Primary School	50	32	40	42
Drama Studio	50	36	43	43
Gymnasium	50	32	46	36
TAFE Building	50	34	50	34

* ***Average based on the post-construction measurements only***

CONCLUSIONS

An analysis of the predicted and measured noise reduction among the different types of residencies during the residential part of the program as well as the results achieved in St James Anglican Church and Mile End Church of Christ and the results achieved after completion of the works in St George College revealed:

- <u>Residences</u> - The average improvement in noise reduction gained as a result of the treatment of the St George College was marginally higher than the highest average noise reduction improvement achieved during the residential part of the program (14dBA compared to average of 11dBA measured among the Medium density and Conventional types residencies). We consider this to be a result of the similarity in the construction of the building elements of the buildings comprising St George College (Primary School, Drama Studio and Gymnasium buildings) and the Medium density and Conventional type residences.
- <u>St James Anglican Church and Mile End Church of Christ</u> – The average improvement of noise reduction was significantly lower than the noise reduction improvement achieved in St James Anglican Church (21dBA) and comparable to the noise reduction improvement achieved in Mile End Church of Christ (16dBA). We consider this as a result of the following factors:
  a. Significantly reduced noise transmission through the façade of the St James Anglican Church due to the greater surface mass of the walls.
  b. Similar construction of the building elements of the buildings in St George College and Mile End Church of Christ.
- The analysis of the predicted and measured internal sound pressure levels confirmed that shielding and directivity factors should be accounted for during development of the models.

Table 3. Measured improvement in noise reduction

	Pre-treatment		**Post-treatment**		**Improvement**
	External SPL dBA	Internal SPL dBA	External SPL dBA	Internal SPL dBA	
Language School	86.0	59.0	77.0	40.5	9.0
Primary School	82.0	53.0	82.0	40.0	13.0
Drama Studio	87.0	70.0	85.5	42.5	25.5
Gymnasium	82.5	63.5	82.0	46.0	17.0
TAFE Building	83.0	56.5	83.0	49.5	7.0

REFERENCES

AS 2021-2000 "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction".

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