Construction sites environment management: establishing measures to mitigate the noise and waste impact

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ABSTRACT: In the last few years, the impact of construction industry on the environment has been increasingly recognized. Construction sites activities in urban areas may cause damage to the environment, interfering in the day to day of local residents, that frequently claim against dust, mud, noise, traffic delay, space reduction, materials or waste deposition in public space, etc. In a time that we see with pleasure improvements in construction process techniques, in materials innovation and in safety and healthy conditions, it is also necessary to take care of our environment. In this paper a review is made on the several inconveniences of construction impacts both on the sites and on the surroundings using literature and data from a survey carried out to National Association of Historical Centres. The impact analysis focus in detail the noise and waste impact. Forms to minimize these impacts are suggested.

1 INTRODUCTION

In the Historical City Centres (HCC) the negative effects of the construction projects have yet more relevance, given that they are urban areas with very particular characteristics. As they are touristic locations, it's necessary to maintain them as much as possible pleasant to live, work and enjoy. Furthermore, these areas frequently have significant restrictions regarding available space, bringing about more difficulties for the construction projects. Therefore the HCC, in view of their specificness, require from the intervenients of the construction sector a special attention in order to minimize the impacts of the construction projects.

2 CONSTRUCTION SITES INCONVENIENCES

The resulting inconveniences of the activities of a construction project are numerous. Regarding this theme, an attempt was made to order each impact by the importance given to each one in scientific publications, being the following the most frequently mentioned (Couto 2002)(Teixeira & Couto 2000):

- Production of residue
- Mud on streets
- Production of dust
- Soil and water contamination and damaging of the public drainage system
- Damaging of trees
- Visual impact
- Noise
- Increase in traffic volume and occupation of public roads
- Damaging of public space

3 SHORT DESCRIPTION OF THE INCONVENIENCES

3.1 *Waste production*

Like any other economic activity, construction uses natural resources and generates waste. The amount of waste generated by construction and demolition activity is substantial. Surveys conducted in several countries found that it is as high as 20% to 30% of the total waste entering landfills throughout the world. Moreover, the weight of generated demolition waste is more than twice the weight of the generated construction waste. Other studies compared new construction to refurbishment, and concluded that the later accounts with more than 80% of the total amount of waste produced by construction activity as a whole. The building activity at historical city centres tends to be an important waste generator because both refurbishment projects and new projects often include demolition (Teixeira & Couto 2000).

Figure 1. Construction waste left in Lisbon surroundings.

3.2 *Mud in streets*

Earth movements taking place in raining days often lead to the deposition of mud if tyres of lorries are not cleaned when leaving the construction area. Consequences are unpleasant aspect of streets, increased risk of car accidents and bigger maintenance costs for public space and private properties.

3.3 *Dust production*

Earth movements and demolitions often encompass the production of blowing clouds of dust with pernicious effects in the increasing number of those suffering from breathing diseases and unpleasant effects in deposition surfaces.

3.4 *Contamination of land and water and damaging of the public drainage system*

Construction makes use of a set of pollutant fluids that may spoil the land and adjacent pavements. Direct evacuation to the sewing system is inconvenient and should in some cases be forbidden because they may damage pipes and treatment plants. Paints, solvents, oils and washing water from construction sites are some examples of dangerous products. Pavements in historical city centres are sometimes of considerable value and the risk of degradation should therefore be avoided. Sewers are often very old and quite sensitive to possible aggressions. Repairing costs of such infrastructures tend to be high for several reasons and cause severe inconveniences both in living and visiting population.

3.5 *Damaging of trees*

The activity of construction sites may damage trees within the site and its vicinity. Trees being important natural elements in the urban landscape, as they beautify it, provide shades, shelter for birds, purify the air and retain moisture, among other things, their preservation is a must. In spite of their bulk, trees are delicate living beings; therefore, construction sites must be carefully

prepared. Many times, the damage caused only becomes apparent a full year, or years after completion of the construction project.

Many actions may damage and even kill trees (City of Huntsville Urban Forestry Section 2000)(Gary 1999): soil compacting, increase in soil height, opening ditches and trenches, removal of topsoil, loss or damage to the roots, damage to trunks and leaves, and more.

3.6 *Visual impact*

Fences not preserved with bad graffiti or deteriorated placards contributes for environment degradation and may constitute a form of visual aggression.

3.7 *Noise*

Noise produced by a construction site may affect the right to silence, comfort and health of resident and visiting population and may influence normal activity of near by schools, hospitals and other economic activity. Main sources of noise in a construction site are pneumatic hammers, compressors, concrete mixers, operating machinery, several types of horns and acoustic signals, communication among workers, etc.

3.8 *Increasing car traffic and reduction of parking spaces*

Traffic of vehicles and machinery from the site or related to the site may introduce a significant increase in local traffic. Moreover, this type of traffic and typical narrow streets of historical city centres are often difficult to conciliate. Parking spaces usually available are often reduced due to the increase of demand of workers and suppliers.

3.9 *Public spaces damaging*

A análise dos impactos incluiu ainda a danificação do espaço público, uma vez que pode ser seriamente afectado caso não sejam tomadas precauções. Os danos mais frequentes são a danificação dos pavimentos, das zonas ajardinadas, dos lancis e grelhas dos sumidouros, e a acumulação de restos de argamassas e tintas nos pavimentos.

4 NOISE IMPACT

4.1 *National inquiry results*

The national inquiry carried out to the Portuguese association of cities with historic centers (Couto 2002), which 50% of the members answered had the following results regarding the most habitual prevention attitude for noise impact imposed by municipal authorities:

Table 1. Habitual prevention to the noise impact.

Habitual prevention attitude - noise	Answers (%)
Generally Compulsive Prevention – in the licensing of the construction project accordingly to municipal norms/regulations	6
Punctually Demandable Prevention – in the licensing of the construction project, in some circumstances	20
Eventually Demandable Prevention – during work execution due to the claims from affected citizens	47
Without Prevention – for considering the annoyance regarding the execution of the construction project	27

4.2 *Measures to mitigate the noise impact*

Generally speaking, all relevant emissions of noise should be object of reflection. At least, regulations should be accomplished, but in a historical city centre further criteria should be taken

into account. Some examples are given below (Teixeira & Couto 2000)(Pinto 1997)(Worker's Compensation Board of BC 2000):

Construction plane:
- Obtain probable values for noise emission from the equipment to be used before commencement of works. This is a valuable aid to the choice of equipment
- Planning the choice of site or sites where the loudest equipment is to be placed; plant such as generators, compressors, etc., so as to cause the least possible inconvenience
- Preparing personnel so as to avoid inadequate use of plant and equipment, namely, running full power when the work does not necessitate it
- Careful planning of construction activities. It helps avoid loud verbal exchanges between the intervening parties
- Organizing the construction site so plant, equipment and vehicles can do a u-turn, rather than back out - which avoids the call sign for gears in reverse

Construction equipment:
- Internal combustion engines should preferably be substituted by electric devices
- High power equipment should be limited, so that main construction components may be manufactured outside and adjusted in place, thus requiring smaller electric tools
- Whenever possible emissions should be reduced through noise isolation materials
- Ready mix concrete should be preferred, otherwise concrete, mixers should be electrical
- Cranes should be substituted by electric lifts if possible
- Adjustment nuts should be preferred to wing nuts so that hammer shocks can be avoided when operating concrete shuttering
- Perform maintenance on machines so they do not output as much noise

Operation procedures:
- Walkie-talkies should be preferred to screaming at communicating with the crane operator
- Operation time for a noisy equipment should be minimised, especially if it can be replaced by an alternative less noisy construction process (e.g. the use of pneumatic hammer for cutting concrete can be reduced if shuttering is carefully levelled, boles are precisely located and irregular shapes are cut soon after dismoulding)
- Duplicate noisy equipment is there is space available (more noisy but less time of emission)
- Preview enough roam for machinery to turn back if rearward movement can be avoided (and also rear horn)
- Instruct workers to avoid the use of machinery in full power if it is not required

5 WASTE PRODUCTION IMPACT

5.1 *National inquiry results*

The national inquiry previously mentioned had the following results regarding the most habitual prevention attitude for the waste impact imposed by municipal rules:

Table 2. Habitual prevention to waste production impact.

Habitual prevention attitude - waste	Answers (%)
Generally Compulsive Prevention – in the licensing of the construction project accordingly to municipal norms/regulations	54
Punctually Demandable Prevention – in the licensing of the construction project, in some circumstances	29
Eventually Demandable Prevention – during work execution due to the claims from affected citizens	14
Without Prevention – for considering the annoyance regarding the execution of the construction project	3

5.2 *Measures to mitigate the waste production*

Construction waste is also an important topic to analyse despite the lower volume generated in comparison with demolition waste, because it is more difficult to recycle due to high levels of contamination, a large degree of heterogeneity and a considerable amount of chemicals. But it is produced in small quantities of a variety of construction materials during the project development and may be selected at the source prior to the recycling process. Additionally, an effort should be made in order to reduce their production on site and to increase their recycling value. The following actions may contribute for this purpose (Couto 2002) (Teixeira & Couto 2000) (EnviroSense 1996) (CIRIA 1997):

Construction planning:

- Co-ordination between designers and construction companies should be attended in the definition of materials and construction products
- Promote adequate communication among owners, project designers and contractors. Lack of communication is often the cause of partial demolition and removal of applied material, contributing towards needless output of debris
- Keeping the workers and concerned parties up to date, whether on the steps taken to minimize debris or the importance of such steps, as it is easier to take action when one knows the motives for it
- Before commencement of construction works, assess needed materials and make an effort to locate and acquire used materials beforehand, whenever possible
- Arrival of materials and products should be planned, according to available place on site and to production flow, to avoid excessive stocks and possible deterioration of goods and packs
- Stockpiles of sand, gravel, soil and other similar material should be located so that they do not spill and cannot be washed onto the adjacent street
- Accident spills of those materials should be removed prior to the completion of the day's work
- Quality control should reject defective materials at the time of delivery thus avoiding later disposal
- Materials should be delivered packed on site so that cracking can be reduced during transportation and on handling operations on site
- Packing conditions should be discussed with suppliers in order to reduce the number of packs and the amount of packaging materials, especially those not possible to reuse or difficult to have recycling waste
- Orders to suppliers of materials should respect sizing needs so that size adjustments can be avoided during construction
- Select products that output the least possible amount of residue or, at least, less toxic residue. A good example would be oil-based paint, which contain organic solvents that may render paint residue more dangerous. Water-based paint (latex) is safer to users and easier to handle. One should also try to use paints without metallic pigments, as these may also make the residue dangerous
- Store vegetable soil on piles no higher than 2 meters, and handle it as little as possible, as this may damage its structure
- Cut down as few trees and bushes as possible when cleaning out terrain to implant a construction site. Trees, trunks, branches and other vegetable matter, are solid residue that must be conveniently handled, at considerable cost
- Label packages of material as it comes in, and record the date for the reception of materials that deteriorate easily, so that the first to come in are employed first

Construction processes:

- Re-usable shuttering materials with eventual wreck value should be preferred even if investment costs are higher
- Cutting concrete due to lack of precision in design implementation shuttering and placement of holes should be avoided because it produces waste besides it is time consuming and involves noisy operations

– Protect materials from deterioration. Store them in sheltered areas if they are subject to degradation by rain or sunshine. Materials that can be degraded by mud or dust must be stored away from heavy traffic areas
– Waste selection (Couto 2002). Residue must be stored in segregated containers, according to the material origin; wood, metal, packages, aggregates, etc. Storing residue inconveniently has costs – the storage of dangerous residue is much more expensive than that of harmless materials – and may make the construction site unsafe. Piles of waste scattered throughout the site make accidents more likely; storing residue correctly not only bolsters reuse and recycling as it contributes towards health and hygiene at the site. Waste selection involves roam enough on site to dispose containers and allow for the operation of trucks and cranes and skill workers to the selection procedure, but these conditions are often difficult to achieve, especially in historical City Centres. Some private companies already operate in the area of waste selection and possible re-use of materials in the construction industry

Figure 2. Container by type of waste.

– Each container must clearly indicate what kind of waste it is meant for
– Value segregation of both large and small amounts of waste that have economic value, such as copper cables
– Storing in safe areas using adequately labeled containers for chemicals and oils
– Avoiding the mixing of unsafe waste, such as oil filters, batteries, paints and solvents, with harmless residue, as that would make the resulting mix a dangerous residue. Segregation of waste must maximize the potential for reuse and recycling
– To effect selective demolition

6 CONCLUSIONS

Lastly some legislation came into force either about noise and waste. However, presently, few measures have been carried out to improve the relationship among construction site activities the environment and citizens. Maybe due to the mobility of construction activity is difficult to make the construction companies – specially the smallest – to observe the law. There are some good examples but they are still insufficient. These suggestions pretend to make evident that some actions that are easily done can make the construction site environmentally efficient.

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