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## Can Urban Regeneration improve Walkability? A space-time assessment for the Tintoretto area in Brescia

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### Abstract

In recent years, shared programs have shown that one of the most critical challenges to promote sustainability in the contemporary city is mobility. The actions on physical context can be divided into two correlated themes: (i) the urban regeneration of existing city with a particular focus on public services for each urban unit and (ii) the planning of their accessibility. Nevertheless, if the correlation is clear and generally recognised in theory, an evaluation of how the urban regeneration projects can contribute to achieving sustainability goals in technical and ordinary practice still struggles to consolidate. Hence, the contribution aims to observing and evaluating the effects of local urban regeneration projects from a people-and-climate perspective, highlighting the pros of integrated urban planning and mobility management approaches.

The paper presents an assessment framework that consists of a GIS-based time-space analysis of the walkability scenarios of public open spaces. It maps the urban spaces' pedestrian permeability in a cells grid, which is applied to an algorithm able to measure the isochronic curve of access time. The approach proposed is applied to the case study of the urban regeneration project of the Tintoretto tower unit in Brescia, which is analysed in two temporal instant, ex-ante and ex-post. The results' framework reflects on the proactive importance of measuring public space's systemic regeneration strategies towards "projects people-and-climate oriented".

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## 1. Urban regeneration and walkability: the people-and-climate oriented perspective

In recent decades, there has been a renewed interest in urban planning and design with specific consideration of requirements for proper liveability against pollution and urban traffic and the rational use of resources. This approach is expressed in themes of centripetal urban development and sustainable cities, which take the concrete form to create people-and-climate-oriented neighbourhoods.

European and international programs focused on sustainable development pay particular attention to the issue of mobility. The European Commission's White Paper focuses on reducing GHG emissions of transport (European Commission, 2011). The Sustainable Development Goals of the New Urban Agenda (ONU, 2016), on the other hand, highlight the implementation of sustainable mobility systems as a priority. Therefore, the achievement of resilient and sustainable cities is based on developing a quality infrastructural system and the correct planning and design of the urban space. In the first point, the extension and strengthening of transport systems, rapid and integrated, is associated with terminologies of 'efficiency', 'connectivity', 'accessibility'. The second point on the quality of public spaces is associated with actions of 'regeneration' and 'adaptation' of urban areas. Consequently, sustainable actions in the physical context can be divided into two correlated themes: the (urban) planning of public services and public interest for each urban unit and the planning of their accessibility, according to the optimal ranges of action or usability. Nevertheless, both themes are usually not connected and present some issues.

Regeneration processes are intended as policies oriented to sustainable development, which contribute to reducing soil consumption and restoring economic, social, and environmental quality (e.g., Musco, 2000; Williams, 2005). However, the consolidated urban planning practice mainly focused on abandoned urban areas or the recovery of built structures. Nevertheless, these actions have proven alone is insufficient to achieve desired sustainability objectives. Although of considerable importance on the architectural scale, these projects have little to do with a real change in the urban structure and global energy savings. Effective urban regeneration processes cannot be limited only to single components, but they must be aimed at the simultaneous and integrated adaptation of the physical context of the public city (Roberts et al., 2016).

In this process of urban space regeneration, the theme of accessibility plays a central role (Tiboni et al., 2021). In particular, pedestrian and cycle accessibility, adequately integrated into the public transport system. Indeed, to obtain a greater share of more sustainable travel in the urban environment, it is necessary to ensure that walking is an "attractive" alternative to motorised transport over short-distances-timing. An integrated global approach proposed is the A-S-I, which acts on Avoiding the use of cars, Shifting peoples' movements to other modes of sustainable transport, and Improving its impact by using a mode of transportation with new sustainable technologies (Bakker et al., 2014). Moreover, this happens if the urban environment is safe and pleasant. Therefore, accessibility is a fundamental principle to enhance sustainability and quality of life (e.g., Annunziata & Garau, 2020; Banister, 2008; Campisi et al., 2020; Handy, 2002; Marshall, 2001; Gaglione et al., 2019; Guida & Carpentieri, 2021; Hull et al., 2012; Ignaccolo et al., 2016; Tira & Pezzagno, 2018) because it provides a framework for understanding one another land use and mobility. In addition, many authors and guidelines highlight how the vitality of an urban settlement is closely linked to the recovery of pedestrian movement (e.g., Gehl, 2006). The NACTO (2016) address how the urban regeneration of mobility spaces must be aimed at connecting places and discourage crossing traffic with traffic calming interventions. The recent policies "Reinventing City Challenge" promoted by the C40 Cities network also move in this direction (C40 Cities, 2020). Another relevant experience on integrated planning is the 2030 strategic plan for sustainable development in Freiburg. The plan offers eight tools (enrich, accentuate, reuse, open, model, align, deflect and connect) orienting the design of the existing space, of which 3 directly focused on mobility and others 4 on the enrichment of the public space that indirectly favours the soft mobility (Stadt Freiburg, 2017).

Nevertheless, if the correlation is clear and generally recognised in theory, it would be interesting to evaluate how the urban regeneration actions can contribute to achieving goals of sustainability in technical and ordinary practice. Hence, the contribution of this paper allows observing and evaluating the effects of local interventions on pedestrian mobility and behaviour. The assessment framework consists of time-space GIS analysis of the walkability scenarios in public open spaces, ex-ante and ex-post. The method proposed is applied to a case study.

Therefore, the presented framework could be useful for practitioners and public administrators to evaluate urban regeneration space-time effects on pedestrian components.

The remaining paper is organised as follows. Section 2 explains the methodology to assess the effects of urban regeneration through people-and-climate-oriented mobility. Section 3 presents a methodology application on the Tintoretto tower unit's case study in Brescia. Lastly, Section 4 concludes the contribution by providing some limits

of the method and suggestions for a research and policy agenda.

## 2. Towards an assessment framework: from urban regeneration to pedestrian accessibility

Carrying out local physical interventions of urban regeneration aimed at achieving people-and-climate-oriented objectives is not trivial. If the theoretical references are generally shared and applied in the design stage according to solutions to be adapted case by case, the preliminary evaluation of effects is often lacking. However, if urban regeneration interventions cannot neglect the accessibility analysis (i.e., pedestrian and/or cycle path), it is necessary to define *a priori* evaluation methodologies of effects on the existing urban space.

In this context, the proposed methodology integrates urban planning with mobility planning to evaluate the scenarios of the mutability of pedestrian accessibility. It is possible both for areas directly subject to urban regeneration and those indirectly affected around (to be defined by analysis). The multiphase methodology was developed in a GIS environment as a long-established accessibility analysis tool (Hull et al., 2012). The first phase consists of defining the *ex-ante* cognitive framework of the informative layers concerning the pedestrian area's permeability (or impermeability) in the considered case study (i.e., viability, location of pedestrian paths and sidewalks, presence of physical barriers). The analysis is carried out concerning urban public spaces (e.g., green areas, public services) and public transport nodes. As development of previous studies (Rossetti et al., 2020), the evaluation is based on the detailed discretisation of the area in a uniform vector grid of 3x3 meters cells made with the Geowizard tool. Each cell is connected to the informative layers on land use and contains a record field for evaluating pedestrian permeability. However, the evaluation is not only spatial but also temporal. Indeed, the application of a "backtracking" algorithm (Wirth, 1976) on each cell allows assigning an access time between the links mapped between cells to an origin/destination reference point (cell). The algorithm optimises distances by determining the pedestrian path with the shortest distance. The GIS processing maps pedestrian isochrones from the point/cell assigned to all points on the map. In addition, it returns the catchment area of each established 'boundary' of accessibility. Given the 'pedestrian' dimension of the analysis, this method adopts a time interval of 5 minutes (Geurs & Van Eck, 2001; Curtis & Scheurer, 2010; Zazzi et al., 2018).

The same procedure is carried out in a second phase for the *ex-post* analysis of the project. Comparing the *ex-post* and the *ex-ante* situation illustrates how much improvement (or worsening) the urban regeneration project generates. Consequently, the method can demonstrate how much the project is in line with the objectives of greater pedestrian permeability for people-and-climate-oriented neighbourhoods.

## 3. Results of ex-ante and ex-post walkability scenarios

### 3.1. Redevelopment of Tintoretto tower's unit case study

The methodology was studied in depth in the case study of the Tintoretto tower housing unit, an internal portion of the San Polo neighbourhood in Brescia.

Conceived by the architect and planner Leonardo Benevolo, the neighbourhood represents one of Italy's most relevant examples of public urbanisation. The 1972 project consisted of the settlement of 12,000 people in an area of 350 hectares. Consequently, about 5,000 apartments were built on three different housing types: single-family houses with 2 and 3 floors, multi-family houses with 4 and 5 floors and towers with 15 and 17 floors. Of the latter, 5 have been made (i.e., Tiziano, Raffaello and Michelangelo to the west, Tintoretto and Cimabue to the east) and are the most identifying element of the work (Belli, 2020). Indeed, Benevolo's project wanted to propose an alternative urban model based on a repetitive urban system of large dimensions and characterised by housing units and high urban facilities that provided for each inhabitant 18 m<sup>2</sup> of public services and 50 m<sup>2</sup> of green areas. Nevertheless, the equipment provided and the social and housing mix achieved did not prevent a certain degree of gentrification and consequent social and physical degradation problems. The main problems occurred in the Tintoretto tower (built between 1984 and 1987) and later the Cimabue tower, characterised by the largest concentration of low-income residents. The unit consists of a 17 floors parallelepiped tower with 195 apartments (north) and a green plate of 700 m<sup>2</sup> on a floor above ground (south). It is configured as a compact block that does not allow any permeability, defining a barrier between the area and the neighbourhood. In 2008, the demolition of both towers was planned, and in 2013,

the Tintoretto tower was emptied (Badiani & Savoldi, 2014). However, the emptying of the tower did not have any positive effect on the area.



Fig. 1. The Tintoretto tower unit's area existing situation (a); urban regeneration design proposal (b). Source: Comune di Brescia website.

Recently, the Municipality of Brescia presented an urban regeneration project of social housing for the Tintoretto tower housing unit, which involves demolishing the tower and enhancing (among other goals) soft mobility by increasing urban accessibility. It modifies the structure and existing unbalances and activate new relationships with its surroundings. Indeed, the project proceeds to overcome the concept of separation between housing units by re-ordering the public space between parts. The new buildings are articulated around two large open green courtyards (the existing one to north and the new one of 4,000 m<sup>2</sup>) that define the relationship between north and south spaces and connections east-west between the Tintoretto and the Cimabue unit. Also, project buildings are retreated compared to the existing ones, guaranteeing wide and tree-lined public paths also around the unit. The planivolumetric composition of the open system generates new visual and physical openings in the context. Indeed, cycle and pedestrian permeability within the unit and between the unit and the neighbourhood are primary.

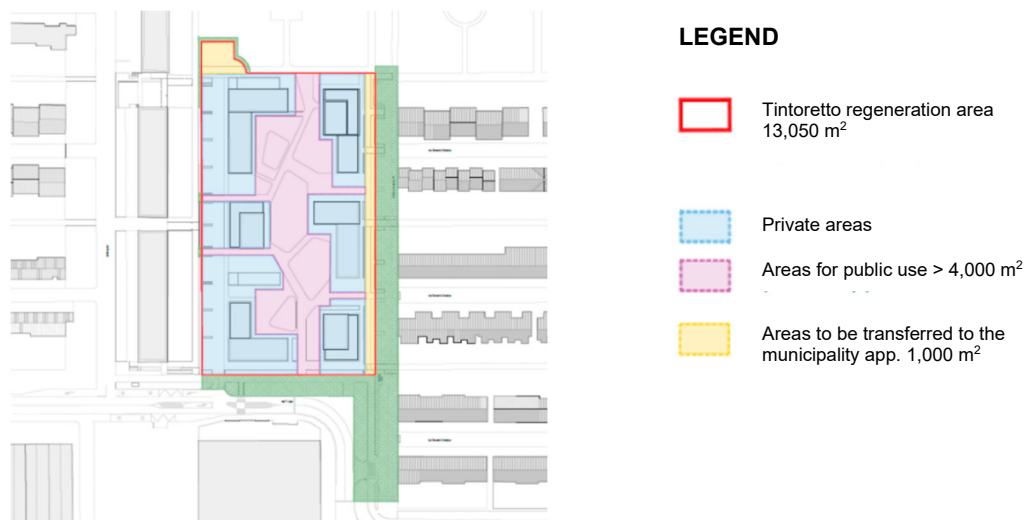


Fig. 2. Urban scheme of the Tintoretto area regeneration as in the implementation plan approved by the municipality. Source: Comune di Brescia website.

### 3.2. Pedestrian accessibility analysis on urban regeneration effects

The implementation plan approved for the Tintoretto area (Fig.2) and the subsequent implementation project enhance the walkability within the regeneration area since they base on the demolition of the plate in front of the tower, which now limits the pedestrian permeability across the site.

A network analysis (Fig.3) was developed to study the effects of the urban regeneration process on the surrounding neighbourhoods. This methodology has made it possible to understand the positive externalities related to creating an open space within the Tintoretto area and defining how the implementation of pedestrian paths contributes to favouring accessibility to services and promoting a healthier lifestyle based on walkability.



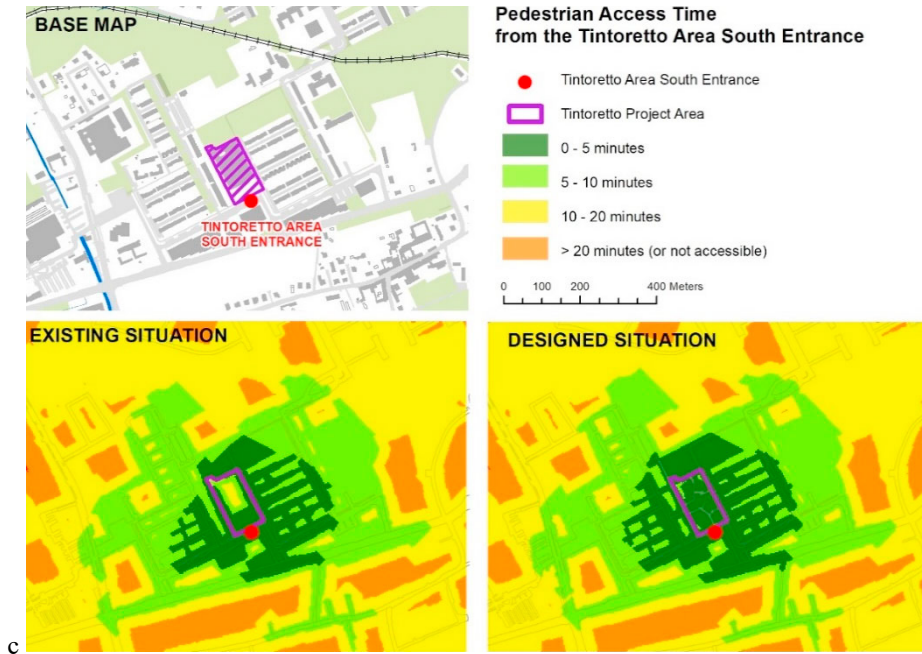


Fig. 3. Pedestrian Isochrones around S. Polo metro station and kindergarten (a), and Tintoretto area’s north (b) and south (c) entrance both for the existing situation and for the situation designed by the regeneration implementation plan.

Starting from the implementation plan, three accessibility assessments were carried out. The first considers pedestrian isochrones from the S. Polo Metro Station and the adjacent kindergarten, the second and the third present isochrones developed from the main entrances of the Tintoretto area (southern and northern ones). The maps show the results for the three assessments, providing the pedestrian isochrones from the three origins.

The outcomes of the analysis clearly show the importance of extending a correct pedestrian infrastructure favouring home-service proximity. The pedestrian accessibility within the whole S. Polo neighbourhood is clearly improved in the designed situation, especially in the west-east axis. This also emerges from fig. 4, which highlights the percentage differences in the pedestrian walking times values between the existing and the designed situation.

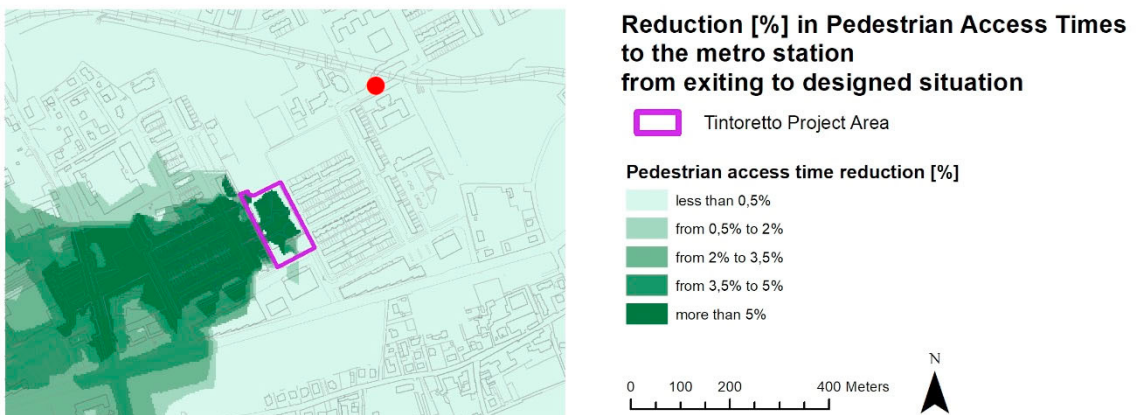


Fig. 4. Percentage reduction in pedestrian access times to the metro station (designed situation compared to the existing situation).



Fig. 5. Pedestrian paths and links located adjacent to the Tintoretto implementation area, but for which an intervention on the infrastructure may be suggested to boost the impact of the regeneration project on the surroundings.

However, it has to be clear that to provide a real enhancement, interventions on the pedestrian infrastructures should not be limited only within the implementation boundary of the Tintoretto district but also involves the immediate adjacent surroundings (Fig. 5).

#### 4. Discussion and conclusion: a research and policy agenda

The paper presented a space-time based methodology to assess local urban regeneration projects' effects on people-and-climate-oriented objectives, specifically on pedestrian mobility and behaviour. The assessment framework consists of a GIS analysis based on a detailed discretisation of urban areas in a uniform grid of cells, which is applied a “backtracking” algorithm. The algorithm optimises distances by determining the pedestrian path with the shortest space-time distance (i.e., isochrones). Applying it to the case of the Tintoretto unit in Brescia, the analysis ex-ante and ex-post show the variable walkability scenarios in public open spaces. The three accessibility assessments from the metro station and main entrances of the area show a walkability enhancement due to the creation of open space and the implementation of pedestrian paths. The pedestrian access time from the existing to designed situation show a reduction between more than 5% and 0.5%.

On the one hand, the results highlight the relevance to improving pedestrian infrastructure to favouring proximity, but on the other hand, the proposed method highlights three controversial facets. Firstly, the results show how the methodology could be useful to achieving sustainability goals in urban regeneration projects and how practitioners and public administrators can verify them. However, the integration between analysis tools and urban planning and design strategies is still poorly applied. The evaluation of urban regeneration effects on accessibility (e.g., pedestrian, cyclist, etc.) and monitoring changes through time seems not integrated into the administrative routine. Therefore, how do administrations know if the proposed intervention pursues its sustainability objectives? The significant theme of “how to make a city” remains today still divided among theoretical, technical and practical issues. Nevertheless, the proposed method could provide a decision support framework for urban, and mobility planning (e.g. in Sustainable Mobility Plans – SUMP) and could be replicated in several territorial contexts. However, further application to more case studies is needed.

Secondly, the subject of how and what to measure is still vast. The method utilises isochronic curves characterised by equal temporal amplitude, which identify a contour of pedestrian catchment area from/to a given origin/destination point. In terms of isochronic analysis, the contribution could be improved through further qualitative and quantitative factors, e.g., considering the level of service of the pedestrian infrastructure or qualitative surveys among pedestrians and vulnerable road users.

Finally, the analysis seems to focus on a restricted area. However, each urban regeneration project could be a “springboard” for further effects of systemic mutation of urban spaces of cities. Therefore, the analysis could evaluate if the effects are localised or generalised and, in the second case, highlight driving factors or barriers that allow/prevent sustainable urban changes.

In conclusion, the results' framework reflects the proactive importance of analysis tools for public space's systemic

regeneration strategies towards "streets people-and-climate oriented", both for public administrations' sustainable mobility policies and users' specific needs. This is also particularly relevant in the Covid-19 pandemic, in which several cities are reinventing and regenerating neighbourhoods to promote soft accessibility.

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