Abstract
Noise in big cities such as Cairo Egypt is an important pollutant in the modern society. Noise coming from airports, road traffic, rail traffic, power plants as well as commercial activities in the city are important contributors to the overall noise level. A noise study including measurements and predictions for noise in East Cairo coming from airport, road traffic, metro and railways was performed and analyzed. A comparison of the different sources was made and the number of affected people in the mentioned area was estimated. The dominating sources and the best mitigation to minimize the noise level was discussed and evaluated. In the analysis, some new projects was discussed individually to find its effect on noise pollution, also expectation for the coming years with the new projects and proposals where discussed. The proposed new projects include the new terminal building and runway at Cairo international airport and the proposed Heliopolis Metro Line-4 Ramsis Square - Nasr City. The analysis showed the dominating noise sources and evaluated the mentioned projects from the noise point of view. Noise out from air traffic was the dominating source of noise in East Cairo

INTRODUCTION
There are many noise sources on the big cities such as airports, traffic, railways and most commercial activities. Major noise contributors in East Cairo are noise due to airplane operation of Cairo international airport and noise due to Heliopolis metro operation. With the quick growth in population, many residential areas are now subjected to aircraft and metro noise, during arrival or departure of aircrafts and the stations which the metro covers. Deciding which source is dominating is of a great
importance. For a new and modern super tram to replace the current metro, mitigation to minimize the effect could improve the situations.

Airport noise

In 2001, the International Civil Aviation Organization ICAO Assembly endorsed the concept of a "balanced approach" to aircraft noise management (Appendix C of Assembly Resolution A33-7). This consists of identifying the noise problem at an airport and then analyzing the various measures available to reduce noise through the exploration of four principal elements, namely reduction at source (quieter aircraft), land-use planning and management, noise abatement operational procedures and operating restrictions, with the goal of addressing the noise problem in the most cost-effective manner. ICAO has developed policies on each of these elements, as well as on noise charges targeting reduce noise level at land [1-2].

Railways noise

Railway transport is known to have lower environmental impact compared with road transport. Nevertheless, there are also effects on the environment that have to be evaluated and solved. This includes especially the issue of noise.

Traffic noise

Traffic noise is one of the most interesting issues in modern life. The level of highway traffic noise depends on traffic volume, traffic composition, and traffic speed. Generally, heavier traffic volumes, higher speeds, and greater numbers of trucks are expected to increase the level of traffic noise. Vehicle noise is a combination of the noises produced by the engine, exhaust and tires. The loudness of traffic noise can be increased by defective mufflers or other faulty equipments on vehicles.

Cairo the capitol of Egypt, as well as the most cities in the world has been exposed to a continuous growth of urban and suburban residential areas accompanied by growth of noise levels along highways. This causes one of the most invasive forms of pollution. The introduction of mass public transport instead of private cars can limit the traffic noise; The idea of a fast condition super tram is a step in that direction.

METHODOLOGY

To assess the dominant noise source in East Cairo, two tools were used; measurements and prediction for both Cairo international airport and Nasser City metro as the main source of noise in that area.
MEASUREMENTS

Cairo international airport

Measurement locations

Measurements were made in up to 50 locations, which are shown in Fig. 1 and 2 [3].

Example of noise measurements at residential area near the airport

(Nasr City) recorded event at Nasr City

Table -1. The measurement results for Cairo international airport

<table>
<thead>
<tr>
<th>Start date</th>
<th>Start time</th>
<th>LAeq</th>
<th>LAFMax</th>
<th>LAFMin</th>
<th>LAF10</th>
<th>LAF50</th>
<th>LAF90</th>
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<td>82.2</td>
<td>62.0</td>
</tr>
<tr>
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<tr>
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<tr>
<td>06/25/2003</td>
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<td>91.7</td>
<td>57.5</td>
<td>85.0</td>
<td>74.7</td>
<td>58.1</td>
</tr>
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</table>
The measurements and prediction shows clearly that:

- The high noise level occurs at night and day. The noise can last for more than 20 seconds several times per hour.
- A very large residential area is now subject to that high noise level
- Approximately 40% of Nasr City is affected by landing noise of 55 DNL. Ten percent are subjected to 60 DNL. See Fig. (3-4) [4].

**Metro (Nasser city – Ramsis sq)**

![Map of measured location for super tram](image)

**Figure 5 - Map of measured location for super tram.**

**Measurement locations**

Up to 29 locations were measured as shown in Fig. 5.
Example of noise measurements for super tram

Location: Nasr City Metro Station 8th District

![Graph showing noise measurements](image)

*Figure 6 - Measurement results covering 24 h.*

<table>
<thead>
<tr>
<th>Start time</th>
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<th>LAFMax</th>
<th>LAFMin</th>
<th>LAF10</th>
<th>LAF50</th>
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<td>47.5</td>
<td>73.5</td>
<td>60</td>
<td>50.5</td>
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</table>

Table 2 - Example of noise measurements results for metro [5]

Prediction for the proposed Super Tram

Data assumptions:

- The current Tram Cat. Is Category 8 type SM 90 (2).
- The average flow per hour is 3 trams per hour.
- The area of El-Banat College station was taken to be a segment of the new tram route.

*Figure 7 - El-Banat College station route segment.*
**The prediction model - Using Predictor railway model noise – RLM2**

A noise map for the current situation (Route segment at El-Banat College station) was generated for the surrounding area using the RLM2. Prediction of noise levels have been carried out and compared to the observed data for model verification. The RLM2 output includes a three–dimensions diagram for the study area and the noise contour map (see Fig.10,11 ) The key for the objects is shown in Fig. 8.

<table>
<thead>
<tr>
<th>Object</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Building</td>
</tr>
<tr>
<td></td>
<td>Ground region</td>
</tr>
<tr>
<td></td>
<td>Railway source</td>
</tr>
</tbody>
</table>

*Figure 8 - Legend key for the model objects.*

*Figure 9 - A 3D model for the super tram at College station route segment both side.*
Figure 10 - A noise contour map the super tram without barrier.

Figure 11 - A noise contour map the super tram with straight glass barrier 2m height
Comment for super tram

It is noticed that the affected area is the area surround and close to the tram track and extended to the first line of building along the tram track 2 end terminals only. It is also noticeable that noise level reduced to 50 db(A) using a glass barrier.

CONCLUSIONS

1. By using the prediction and measurements for the two cases; Cairo international airport and the proposed super-tram, it cab clearly be seen that the affected area is larger for the airport noise compared to the super-tram.
2. The effect of the noise coming from the tram is limited to the first line of building nearby the tram track, while aircraft noise is affecting a larger area.
3. The second row of buildings are not affected at all by super-tram noise due to the shielding of the first row.
4. The maximum value predicted for super-tram was only 50 dB(A) with a proper glass barrier, while the current metro gives 72 dB(A).
5. From the above and due to the fact of not imposing a restriction on night flight, aircraft noise is the dominating source of noise at East Cairo.

REFERENCES

[3] The international ISO3891standards - Procedure for describing aircraft noise heard on the ground