



Acoustics 2019

Sound Decisions: Moving forward with Acoustics

Noise in A Big City - Is Jerusalem Different?

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ABSTRACT

Jerusalem is a capital city encompassing three religions and nearly 1 million inhabitants. The city is constrained in area and construction activities including new roads, new light rail lines and office and residential buildings are ongoing. In addition, there are unique sources of noise complaints that need to be dealt with such as muezzin calls five times a day from mosques and music before the Sabbath from synagogues which have a noise impact on some neighbours. The acoustic challenges due to all these noise sources in Jerusalem will be explored in this paper.

1 INTRODUCTION

Jerusalem; Hebrew: יְרוּשָׁלַיִם; *Yerushaláyim*; Arabic: القُدس *al-Quds*) is a city in the Middle East, located on a plateau in the Judaeen Mountains between the Mediterranean and the Dead Sea. It is one of the oldest cities in the world, and is considered holy to the three major Abrahamic religions—Judaism, Christianity, and Islam. At the end of 2017 its population numbered 901,300, accounting for 10% of Israel's population. The population of Jerusalem is the most diverse among Israel's cities and construction activity is a constant with new infrastructure (roads and light rail) and new housing and office buildings popping up all over the city.



Figure 1: Various construction activities happening around the City

Noise issues are dealt with by the Environmental Protection branch of the Jerusalem Municipality. The Branch is responsible for reviewing all construction infrastructure and building requests to ensure that the construction noise Guidelines are met and also plays a role in writing its own guidelines. For example, a guideline for measuring background noise and noise due to construction works is currently undergoing legal review. In addition, the Branch is also responsible for answering any noise complaint that comes in to the Municipality via the Hot-line or the internet. The diversity of complaints does result in some major acoustic challenges, and occasionally requires the co-operation of the Business Licencing Branch, the Municipal Police or other branches of Government. This paper discusses some of examples of these issues.

2 REGULATIONS FOR NOISE

The basic National Noise Regulation was published in 1961 and then further National Regulations were added which describe the measurement procedure and criteria.

There are three key Regulations that deal with noise

- Noise from Construction Equipment (1979) – this prescribes that the maximum allowable Equivalent Continuous Noise Level LAeq from various equipment at a distance of 15m should not exceed 80 dBA. These levels are emission standards that are meant to be applied to equipment to be used on site.
- Abatement of Noise Regulations - Unreasonable Noise (1990) – this prescribes the allowable Equivalent Continuous Noise Level for various occupancies depending on time of day and the length of exposure – see Table 1. It also prescribes the measurement requirements. The noise level measurement is inside the room with the **windows open** and there are tonal and “offensive noise” penalties.
- Abatement of Noise Regulations - Noise Prevention (1992) – this prescribes what is considered to be an annoyance for many types of noise and the times when certain noise sources can be operated. It includes noise from any amplified sound, air conditioners, alarms, noise due to house renovations, loading/unloading rubbish/equipment, beating carpets, noise due to pets. It is a qualitative Regulation that allows for implementation by lay people (police and municipal officers) without the need for measurements.
- For construction noise impact, the Environmental Protection Ministry has provided a guideline as to what is the maximum acceptable noise level. It is based on the 1990 Regulations for the daytime (07:00 – 19:00), and allows an increase of 20 dB in the criterion level with the noise level measured at 1 metre outside the window of the room. For the nighttime (22:00 – 07:00), the guideline states that disturbance or annoyance will occur if the construction plus background noise level is greater than the Background Noise Level plus 5 dB. The Background Noise Level is not clearly defined.

There is also an By Law (Prevention of Noise) promulgated by the Jerusalem Municipality that adds some local definitions or prescriptions for the Jerusalem area.

In addition to the above, there are also two Regulations that apply to wedding halls and discotheques with a view to regulating the noise level on the dance floor. For Wedding Halls, the Level is not to exceed LAeq,10sec 85, for discotheques, the level is not to exceed LAeq,10sec 95 dBA.

Table 1: Criterion Noise Levels For Day (right column) and Night (left column)

Noise Level LAeq										Exposure Duration
מבנה ה'		מבנה ד'		מבנה ג'		מבנה ב'		מבנה א'		
לילה	יום	לילה	יום	לילה	יום	לילה	יום	לילה	יום	
	70		55		55		50		45	1. עולה על 9 שעות
	75		60		60		55		50	2. בין 3-9 שעות
	80		65		65		60		55	3. בין 1-3 שעות
70		40		40		40		35		4. עולה על 30 דק'
	85		70		70		65		60	5. בין 15-60 דק'
75		45		45		45		40		6. בין 10-30 דק'
	90		75		75		70		65	7. בין 5-15 דק'
	95		80		80		75		70	8. בין 2-15 דק'
80		50		50		50		45		9. אינו עולה על 10 דק'
	100		85		85		80		75	10. אינו עולה על 2 דק'

Residential in Industrial or Commercial

Residential in Commercial, Business,

Residential

Hospitals, Schools, Old Age homes,

Time in Hours

Time in Minutes

Time Not Exceeding X Minutes

3 BUILDING CONSTRUCTION NOISE IN CLOSE PROXIMITY

Housing in Jerusalem generally consists of apartment blocks and due to the need to accommodate many families and people, the spacing is very dense. An apartment with a garden is a rarity as are single dwelling houses in the Australian sense.

In recent years, Jerusalem had an incentive in place for redevelopment of existing 2 or 3 level apartment blocks to 5 – 7 level blocks (or more) so as to create more living space for the current residents. As a consequence, major construction was taking place very close to existing residential apartments place, often within 5 – 20 metres of adjoining apartments. In addition, due to the lack of space for parking, nearly all new buildings require underground car parking. Seeing that Jerusalem is predominantly built on rock/stone, the majority of works for foundations and for excavating the “underground parking levels” requires the use of jackhammers and piling.

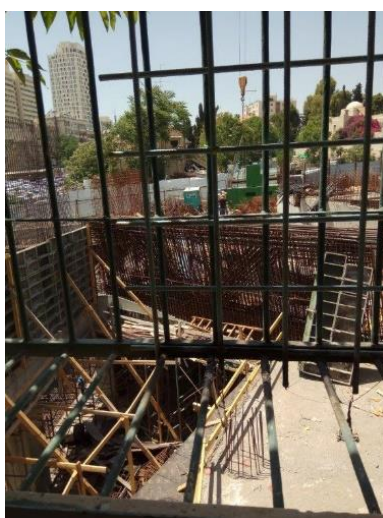


Figure 2: View from Kitchen Window of Construction of Major Building Next Door

As an example, the Municipality received a complaint of excessive noise from a resident adjacent to such a construction. Figure 3 below shows that, in this instance, piling on the edge of the development was occurring within 8 metres from the façade of the adjacent apartments with some of these apartments clearly overlooking the 2m high fence that had been erected around the work site. The measured noise level of over $L_{Aeq,5min}$ 86 dBA exceeded the allowable construction noise level of $L_{Aeq,5min}$ 75 dBA and the Contractor was made to cease work until a 4m high barrier was constructed in place. This latter barrier was completed within a week and construction continued afterwards without any further complaints.

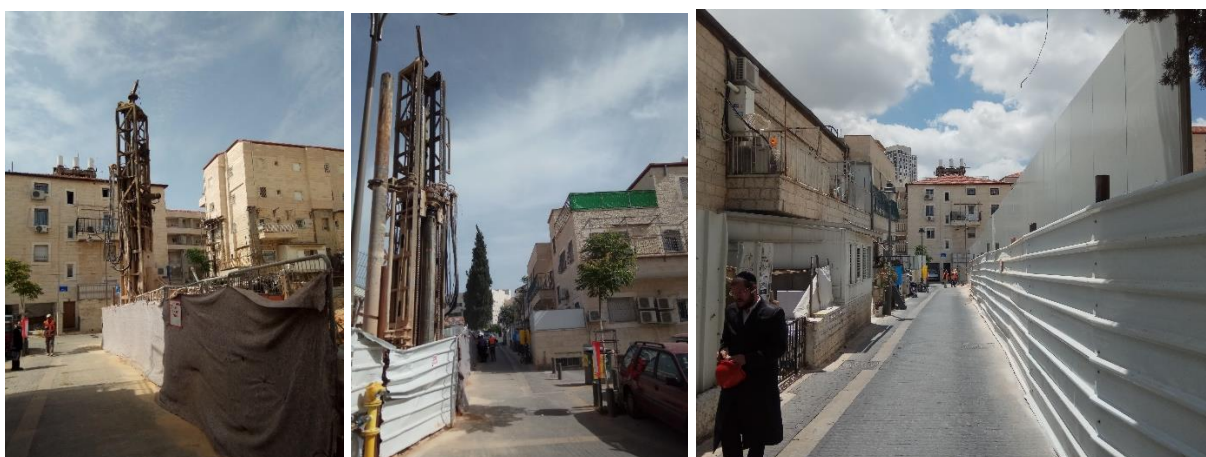


Figure 3: Piling in close proximity to residential apartments before and after construction of the 4m barrier.

4 NOISE DUE TO CONSTRUCTION OF INFRASTRUCTURE

There are many road projects being built to expand services to the City. In addition, there is currently one Light Rail line in Jerusalem and construction is currently being carried out to allow the addition of two new routes. The entrance to the City is currently being significantly changed with a completion of the Fast Train to Tel Aviv and with the upgrading of the road network and construction of new office space and residential apartments.



Figure 4: Major Road and Building Construction At the Entrance to the City

The Jerusalem Central Bus Station is one of the busiest in the country. Inter city bus travel is currently the major form of public transport between cities apart from cars, and every city/town therefore has a “central” bus station to service the locals and visitors. The Fast Train Station that was recently completed is adjacent to the Central Bus Station and also adjacent to a Light Rail Stop on Jaffa Road. To enable the wider use of public transport, an underground carpark that is a short walk to the train and bus stations and with a capacity for over 2000 cars is currently being built. Two neighbours in two different buildings of the order of 120m away complained about a noise from the work site and it was determined by site inspection and by SPL measurement and prediction that the source of the disturbance was the exhaust air fan drawing air from underground. The predicted external noise level at the apartments was of the order of $L_{Aeq,5min}$ 66 dBA. The internal night time noise level requirement is $L_{Aeq,5min}$ 40 dBA. An additional silencer was added which solved the complaints.



Figure 5: The Fan discharging air from the underground car parking area and the adjacent buildings

5 CITY NIGHT LIFE

There are many locations in the City where problems occur due to inappropriate zoning, i.e. noisy activities occurring immediately adjacent to or intermingled with residential living. The most famous is the Jerusalem “Shuk” which is a market place for fruit, vegetables, meat, breads, cakes and other produce by day. After hours, the Shuk turns into the central place for nightlife with bars, restaurants and pubs coming to life. While many tourists and city residents enjoy the atmosphere, the local residents, some of whom have lived there for 20 – 40 years and were there before the Shuk became one of the “in-places” to be at night, have to put up with people talking, shouting, laughing and sometimes loud music on a nightly basis. Many of the residents are only 5 – 20 metres away from these noise sources, and, if you want to sleep with your windows open, you can imagine that it is not pleasant to say the least. In addition, whilst by law, the music is meant to cease at 23:00, it often doesn’t, and even if the residents call the Municipal City Police who come and shut down the music, most of the time, half an hour later the music is back on until the early hours of the morning.

Another entertainment location is the “First Station” which was the original Jerusalem Train Station but is now a location for restaurants and shops which operate during the day and into the late night. However, this location is generally not problematic as residents do not live that close by.



Figure 6: Scenes at the “Shuk” during the Day and Night

With respect to amplified music, the Abatement of Noise Regulations - Noise Prevention (1992) state in Section 3a that:

A person shall not sing nor shout nor operate a musical instrument, a radio or television and shall not make noise by means of a record player, a speaker, an amplifier or sound generating devices and the like between the hours of 14:00 and 16:00 and between the hours 23:00 and 07:00 of the next day, in a residential area in one of these places:

1. In the open air;
2. In a place which is not in the open air but which is not closed from all sides towards the outside, or whose doors, windows or other openings are not all closed;

3. In a structure that includes residential units (hereafter – residential building).

Having residents so close by to venues that generate crowd noise and music is clearly problematic. One example is a bar in down town Jerusalem which every Friday (the “weekend” in Israel) seats up to 200 patrons outside and plays “disco” music with a pronounced low frequency “thump” as entertainment for these patrons. A resident living some 30 metres from the Bar complained that the Bar plays this music from 16:00 every Friday afternoon until 04:00 Saturday morning. A noise level measurement was conducted in the bedroom fronting the street with the window open which showed that the criterion noise level of $L_{Aeq,5mins}$ 40 dBA was clearly exceeded by a minimum of 10 dBA even without a noise penalty to account for the aversiveness of the low frequency thumping. The residents are in the process of taking legal action.



Figure 7: “Disco” style noise from a Bar resultant in an exceedance in the bedroom some 35 metres away.

6 MUSIC BEFORE THE SABBATH

There are hundreds of Synagogues dispersed throughout Jerusalem, some very large with hundreds of congregants and some very small with only 20 or so congregants. Recently, up to 5 of these randomly dispersed throughout the City have taken to playing loud music for 2 minutes half an hour before the Sabbath begins to advise people that the Sabbath is approaching. Because they want this music to be heard over a large distance, the music level is generally quite high at the source and a very small number of people living in close proximity have complained to the Municipality about the noise intrusion. It is somewhat surprising that the number of complaints is indeed so small.

Figure 8 shows one example where the loudspeakers on the roof are as close as 10 metres away from the nearest residential building. The complaint in this case was from one person not in the nearest building but from a building that was of the order of 20 metres away. The sound pressure level is checked against the Regulation for a sound that has a duration of 2 – 5 minutes. The sound pressure level is then reduced at the source so that the resultant SPL at the resident complies with the Regulation.



Figure 8: Loudspeakers on the roof of a Synagogue and the nearest buildings

The Municipality also sometimes receives complaints from people living up to 1 km from Mosques. The Muslim call to prayer occurs five times a day and the earliest call varies from about 03:30 – 06:30 in the morning depending on the time of year. The problem in this case is similar to that of the Synagogues in that the loudspeakers which are used by the Muezzin to call to prayer are placed high up on the Minaret or a tower. The loudspeakers are omni directional and thus radiate over a large angle and over a large distance. Figure 9 shows an example of loudspeakers placed high on Mosques and also shows a typical sound envelope from the local Mosques. One of the issues is that there are many local mosques in an area and that they all call to prayer but they are currently not synchronised. So some people hear multiple calls to prayer from a number of directions. The proposed solution is to introduce directional loudspeakers and synchronised prayer calls and to try and place loudspeakers in less problematic locations. This is to be done in consultation with the local Imams and has been successfully implemented in the city of Haifa.



Figure 9: Loudspeakers above Mosques and Areas of Perception

7 SUMMARY

Jerusalem has a high density population and many of the acoustic problems in the City are similar to those of any other large Capital cities with dense living. Construction noise is quite prevalent during the day, whether it is for the construction of new light rail routes or roads or of new buildings. There are also some problems that are unique to the City eg music being played once a week prior to the Sabbath at some Synagogues or the five Muezzin calls to prayer every day from the local Mosques. With co-operation between the parties, solutions can be found. Future planning will enable Jerusalem to truly be a City of Peace.

ACKNOWLEDGEMENTS

I would like to acknowledge the Environmental Protection Department of the Jerusalem Municipality for giving me the opportunity to work for the betterment of the acoustic environment of the residents in the City of Jerusalem.

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