The effect of parking lots distribution arrangements on environmental noise level for the universities campuses

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Abstract: Recent years witnessed wide increased in private car numbers in Baghdad city. Cause of the lack of public transportations. That leads to increase of demands for car parking, which caused many environmental problems. Recent studies focused on the field of environmental noise levels reduction in cities and educational buildings. This research problem is that there were no obvious studies about the effect of parking lots distribution on environmental noise levels for the universities campuses. The aim of this research is to explore the environmental noise levels resulting from parking lots distribution arrangements within the southern complex at Al-Nahrain University in Baghdad. Software program had been adopted to measure the levels of environmental noise for the educational complex to determine the levels of environmental noise with the future prediction of environmental noise levels in the event of an increase in the number of car parking spaces.

1. Introduction

Nowadays, parking lots are one of the major noise sources in the cities. Noise from the existing parking lot would typically consist of sources such as vehicle engines starting, doors closing, radios, conversations, vehicle alarms, plus the types of parking, road surfaces, so, vehicles during its movement and stop emitted noise [1]. Many international standards submitted recommendations about the accepted noise level for environmental noise and parking area noise level like World Health Organization (WHO), DIN 18005, NZS 6801:2008, ANSI:S12.60 and Environmental Protection Agency (EPA) [2,3,4,5,6], the limited noise level in outdoor spaces up to 55 dBA. The adverse noise effects can be recognized obviously on the students during their study days. When the noise levels exceed 50 dBA in the classrooms, laboratories and campus, they feel by annoyances, discomfort, lack of concentrations and communications, difficulties of hearing [7]. Iraqi researchers noticed the aggravation of noise problem in the universities; they studied the noise sources, noise levels and the adverse effects of noise. For noise sources, it's divided to indoor and outdoor sources. The main indoor sources are air conditioner devices, Laboratory devices, whereas outdoor sources are students' voices when they gather in the squares, electric, diesel generators, vehicles noise come from traffic and the parking lots at the nearby boundaries of the campus [8]. Noise levels in universities classrooms, labs and campuses were exceed the standards limitations; it's recorded up to 90dBA [9,10,11,12,13,14]. This research problem that there were no observable literatures about the effect
of parking lots distribution on environmental noise levels for the universities campuses, and for Al-Nahrain University as an example.

2. Research objectives
The main objective of this research is to contribute the understanding of the effect of car parking distribution on increase the environmental noise levels in universities campus and for Al-Nahrain University as an example. This goal can be achieved through: Site analysis - Investigating the effect of distribution arrangements properties and physical attributes of car parking in Al-Nahrain University, Samples - Investigation of existing and proposed car parking noise levels that exist at the site on planning of car parking locations.

3. Research methodology
The research aims to study effect of distribution arrangements properties and physical attributes of parking lots in Al-Nahrain University. Al-Nahrain university south campus which contain four collages, that are three to two stories from precast concrete face finishing, and there are many proposed educational building in the rest open spaces inside this campus. This campus having seven open parking lots, one for the buses of employees, six of these parks are located on the ring road that surrounded the university buildings near to lecture halls and student open spaces. Their capacity of cars range between 30-200 cars. There is a suggested huge parking lot that currently working on near Baghdad University, that supposed to serve both university and content bus stops and personal vehicle for both universities, it capacity range 1600. Figure 1 explains the main parking lots, suggested parking and main roads.

![Figure 1. Showed the main parking lots, suggested parking and main roads](image)

Analysis were done to exist and proposed parking lots for noise levels with SoundPlan software using both, observed, measurements and hypothesized data based on standards (RLS-90 for roads and ISO9613-2 for parking lots). For noise level measurements, a sound and vibration meter with an analyzer (SVAN957 Type 1) was used and all measurements were taken according to ISO1996, at day hours (7a.m-3p.m.) According to observation data, Table 1 showed the parking characteristics that are used to estimate noise levels by using SoundPlan software.
Table 1. Parking characteristics

| Parking No. | Parking lot type               | Road surface                      | Vehicle No. |
|-------------|--------------------------------|-----------------------------------|-------------|
| P1          | Visitors and staff             | Asphaltic lanes                   | 200         |
| P2          | Visitors and staff             | Asphaltic lanes                   | 170         |
| P3          | Visitors and staff             | Asphaltic lanes                   | 120         |
| P4          | Visitors and staff             | Asphaltic lanes                   | 170         |
| P5          | Central bus stops (diesel)     | Concrete paving, joint >3mm       | 50          |
| P6          | Visitors and staff             | Asphaltic lanes                   | 100         |
| P7          | Visitors and staff             | Asphaltic lanes                   | 30          |
| P8 Suggested* | Central bus stops (diesel)   | Concrete paving, joint >3mm       | 1600        |

*P8 Suggested is mix between bus stops and personal cars, so it is appropriate to use central bus stops as parking lot type.

To study the noise effects of parking lots, it is necessary study the main roads that’s noise spread from its which interfere with parking lots noise. Table 2 showed main roads characteristics.

Table 2. Roads characters

| Road No. | Vehicle flow rate v/h Light* | Mean speed km/h Light* | Road surface |
|----------|------------------------------|-----------------------|--------------|
| Entrance | 66                          | 25                    | Smooth asphalt |
| R1       | 26                          | 45                    | Smooth asphalt |
| R2       | 40                          | 35                    | Smooth asphalt |
| R3-sec1  | 673                         | 40                    | Smooth asphalt |
| R3-sec2  | 337                         | 40                    | Smooth asphalt |
| R4       | 3875                        | 45                    | Smooth asphalt |

* Light vehicles = less than 3500 kg (e.g., cars, vans, minibuses, motorcycles). Heavy vehicles = more than 3500 kg (e.g., trucks).

4. Results and Discussion

Results of noise mapping for Al-Nahrain University showed in Figure 2. Differences in noise levels that emissions from parking lots were recorded. According to noise levels, parking lots divided into two groups, the first include (P1, P6 and P7) and the second include (P2, P3, P4 and P5). The first group recorded highest noise levels range between 85 - 90dBA. While the second group recorded highest noise levels range between 95 - 100dBA. Noise levels that recoded for roads (R1, R2, Entrance and R3-sec2) ranged between 45-60 dBA which were less than parking noise levels. While Roads R3-sec1 and R4 recorded noise levels ranging between 65-76 dBA and their effects was limited for noise levels of parking because its far away from these parking lots.
Figure 2. Noise mapping for existing parking lots

Suggested parking lot is assumed to serve Al-Nahrain University and Baghdad University by accommodate 1600 public buses and personal vehicles. Noise mapping draw according to estimate parking lot P8 data and the results showed in Figure 3. Noise levels range between 95dBA and 100dBA, which will raise noise levels in the open spaces and Campus University up to 30dBA.

Figure 3. Noise mapping for existing parking lots
5. Conclusions
Parking lots distribution should be planned and located carefully by the designer of the university campus. Its impact on raising the environmental noise level inside open spaces, and educational buildings, the increasing in noise levels will effect negatively on the educational process and many health problems for students and staff may be appear such as lack of concentration, difficulties in communication and learning, annoyance, stress. According to the results of software program noise mapping for parking lots in Al-Nahrain University, the parking lots emitted noise range between (85-100) dBA. Predominant noise levels equal or less than 70 dBA in open spaces and Campus University, while WHO recommended the permissible noise level outdoor should not exceed 55dBA for daytime. This needs to rearrangement the parking lots as far as possible from open spaces and educational buildings. With considered rethinking design for the suggested parking lot. Cause of the noise pollutions that will cause raise noise levels in the open spaces and Campus University up to 30 dBA.

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