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Managing sidewalk pavement maintenance: A case study to increase pedestrian safety



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ABSTRACT

Comfort is a major requirement in planning pedestrian facilities. Pedestrians walk where they feel comfortable and when they do not feel at ease, they walk elsewhere. A typical example is that filthy, distressed, or too narrow sidewalks induce pedestrians to walk on carriageways. This behaviour jeopardizes road safety and highly dangerous to most users, leave them vulnerable. Unsuitable pavements can be the result of irregular maintenance operations to restore evenness after shock damage, weather phenomena, installation of equipment (e.g., posts, fences, urban furniture) with a reduction of walkable surface, or substandard repair work on pavements and patches due to emergency operations. These problems can be solved with an appropriate maintenance management system, which optimizes financial resources to make smart decisions about how to intervene with an adequate and lasting maintenance operation. This paper defines an evaluation index for sidewalk conditions as a part of an efficient set-up of a Sidewalk Management System, which is similar to the better known Road Management System. The study relies on surveys, as well as the classification and analysis of sidewalk distresses. The authors adapted an index already standardized by ASTM for roads and airports: the Pavement Condition Index (PCI). PCI has been modified to consider the specific types on the sidewalks studied within this paper. To validate the method, a case study of a residential district in Rome, Italy, was carried out. The chosen area lacks regular maintenance and has therefore resulted in a network of unsafe sidewalks. Frequent detour routes were surveyed and related to the level of distresses within a general assessment of safety. This study concentrates on sidewalks with flexible pavements because this type of pavement is the only one adopted in the survey areas and, in general, throughout Italy.

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1. Introduction

Pedestrians of every age travel erratically, deciding to walk on pavements they feel comfortable on or attracted by. When they do not feel at ease, they detour from the current route towards a more comfortable one (Marisamynathan, 2014; Ren et al., 2011). A typical example is a filthy, distressed or too narrow sidewalk which induces pedestrians to jaywalk or simply travel directly on the carriageway. Although extremely unsafe, this kind of behaviour is quite common, even among older pedestrians. The literature in this field highlights the need of high-quality walking surfaces for older pedestrians (Dunbar et al., 2004; Heinonen and Eck, 2007; Zegeer et al., 2013). However the real environment often does not meet such requirements and is usually ignored by road managers.

Subpar sidewalk conditions can be aggravated by adverse weather conditions, shocks, poor maintenance or cleaning, installation of inappropriate urban furniture or equipment, substandard execution, low quality materials, and other deteriorating factors. Emergency operations are the promptest solution to restore evenness conditions, as evidenced by the large number of patches. As a result sidewalks are not safe nor comfortable, and least of all, attractive.

Rome's infrastructure exemplifies this and serves to emphasize the need to plan regular sidewalk maintenance operations.

Therefore, this paper introduces the methodology of Sidewalk Management System (SMS), as derived from the better known Road Management System. The method includes survey, classification, and analysis of sidewalk distresses to adapt an index already standardized by ASTM for roads and airports: Pavement Condition Index (PCI).

A case study was carried out in Rome to validate the procedure, and this paper describes the main outcomes and provides final recommendations to improve the quality of sidewalks for pedestrians. The results obtained also allow administrations to plan maintenance treatments according to user perceptions and standard technical practices. The purpose is coherent with the need of the Italian Public Administration to survey the state of roadways and sidewalks and launch a comprehensive action plan based on existing maintenance plans.

2. The case study

The case study was performed in the Second District in Rome (Fig.1), a northern residential district where the lack of regular maintenance resulted in a network of unsafe sidewalks.

This district, subdivided into several smaller sub-districts, as shown in Table 1, is a typical medium-to-high income Roman neighbourhood with a medium population density area built between 1920s and 1960s. Residential and business activities prevail in this district. The built environment is of high-quality with low-rise buildings that seldom exceed five stories and landscaped areas with planted strips and plenty of vegetation. This area also contains several landmarks such as parks, churches, and a full provision of sidewalks that make the district ideal for walking. According to 2006

Municipality study (Cecconi, 2007) the walking share in the local modal split was higher than Roman average value (respectively 6.9 vs 5.6, as in Table 1). No more recent data on local modal split are available. However the reference scenario for the whole city provided by the Roman Urban Traffic Plan (Rome Municipality, 2015) suggests that no considerable changes have occurred so far.

Although theoretically ideal for walking, the area is far from ideal for pedestrian travelling. As shown in Fig. 2 road accident data are represented by black spots and they concentrate in specific areas. The larger, central cluster (yellow area in Fig. 2) is located in a residential zone, the Trieste area.

Surveys from a previous study focused on two main squares (Piazza Mincio and Piazza Caprera) of Trieste area. Their surroundings highlighted that modest motorized traffic (estimated ≤ 5000 passenger cars/day) and strong pedestrian flows (estimated ≤ 4000 pedestrians/day) resulted into a walking occupancy of carriageways, as shown in Fig. 3, where the surveyed pedestrian routes and flows are reported. A contributing factor was the sidewalk unsuitability, as the paths were too narrow and uneven, which were mainly due to potholes, chinks and exposed tree roots. In addition, drivers moved well below the speed limit, yielding priority to pedestrians (Corazza and Di Mascio, 2003).

Despite of the fact that some functions and businesses changed in the surveyed area in the last decade (a high school closed permanently on one square, a redesign program was carried out on the other one, with sidewalks slightly widened and a number of new supermarkets opened nearby), a recent survey confirmed the habits and the features previously observed. Sidewalks maintenance is still poor and due to the same problems, pedestrians still favour carriageways instead of sidewalks. Traffic and pedestrian flows are not markedly different; drivers still travel well below the speed limit. The new aspect to consider is the increased amount of elderly pedestrians, especially in the morning hours. As for this specific category, the observed behavioural patterns include walking with shopping trolleys (35% surveyed), walking with pets (25%), and general strolling (30%). The majority (around 65%) performed these duties jaywalking, detouring from sidewalks, or walking directly on carriageways.

Further recurring habits have been observed among the general pedestrian population, and especially among older pedestrians. They prefer walking on the sunny side of the street in winter (the survey took place on average working days in wintertime). Probably they would choose the shadowed side in summertime. When carrying shopping bags or walking pets they tend to avoid sidewalks perceived too narrow or crowded (due to furniture, trees, etc.) and even when plenty of space was available to walk on. Once they left the sidewalk for any reason, they continued to walk on carriageways until having to cross the street or change direction.

3. A methodology to improve pedestrians safety

Unsafe behaviour and the observed recurring black spots in the survey areas demonstrated the unsuitability of the case

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