THE TORTUOUS PATH FOR UPGRADING ACOUSTIC REGULATIONS

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Abstract

The acoustic regulations prior to May 2004 contained within the Building Code of Australia trace back to Ordinance 70 of the NSW Government for the year 1969. Even when Ordinance 70 was promulgated, the acoustic performance standards were the lowest in the developed world. Providing appropriate acoustic standards in terms of sound insulation within dwellings in line with community expectations has been a long and difficult process. There are many stakeholders and lobby groups that may resist acoustic change due to the impact that it may have on their industry.

This paper looks at the process that has been involved and explains a number of key issues of the acoustic provisions of BCA2004.

Introduction

When I first started a career in the field of acoustics in 1958 I quickly learnt from the major builders of the day the minimum acceptable practice was a double brick wall if you want a so-called soundproof wall between duplex houses or apartments. It is interesting that in a non-regulated environment builders knew the acoustic quality of the wall that had to be installed. What is more interesting is that at that time our humble radio, as a source of entertainment, had an output of approximately 1.5 watts and probably was capable of a comfortable sound pressure level of about only 75 dB(A).

One evening in 1969 I had the privilege of having dinner with Ted Weston from the Experimental Buildings Station at North Ryde. He was involved in drafting the acoustic provisions for the New South Wales Government Ordinance 70. He flashed across my bow a wall performance of STC 45 as a proposed standard. My response was to say that this is a United Kingdom council flat standard and it has to be STC 50. He said, "I know but let's get the regulation passed as there is likely to be opposition, then in a couple of years we will increase the value to STC 50". New South Wales Government Ordinance 70 went on to become the basis of the Building Code of Australia. The event that Ted Weston predicted did not take couple of years, it has taken thirty-five years and was not without a considerable battle to bring the acoustic performance to what it was prior to regulations being implemented.

The Legacy of STC/Rw 45

The use of STC/Rw 45 and the misunderstanding of the objectives of the BCA by the building industry in general resulted in an unfortunate mindset. The victims of this mindset became residents living in the newly built apartments. It is ironical that people living in low cost housing provided by the New South Wales State had a better chance of achieving acoustic separation than up market apartments costing over $1 million. This situation was not helped by some sharp acoustical consulting practices that became the builders' friend and helped them achieve STC/Rw 45 and not one rating point more.

When you are at the coal face and see the unhappiness of the residents when the wall system has been tested on site and found to comply with the BCA, or in some cases the performance was well in excess of the BCA, it is obvious that the building regulations are failing to reach their objective.

Also a change in lifestyle was occurring, it was readily easy and cheap to acquire a home entertainment system capable of relatively high sound pressure levels. A new and important entertainment revolution was starting to occur. The introduction of DVD and the home cinema concept in its many forms was taking Australia by storm. The very concept of running through a blockbuster movie with surround sound at whisper levels was ludicrous. The main attraction of the DVD was the high visual performance and the attraction of immersing yourself in the surround sound allowing the cinema experience to be almost equaled. The number of DVD players sold on the Australian market exceeds the rate of any other form of electronic entertainment device that has been introduced onto the Australian market.

How much Sound Insulation?

This is not in the area of rocket science. The mathematics is very simple, firstly how loud is the sound, secondly what level is the background noise. The difference is an indication of the sound insulation that is required by the intervening barrier. If we want the intruding sound to be inaudible then it would have to be below the background by at least 5 to 6 dB.

John Andrew in his master's thesis "The Sound Insulation Of Dwelling Units", prepared in 1977 looked at sound level that was created by a home entertainment system reproducing classical or contemporary music. The table of the two music spectra is reproduced below. These measurements and studies were under taken at a time when a 20 watt amplifier was considered the ultimate that an audiophile could own. The sound levels were in the range of 85 to 98 dB(A) Using the spectra for either classical music or contemporary music compared to a background noise level of approximately 35 dB(A), for a typical living room clearly shows that a high level of sound insulation is required by the intervening barrier. This is well beyond the then legislation of STC 45. If the adjoining room was a bedroom then a further 5 dB of sound insulation would be required to equal a typical 30 dB(A).

Maximum Noise Level – Quality Stereo Sound System

Program Material	dB(A)	Octave Band Centre Frequency (Hz)							
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Classical music – loud	**98**	76	93	96	97	95	90	79	83
Rock music – loud	**100**	86	98	102	97	95	90	80	78

Required Sound Insulation to Equal Background of 35 dB(A)

Program Material	dB(A)	Octave Band Centre Frequency (Hz)							
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Classical music – loud	**98**	76	93	96	97	95	90	79	83
Background	**35**	57	46	38	32	28	25	23	21
Required Sound Insulation		19	47	58	65	67	65	56	62
Rock music – loud	**100**	86	98	102	97	95	90	80	78
Background	**35**	57	46	38	32	28	25	23	21
Required Sound Insulation		29	52	64	65	67	65	57	57

It is interesting to plot the required sound insulation compared to an equivalent Rw curve.

Program Material	dB(A)	Octave Band Centre Frequency (Hz)							
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Classical music – loud									
Required Sound Insulation		19	47	58	65	67	65	56	62
Rw 65			49	58	65	68	69	69	
Deficiency of Rw 65			0	0	0	0	0	0	
Rock music – loud									
Required Sound Insulation		29	52	64	65	67	65	57	57
Rw 65			49	58	65	68	69	69	
Deficiency of Rw 65			3	6	0	0	0	0	

The required sound insulation listed above clearly indicates that the level of sound insulation required to reduce the transmission of a loud sound system is in the order of Rw 65. In the case of rock music, the performance at 125 and 250 Hz exceeds the Rw curve. This is significant, as the Rw rating system allows for performance under the curve and in most cases of wall systems the deficiencies are in the range from 100 Hz to 400 Hz. The Rw rating system is significantly flawed.

What has become a significant intrusion in the domestic scene is party music. This is basically very similar to disco with a very heavy low frequency beat and an overall sound pressure level around 90 to 95 dB(A). The acoustic insulation requirements are very similar to that required for loud rock music.

Today we have DVD systems with five channels of amplification and including a sub woofer. The power output of a decent five-channel amplifier is now about 100 watts per channel. This represents a potential 11 dB increase over the two-channel 20 watt amplifier system considered by John Andrew in his studies. In reality a modern DVD installation can be run at cinema sound pressure levels of between 95 to105 dB(A). Statistical measurements have been made of DVD installations in the domestic environment. One study conducted by this office using the motion picture Titanic is reproduced below. Other motion pictures such as Independence Day, Saving Private Ryan, the Band of Brothers and Blackhawk Down have been measured and these are capable of even higher noise levels. My own cinema system runs at normal cinema sound pressure levels of 95 dB(A), however I have a house providing an Dntw +Ctr of 30 and my neighbours are 600 metres away.

Sound Pressure Levels for 20 minute run of the DVD Motion Picture "Titanic" with Surround Sound and Sub-Woofer measured in a Typical Living Room at the Listener Position Sound set to Pleasantly Loud (Less than a Cinema Showing)

Statistical Data	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
L1	**91**	99	97	92	87	85	84	80	77
L10	**83**	89	88	83	79	77	76	73	67
L20	**78**	81	82	77	75	72	71	66	61
L30	**73**	73	72	73	71	67	65	60	55
L40	**68**	66	65	68	66	62	59	55	50
L50	**63**	61	61	64	62	57	55	51	43

Required Sound Insulation for Typical Home Cinema Sound Pressure Levels

Program Material	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
L1 - Titanic									
Required Sound Insulation		42	51	54	55	57	59	57	56
Rw 55			39	48	55	58	59	59	
Deficiency of Rw 55			12	6	0	0	0	0	
L10 - Titanic									
Required Sound Insulation		32	42	45	47	49	51	50	46
Rw 50			34	43	50	53	54	54	
Deficiency of Rw 50			8	2	0	0	0	0	

Clearly, the Rw curve does not correctly address the low frequency region from 100 Hz to 400 Hz. This situation is further compounded if all the 32 dB tolerance is used up in this low frequency range. The discrepancy for the 125 Hz octave band could easily be 20 dB lower than that required to insulate against the L1 value of a typical blockbuster movie. This is an unacceptable outcome.

Basically the Rw spectrum is closer to speech related activities, with modern lifestyle the Rw rating is now inappropriate. The Americans recognized this some time ago when there was a push to introduce Music Transmission Class (MTC) to supplement the STC rating system.

The deficiency of the Rw spectrum has been recognised elsewhere in the world. The current method of attempting to compensate for the deficiency is to add the Ctr (traffic noise adaptation correction) to the Rw value to provide a more appropriate spectrum for home entertainment noise. This is a clumsy way of achieving the end goal, however studies carried out by this office clearly show that using the Ctr factor with wall performance relates much closer to subjective acceptance than using the Rw value alone.

The United Kingdom has adopted the Ctr correction to quantify the sound insulation between apartments and it was the recommendation of the Association of Australian Acoustical Consultants to the Australian Building Codes Board that this be adopted for Australian Standards.

How much Sound Insulation do we require Today?

Whilst it can be argued, from a purely acoustical point, that the performance required between apartments is at least Dntw + Ctr ≥ 55 dB (equal to Rw + Ctr = 60 dB), there are a great number of factors that come into play. Firstly, the purpose of the Building Code of Australia has generally been misunderstood. Many in the building industry have assumed that it was a magical line in terms of performance and once that was achieved by the merest margin there was no further responsibility. In the area of acoustics, this concept has shown to be grossly incorrect. The Building Code of Australia seeks to set a minimum acceptable community standard and in particular has to take into account affordability of housing.

From an acoustician's viewpoint this is a very clear and a simple situation and it is blatantly obvious that the acoustic performance covered in the BCA (the lowest in all the developed countries in the world) should be significantly upgraded.

The BCA and its Stakeholders

Changes to the BCA are not easy due to the immense army of stakeholders that are linked to various aspects of the building code. This includes the States and Territories of Australia; it includes industry groups such as the Housing Industry of Australia and the Master Builders Association, together with representatives of many industrial groups concerned with the supply and installation of building materials. The acoustical side of the proposal is in the minority and it is truly a "David and Goliath" situation.

Surprisingly, strong lobby groups representing particular parts of the building industry saw the upgrades of the acoustic performance of the BCA as threatening their livelihood as they were not prepared to change their systems to meet the new challenge. We saw classic examples of "dynamic conservatism" in operation to prevent any upgrades of the acoustic provisions of the BCA. Their actions can only be seen as very selfish.

On the other hand, other industry groups saw opportunity for the development of some high performance wall and floor systems using very economical approaches to system development. We are conscious of a significant number of new wall and floor systems that will become available on the market in the next couple of years. These systems will threaten the entrenched bodies that tried to resist the acoustic upgrade to the BCA. In many ways the conservative groups deserve this outcome.

Early Successful Outcomes of BCA 2004 Acoustic Provision Upgrades

Clearly, the general attitude of the building industry to the acoustic provisions of the Building Code of Australia has radically changed in the last five years. In previous years the attitude was to just achieve Rw 45 and not a dB more. Today builders and developers talk of exceeding the BCA conditions. Recently our office carried out a field measurement of a relatively simple wall system that achieved a field condition of Dntw + Ctr of 57 dB. This performance was provided by a relatively low cost wall system that only occupied 232mm of floor space. Wall systems providing Dntw 55 or more have been commonplace in the last two years.

One of the most significant changes to the BCA was the provision of on site verification of acoustic performance. The main purpose of this inclusion was to clarify the method of measurement required in the field. Over the last five years we have seen some shameful approaches by acoustic consulting firms to justify the appalling performance of some installed wall systems on various projects.

Another reason for the on site verification was to warn the industry that acoustic measurements could be carried out if there was doubt as to the appropriate acoustic performance. This latter part has had a revolutionary change of attitude in the industry. Suddenly the industry has gone from just providing the requirements of the BCA to now asking can they exceed the BCA requirements within the cost restraints of the project. The change in attitude is refreshing.