Impact of Universal Accessibility in Tertiary Infrastructure Projects of Indonesia and the KOTAKU Project: A Cost-Effectiveness Analysis of Two Pilot Projects
Rights and Permissions

This work is available under the Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO) http://creativecommons.org/licenses/by/3.0/igo. Under the Creative Commons Attribution license, you are free to copy, distribute, transmit, and adapt this work, including for commercial purposes, under the following conditions:

Attribution—The National Slum Upgrading Project (NSUP/ KOTAKU) Universal Accessibility Toolkit was prepared by a team led by Yuko Arai, composed of Alex Robinson, Eliana Pires de Souza, Fernando Alonso, Francesco Cocco, Jeremia Sir Nindyo Mamola, Risye Dwiyani and Tony Hartanto Widjnarsono under the guidance of Satu Kristiina Kahkonen, Country Director for Indonesia and Timor-Leste and Ming Zhang, Practice Manager of the World Bank’s Urban, Disaster Risk Management, Resilience and Land Global Practice (GPURL). The implementation of NSUP/ KOTAKU was led by the Task Team Leaders, Evi Hermirasari, Andre Bald and Kumala Sari. The Team is grateful to all advice received from the peer reviewers, Charlotte Vuyiswa McClain-Nhlapo and Narae Choi. Lisa Ferraro Parmelee gave editorial support, and Amy Chan designed the report. We end with a final word of gratitude to the Australian Government Department of Foreign Affairs and Trade (DFAT).

Translations—If you create a translation of this work, please add the following disclaimer along with the attribution: This translation was not created by The World Bank and should not be considered an official World Bank translation. The World Bank shall not be liable for any content or error in this translation.

Adaptations—If you create an adaptation of this work, please add the following disclaimer along with the attribution: This is an adaptation of an original work by The World Bank. Views and opinions expressed in the adaptation are the sole responsibility of the author or authors of the adaptation and are not endorsed by The World Bank.

Third-party content—The World Bank does not necessarily own each component of the content contained within the work. The World Bank therefore does not warrant that the use of any third-party owned individual component or part contained in the work will not infringe on the rights of those third parties. The risk of claims resulting from such infringement rests solely with you. If you wish to re-use a component of the work, it is your responsibility to determine whether permission is needed for that re-use and to obtain permission from the copyright owner. Examples of components can include, but are not limited to, tables, figures, or images.

All queries on rights and licenses should be addressed to
World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; e-mail: pubrights@worldbank.org.

Cover, clockwise from upper left: Detail of accessible mobility chain urban sequence (from home to public buildings); A person in a wheelchair reaching a toilet door handle, © Eka Pristianto; Implementation of accessible design; A UA assessment in Malang, © Malang City Coordinator Team; Detail of example of snowball sampling.

Cover design: Amy Chan
Contents

Introduction ................................................................. 7

1. Objective and Methodology ........................................ 9

2. Regulatory Framework ................................................ 12

3. Sampling the Economic Impact of UA in Tertiary Infrastructure ........ 15


   The context for impact valuation of a universally accessible toilet .... 19

   Description of the project: Location and UA features ............... 20

   Traditional and UA toilet facility costs compared .................... 26

   Cost-effectiveness analysis of UA versus personal assistance in toilet use ........................................ 26

5. Pilot Project B: Street Rehabilitation in Kelurahan Kemijen, Semarang ... 33

   Public space mobility: UA versus personal support services for PRMs . . 34

   Description of the project: Location and UA features ................ 35

   The costs of UA in the Kemijen Street .................................. 38

   Cost-effectiveness analysis of UA on street used by encumbered persons. ........................................ 39

6. Graphic Description of the Process Followed .......................... 43

7. Final Comments After the CEA of Both Pilot Projects .................... 44

Annex ................................................................. 46

   Detailed UA Investment Cost Assumptions (Toilet Facility, Baciro) ...... 46

   Detailed UA (Complete Street) Investment Cost Assumptions (Street, Kemijen) ........................................ 47

References ................................................................. 48
Impact of Universal Accessibility in Tertiary Infrastructure Projects of Indonesia and the KOTAKU Project

Figures

Figure 4.1. UA Improvement Diagram (Before and After) ........................................... 23
Figure 4.2. General Overview of UA features Implemented to the Exterior
of the Toilet Facility ............................................................ 24
Figure 4.3. UA Design Features of Accessible Stall Interior ......................... 25
Figure 4.4. 3D Representation of the Sitting and Squatting Toilets Provided .... 25
Figure 5.1. Road and Sidewalk Design for Kelurahan Kemijen ....................... 33
Figure 5.2. UA Improvement Diagram (Before and After) ............................ 37
Figure 7.1. Cost Effectiveness of UA Implementation in Two Pilot Projects:
Flowchart of the Process ....................................................... 43

Tables

Table 1.1. Sector Regulations on Infrastructure that Include References
to UA in Indonesia ................................................................. 13
Table 4.1. Comparative Costs for Toilet Facility, With and Without UA Features. .... 26
Table 4.2. Estimation of General Population and PRMs Living in the
Facility’s Area of Influence ......................................................... 28
Table 4.3. Two Scenarios for Calculating the Effectiveness of UA investment
in the Baciro Toilet Facility .................................................... 31
Table 5.1. Costs for the Kemijen Street Project, With and Without UA plus
Complete Streets Features ........................................................ 38
Table 5.2. Estimation of General Population and PRMs Living in the Street’s
Area of Influence ................................................................. 40
Table 5.3. Two Scenarios for Calculating the Effectiveness of UA Investment
in the Kemijen Street ............................................................... 42

Photos

Photo 4.1. Baciro Toilet Facility Before the Renovation ................................. 23
Photo 4.2. Baciro Toilet Facility After the Renovation .................................. 23
Photo 5.1. Part of Kelurahan Kemijen Street after the Intervention ............... 37

Maps

Map 4.1. Kelurahan Baciro, Yogyakarta, with Toilet Facility Location Outlined in Green ..................................................... 21
Map 4.2. Graphic Analysis of the Population Living in the Buffer Zone ............. 22
Map 5.1. The Kelurahan Kemijen Accessible Street Location in Semarang ........ 36
Map 5.2. Graphic Analysis of the Population Living in the buffer zone .......... 36
### Abbreviations and Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL</td>
<td>Activities of daily living</td>
</tr>
<tr>
<td>AMC</td>
<td>Accessible mobility chain</td>
</tr>
<tr>
<td>CEA</td>
<td>Cost-effectiveness analysis</td>
</tr>
<tr>
<td>CRPD</td>
<td>Convention on the Rights of Persons with Disabilities</td>
</tr>
<tr>
<td>DFAT</td>
<td>Australian Government Department of Foreign Affairs and Trade</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>IADLs</td>
<td>Instrumental activities of daily living</td>
</tr>
<tr>
<td>KEMENHUB</td>
<td>Ministry of Transportation</td>
</tr>
<tr>
<td>KOTAKU</td>
<td>Kota Tanpa Kumuh (Indonesia’s Slum Upgrading Program)</td>
</tr>
<tr>
<td>MPWH</td>
<td>Ministry of Public Works and Housing</td>
</tr>
<tr>
<td>NPV</td>
<td>Net present value</td>
</tr>
<tr>
<td>NSUP</td>
<td>Indonesian National Slum Upgrading Program</td>
</tr>
<tr>
<td>ODF</td>
<td>Open Defecation Free</td>
</tr>
<tr>
<td>PP</td>
<td>Peraturan Pemerintah (Government Regulation)</td>
</tr>
<tr>
<td>PRM</td>
<td>Person with reduced mobility</td>
</tr>
<tr>
<td>PUPR</td>
<td>Ministry of Public Works and Housing Works (PU)</td>
</tr>
<tr>
<td>RPLP</td>
<td>Rencana Penataan Lingkungan Permukiman (Community Settlement Plan)</td>
</tr>
<tr>
<td>UA</td>
<td>Universal accessibility</td>
</tr>
<tr>
<td>WASH</td>
<td>Water, sanitation, and hygiene</td>
</tr>
</tbody>
</table>
Introduction

Access is not just about spatial configuration and design, but is a political and social issue: it is about the ability to take part in public life.

— Kitchin and Law 2001, 289

Universal accessibility (UA) has become a legal requirement and a key objective of urban planning and transportation policy, but the implementation of accessibility-enhancing measures is constrained by a number of barriers. These include competing demands for investment due to budget constraints and an unclear understanding of the economic benefits of improved accessibility.

This cost benefit analysis pilot for KOTAKU focused on the economic impact of UA in tertiary infrastructure and presented a series of discussions, analyses, and calculations that led to several conclusions:

Improving UA can help increase national production by its potential to internalize human resources previously excluded from the market.

In the case of specific infrastructure projects, investing in UA can be a good economic decision from an opportunity cost perspective. This conclusion is based on well-argued qualitative analysis rather than quantitative estimations, which are impeded by the limited existing data on which willingness-to-pay calculations of changes in welfare after UA intervention can be based.

Data restrictions appear to be the more limiting factor for a full revision of direct benefits calculations.

A new analysis of small-scale interventions by KOTAKU is introduced here in search of a more precise economic rationale for the implementation of UA. It is presented as an alternative to more complex research and as a means of investigating the impacts of accessible infrastructure on local populations.

This second report adds dimensions and arguments to the economic case for accessibility at the local scale and is founded on analysis of need and use. Two renovation projects are analyzed: those of a communal toilet in kelurahan Baciro, Yogyakarta, and a local street reconstruction in kelurahan Kemijen, Semarang. In both cases, cost-effectiveness analysis (CEA) is used to compare the costs of improving UA with those of an alternative way to achieve similar sanitation and mobility outcomes for persons living in defined areas of influence around the infrastructure.
CEA is a form of economic evaluation concerned with efficiency—that is, with attaining the most benefit from the resources expended, or “value for money.” In this analysis, the costs of adding UA to infrastructure are compared to those of the personal assistance needed by encumbered neighbors in non-accessible traditional infrastructure. The measure of effectiveness is inclusion, or the potential to enjoy equal access. The respective costs of the two alternatives to be compared in any such project are (1) the added cost of features and improvements to achieve universal accessibility and (2) the opportunity cost or due salary of the personal assistant needed to provide the same service when UA is not provided. When both costs are the same, a tipping point is reached at which, ceteris paribus, spending on UA begins to be economically justified.

In the investigation that follows, different considerations are analyzed and discussed to complete impact assessments of UA in the two pilot projects and to present them as representative of other KOTAKU tertiary investments facing similar choices.

1. According to Webster's New World College Dictionary, fourth edition, “cost effective” refers to “producing good results for the amount of money spent; efficient or economical.”
1. Objective and Methodology

The analyses presented in this report aimed to support the view that improving accessibility in tertiary infrastructure projects is of economic value. The study rested on three main ideas:

- The economic impact of UA can be measured by comparing the costs of an alternative way of producing outcomes equivalent or similar to those produced by UA.
- The economic impact of UA can be assessed accurately by measuring the outcomes and costs of small-scale pilot projects under controlled conditions. These conditions include a precise measurement of the costs, a precise set of UA features, a good estimation of the people affected, and a number of assumptions underlying estimations of direct outcomes.
- The design and relevance of UA features included in a project can be analyzed in detail and combined with the potential outcomes.

The operational objective of the study was to compare the costs with and without UA features of two representative pilot projects, already budgeted or executed by the KOTAKU program, and the corresponding consequences for the autonomy of the users (that is, the population living nearby).

The methodology used for the calculations was cost-effectiveness analysis (CEA), a form of economic analysis that compares the costs of different ways of producing equivalent or similar outcomes. It is useful when the main benefits cannot be easily expressed in monetary terms or when undertaking the valuation is difficult. While costs are expressed in monetary terms, benefits are expressed in terms of physical units, health outcomes, or any other improvements that can result from the project. The main benefit of CEA for decision makers is that it provides information about the best investment solution—the one whose outcome, all else being equal, can be achieved at the minimum cost.

The costs of the two pilot projects were obtained in two ways: (1) by taking relevant unit prices directly from the construction budgets of the specific facility and infrastructure improvement being analyzed and (2) based on estimations of quantity and unitary costs of other comparable projects in the pilots. Projects were considered comparable when they were of the same infrastructure subtype and located within the same province (in this case, Central Java). The rationale for the parameter was to minimize differences in unit costs related to location or geographical factors, such as transportation costs, or to availability of materials.
UA can reduce the personal assistance needs of the elderly or persons with disabilities through better environmental design and management of facilities and infrastructure.

The economic implications of care and assistance—whether paid or unpaid—are huge. Twenty years ago, a large national survey covering all adults ages 18 years and older in the United States found that 13.2 million received help in activities of daily living (ADLs) or instrumental activities of daily living (IADLs; see below), averaging 31.4 hours per week. This amounts to 21.5 billion hours of personal assistance service help per year, of which 13.4 percent is paid and the remainder is unpaid. If paid hours are valued at the wage rate of the average home health worker at $11 per hour in 1996, the market value of home health services would be roughly $32 billion a year (LaPlante 2002).

Caregiving is very complex from an economic perspective, as it is mostly provided informally, through family and relatives,3 while at the same time representing a growing market for services provided by private or public companies supported by public funds, insurance, or direct payments. The exact proportions in which informal versus market services are procured or provided is not known, but studies show that provision by family members is the most recurrent. The issue of costing these informal services

---

3. “Informal caregiving or care work” has been defined as “the provision of unpaid personal services to meet the physical, mental and emotional needs that allow a dependent person to function at a socially determined acceptable level of capability, comfort, and safety” (Friedemann 2011, 514).
is open to discussion, but the most obvious reference is the market price of privately provided assistance services.

The salary for professional services was used as a starting point in the valuations presented here, but to be more realistic it was reduced to 25 percent when the services were provided by family members or the informal sector. That no economic transfer takes place between the beneficiaries and those providing the assistance inside their families is obvious, but that an actual economic tradeoff exists shouldn’t be ignored. This tradeoff is the opportunity cost of the hours devoted to the care of or assistance to the encumbered person that could be used for other purposes, such as work, study, or leisure, all of which have economic implications.

Under this valuation framework, the two selected pilot projects are used as samples for an analysis of the economic consequences of investing in UA in two different contexts: (1) the accessibility of a communal toilet and (2) the walkability, safety, and accessibility of a strip of a local street. In both cases, the beneficiaries in the analysis were those living nearby who would potentially be using the infrastructure.

The amount invested in accessibility starts to be cost effective in either of the two environments (toilet facility or street) at the point at which the net present value (NPV) of that investment equals 0, considering the financing terms, such as the discount rate, investment cost, and lifetime or amortization period—in other words, the point at which the gains and losses of investing in accessibility become equal.

The NPV is calculated using the following formula:

$$E[\text{NPV}] = -I_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

where $I_0$ is the investment in the accessibility feature, over time (t) with a discount rate (r), while $C_t$ represents the annual cash flow resulting from the improved accessibility. This is measured as costs averted by the project—that is, the value of the number of hours of assistance saved as a result of the investment.
2. Regulatory Framework

Indonesia has long recognized the needs of persons with disabilities, a sensibility that became particularly acute after the ratification of Law No. 4, 1997, on People with Disabilities. The regulation was revised, following Indonesia’s ratification of Law No. 19, 2011, on Ratification of the Convention on the Rights of Persons with Disabilities (CRPD) and the subsequent ratification of Law No. 8, 2016. Chapter 1, article 2, of the latter law states that the fulfillment of rights for people with disabilities shall adhere to a series of principles. Accessibility is one of them.

Much of the available legal framework at the national level regulates aspects of the built environment or public services. These laws and regulations include the following:

- Law No. 28, 2002, on Building (which was updated with the Omnibus Law or Law No. 11, 2020, on Job Creation but maintained the provisions on accessibility)
- Government Regulation (PP) No. 16, 2021, on Implementing Regulation of Law No. 28, 2002, on Building
- Government Regulation (PP) No. 42, 2020, on Accessibility of Settlements and Public Services and Protection from Disaster for Persons with Disabilities

In particular, PP 16/2021 (which updated the former PP 36/2005) provides an annex of detailed standards for accessibility in the context not only of building construction but of the built environment in general (pertaining to access to and from buildings). On the other hand, PP 42/2020 stipulates conditions for universal accessibility specifically for persons with disabilities in the context of settlements and public services or spaces.

Regarding UA investments in streets, sidewalks, and other relevant public infrastructure, the most pertinent regulations on the subject have been issued by the Ministry of Public Works and the Ministry of Transportation, as listed in table 1.1.

---

4. Chapter 2, article 4, of Law No. 8, 2016, acknowledges four types of disabilities—physical, intellectual, mental, and sensory—as well as the possibility for persons to possess multiple disabilities. An additional regulation at the national level, Law No. 18, 2014, on Mental Health was ratified to reinforce the state’s obligations toward persons with mental disabilities.

5. Chapter 3, article 5, of Law No. 8, 2016, recognizes 22 rights of persons with disabilities in Indonesia. These include freedom from being stigmatized; rights to protection under the law; rights to education, employment, and health care; political rights; rights to protection from disasters; rights to accessibility; and rights to public services.
Impact of Universal Accessibility in Tertiary Infrastructure Projects of Indonesia and the KOTAKU Project

Table 1.1. Sector Regulations on Infrastructure that Include References to UA in Indonesia

| Ministry of Public Works and Housing (MPWH), formerly Ministry of Public Works (PU) | • PU Ministerial Regulation No. 3, 2014, on Guidance in Planning, Provision, and Utilization of Pedestrians’ Walk Infrastructure and Facilities Network in Urban Areas  
• PU Ministerial Regulation No. 14, 2017, on Convenience Requirements for Access to Buildings |
| Ministry of Transportation (Kemenhub) | • Transportation Ministry Ministerial Regulation No. 98, 2017, on Public Transportation Providers’ Provision of Accessibility for People with Special Needs |

In 2000, the government of Indonesia replaced its previously centralized government and development planning systems with a decentralized system. The reform redistributed a great many direct responsibilities to regencies and municipalities, bypassing the provincial governments. These included primary sectors for which the central government was previously responsible, such as budgeting, health, education, environment, communication, public works, spatial planning, and many others (Nasution 2016).

In terms of imposing UA standards on public infrastructure and environments, such as streets, sidewalks, or public spaces, this meant municipal governments would have autonomy over planning, design, and construction at the city level, as well as in the urban neighborhoods lying within their jurisdictions. Depending on the current priorities of a city, UA-related programs may exist, but they may be focused on sectors other than those related to infrastructure planning and development.

Consequently, not a single comprehensive regulation has been issued that addresses universal accessibility in all aspects of infrastructure subinvestments. Moreover, some of the sectoral regulations are still based on the outdated paradigm that sees persons with disabilities as “defective” or needing exclusive treatment. Municipal governments play an important role in executing, and filling gaps in, regulations and initiatives at the national level, although the vertical integration between national and municipal regulation remains a slow and difficult process. This may have contributed to a lack of intersectoral coordination in cities that has hampered the creation of holistic UA programs and policies at the municipal and neighborhood levels.


Of particular relevance to this analysis is Chapter III of Regulation No. 14, 2017, on Building Ease of Access Requirements, which may be applicable in the case of toilet facilities. Article 8 states that each must meet the requirements for building
facilities, which include easy connection to, from, and inside the building, as well as completeness of infrastructure and facilities in the use of the building. Article 9 states the required accessibility conditions at facilities and inside buildings in three respects:

1. The horizontal relationships between spaces/between buildings
2. The vertical relationships between floors in a building
3. Evacuation facilities

Annex I of the regulation, on requirements regarding convenience of access for buildings, states the technical details for the fulfillment of these requirements, which are “carried out through the application of Universal Design principles (universal design) in the building construction stage (technical planning and construction implementation).”

In summary, under Indonesian law, accessibility is a requirement to be met for the protection of the rights of persons with disabilities, and this adds to the justification for any cost-benefit analysis or cost efficiency approach.

Increasing accessibility in kelurahan Tambaan, Pasuruan City.
3. Sampling the Economic Impact of UA in Tertiary Infrastructure

No single way exists to value the economic impact of improving UA in tertiary infrastructure. In a big and diverse program like KOTAKU, there are so many variables to take into account that the best valuation approach should involve small-scale sampling. Choosing pilot projects representative of the core lines of investments for study can provide this.

Pilot projects are often used in policy and management contexts to apply and adapt an innovation to a real-world situation. They provide a means to deal with the complexity and uncertainty of innovative practices. Through them, new approaches are tested in a confined field setting to gain practical experience about the innovation and how it interacts with its context and to derive lessons that can be applied to improving or adjusting management practices and policies. The experiences gained in the design of a pilot project will positively reduce comparable expenses in subsequent projects utilizing the same solutions. In urban contexts, the lessons learned from pilots can be applied to address sustainability issues, improve the effectiveness of urban services, and enhance the quality of life of citizens.

The Indonesian National Slum Upgrading Program (NSUP), better known by its Bahasa Indonesia name, Kota Tanpa Kumuh (KOTAKU), encompasses numerous facility and infrastructure construction projects, some of which are financed jointly by the World Bank and the Australian government’s Department of Foreign Affairs and Trade (DFAT). For this study, two different projects under KOTAKU-DFAT were selected to assess the economic impact of the tertiary investments in UA being made through the program. The first introduced full UA features in the design of a communal toilet located in kelurahan Baciro in Yogyakarta. The second involved a local street renovation, also following UA criteria, in kelurahan Kemijen, Semarang.

We reviewed both projects to determine whether UA improvement had a positive economic impact—that is, whether it generated enough return from the investment to cover its costs. To do so, we had to isolate the UA costs from the full construction costs and find a way to estimate the resulting social benefits. This process formed the basis for what was a typical cost-benefit analysis.
For persons with disabilities, the provision of public services and the design of the built environment can be crucial determinants of participation and integration in the community.

Unfortunately, from the benefits side not much information was available, and, given that insufficiency and the inappropriate conditions for devising and conducting surveys that would ascertain people’s preferences on the matter, neither willingness to pay\(^6\) nor opportunity cost\(^7\) approaches seemed applicable in this context. Consequently, cost-effectiveness analysis was chosen so the outcomes of the investments could be analyzed and maximized in relationship to their costs. The measure of “effectiveness” in both projects was defined as “the possibility of persons with functional limitations to use the facilities or infrastructure provided through the use of different strategies: personal assistance or universal accessibility.”

For persons with disabilities, the provision of public services and the design of the built environment can be crucial determinants of participation\(^8\) and integration in the community. Reduced ability to manage critical environmental demands with respect to mobility and usability is characteristic of disability in older adults and disabled people, but accessibility is not just about spatial configuration and design; it is also a political and social issue. It affects the ability to enjoy daily activities and take part in public life as any other individuals would, and it extends to the possibility of using a communal toilet or a local street.

---

6. “Willingness to pay” is an indicator of the maximum amount of money an individual is willing to give up to receive a good. In this case, it would measure the change in utility or satisfaction a person gets from consumption of the good or project where UA is implemented.

7. “Opportunity cost” indicates the loss of value from the alternatives given up when one alternative is chosen. In this case, the measure would require calculating the earnings that potentially would be lost by beneficiaries of the good being valued if it were not provided.

8. Based on Lawton’s environmental theory of aging (Lawton 1980), which can be applicable to any disabled or encumbered person, it is hypothesized that as functional capacity declines, environmental conditions are more likely to affect—either by impeding or enhancing them—activities of everyday life, including mobility.
It made sense, then, to choose for the evaluation of the economic impact of accessibility in the KOTAKU program two pilot projects that pertained to some of the most important activities of daily living (ADLs). In the first case, the impact would be demonstrated through the construction of a new communal UA toilet, and, in the second, it would be assessed in terms of the possibility to participate in public life by walking autonomously and safely on local streets.

The same measure of effectiveness was used for both projects: achieving full autonomy in any of the activities with the lowest cost. The capacity to use the toilet autonomously and to walk safely and independently on the street are basic rights any person should be guaranteed by means of inclusive design or personal assistance or care. The effectiveness of UA investment in both projects could, therefore, be measured according to the number of mobility-encumbered neighbors whose increased autonomy would compensate for the cost of the UA features through savings in their personal assistance costs.

9. Activities of daily living (ADLs) are basic tasks that must be accomplished every day for an individual to thrive. Generally, ADLs can be broken down into the following categories:
   - Personal hygiene: Bathing, grooming, oral, nail, and hair care
   - Continence management: A person’s mental and physical ability to use the bathroom properly
   - Dressing: A person’s ability to select and wear the proper clothes for different occasions
   - Feeding: Whether a person can feed themselves or needs assistance
   - Ambulating: The extent of a person’s ability to change from one position to the other and to walk independently.
4. Pilot Project A: Communal Toilet in Kelurahan Baciro, Yogyakarta

The toilet [facility] is a political place. The labels on its doors intentionally include some and exclude others, whilst the space, design and facilities themselves permit certain bodies, needs and actions, and forbid others.

— Jones et al. 2019, 219

The accessibility of toilet facilities may be a political issue, but it certainly is also an economic one. Inadequate sanitation is a global concern affecting the global community. It undermines economic performance considerably (Daudey 2018); for example, a recent study estimated that the global cost of poor sanitation reached US$223 billion in 2015, up from US$183 billion in 2010 (Lixil and Oxford Economics 2016). In Africa, economic losses resulting from poor sanitation account for around 1–2.5 percent of gross domestic product (GDP; Water and Sanitation Program 2012).

In many cases, persons with certain types of disabilities who are unable to approach or enter communal toilet facilities are forced to follow bad sanitation practices, such as open defecation,10 with all their attendant dangers to health and safety issues. For those who have movement difficulties and are at risk of falling, the location and design of accessible toilet facilities are essential if they are to have use options similar to those enjoyed by persons without disabilities. The availability of accessible toilets can contribute significantly to the self-esteem of persons with disabilities, as well as afford them and/or their caregivers more time to engage in productive activities instead of wasting it on mundane water and sanitation chores (Groce 2011).

Moreover, it is important to stress that inclusive approaches to water, sanitation, and hygiene (WASH) are likely to benefit a population far wider than that of persons with disabilities. Ill health, pregnancy, and aging may all restrict or limit access to water points, latrines, public transportation, and health care facilities. Inclusive practices will also help prevent new cases of disability (Enfield 2018).

In Baciro, Yogyakarta, the rationale behind providing a universally accessible toilet facility was that access to and the regular use of such facilities by those who are

10. An estimated one billion among the global population do so.
physically challenged is key to their integration into the community, to providing release
time for family members who help solve sanitary problems at home, and to reducing the
risk of contracting diseases associated with poor sanitation.

The context for impact valuation of a universally accessible toilet

Data about the use of sanitation facilities by persons with disabilities (particularly the
use of an accessible communal toilet) that would have allowed a more precise analysis
of the costs and benefits of the alternatives were unavailable in the study area at the
time of the analysis. Similarly lacking was knowledge about sanitation practices in the
families affected by the communal toilet project, including average numbers of persons
with disabilities who were in need of toilet facilities, time needed by these persons
to use them, time needed by members of their families to help these persons use
them, location of waste disposal, and so on. This information could have informed the
valuation of the accessible toilet alternative, especially in terms of the improvement’s
most relevant attributes: those relating to health and the avoidance of disease.

In the absence of such data, a literature review allowed for a closer examination of the
context of valuation and its difficulties in this particular case:

- Field research in Tanzania demonstrated that the use of a simple pit latrine
  reduces the risk of trachoma by half, but many such latrines continue to be
  inaccessible to persons with disabilities, and the necessity for many to crawl to the
  latrine area or across latrine floors only increases the risk of exposure
  (Groce et al. 2011).
- If persons with disabilities can get access to water and sanitation facilities without
  assistance from family members, both the persons and their family members can
  use their time more productively, both at home and in the workplace
  (Hannan 2005).
- As of 2012, the consequences of poor sanitation cost Ghana approximately US$12
  per person per year (Water and Sanitation Program 2012).
- According to Tsinda (2016), increased investment in improved sanitation provides
  excellent value for money, with the economic value of returns greatly exceeding
  costs. The estimated economic cost of inadequate sanitation in Africa is between 1
  and 2.5 percent of GDP.
- Bannister et al. (2005) demonstrated the benefits of adapting school facilities for
  Kenyan children with disabilities. Enhancements such as handrail installation and
  path improvement resulted in a 113 percent increase in school enrollment among
  children with disabilities over a three-year period.
- Making sanitation accessible to persons with disabilities benefits the entire
  community, including by addressing the needs of pregnant women, the elderly, and
  young children as well (Pearson and McPhedran 2008).
• Persons with disabilities need more assistance to use sanitation facilities and have more contact with fecal materials when using them than their family members and others in the community (Kuper et al. 2018).

• An open defecation free (ODF) community is made possible only by providing user-friendly latrines for persons with disabilities (Pradhan and Jones 2008).

• The experience most widely reported by participants in a study of paraplegia in rural Bangladesh was of encountering environmental barriers and needing to spend excessive time and energy obtaining access to water and sanitation, leaving them with insufficient time and energy for their families, communities, or leisure activities (Alam and Bryant 2016).

• Gaining independence in toileting means people with paraplegia and family members can use their time more productively, both at home and in the workplace (Jones and Reed 2005).

• In a study conducted in Malawi (Kazembe 2017), participants with physical impairments cited the challenges of having to travel long distances to water points, toilets, and bathrooms—a burden that became particularly onerous when the toilet facility was in poor condition. The study included the following testimonies:

  – “Toilet is honestly a challenge to me because I have squatting problems. So when I need to use the toilet, I have to touch both walls of the toilet to support me.” (Girl, age 9, paralysis)

  – “I always need someone to take me to the toilet when I need to answer the call of nature. I feel uncomfortable when there is no one around.” (Man, 43, blind)

  – “When there is no one around to help, it means I have to crawl into the toilet. But when I come out of the toilet, everyone knows that I was in the toilet—I look filthy with moisture” (Man, 61, wheelchair user)

  – “I cannot use the toilet at night because there is no one around to take me to the toilet. My wife is totally blind. Therefore, I have to hold myself till morning when children come to see me so that I can go to the toilet.” (Man, 37, limb impairment)

Description of the project: Location and UA features

Baciro, a kelurahan in Yogyakarta, is home to a population of 11,040 (BPS 2021). The KOTAKU-DFAT project implemented there involved the renovation of a sanitary facility to make one of the two toilet stalls fully accessible. The facility is located close to the municipality boundary in a residential area inhabited by families with low resources; map 4.1 shows the exact position of the project and the different municipal divisions.
For the purposes of this analysis, the impact of the project was assessed relative to the distance between the households and the toilet facility, since location and distance is a major determinant of the use of shared toilets.\textsuperscript{11} We could make a very rough estimate of the proportion of the population who were potential beneficiaries, first, by fixing the boundaries of the area of influence of the project. Taking into account average walking speed and the current distribution of the communal toilets locally, we drew a circle around the project facility with a radius of 100 meters, supposing the population within it to be homogeneously distributed (map 4.2). Although this is a long distance that can restrict frequent use of a toilet—particularly by women, who will rarely use a distant facility at night for security reasons—we chose it to provide a better estimation of potential beneficiaries living nearby than would have been possible with a smaller area.

\textsuperscript{11} A 2021 study determined that the satisfaction with and rate of use of shared toilets is primarily determined by their location and the distance between toilet blocks and households. In this analysis, the majority of survey respondents agreed that the appropriate distance was 25–30 meters, whereas their toilets were located 40–50 meters away from their houses. The study found that respondents whose homes were close to the toilets were more satisfied with their facilities than others (Al-Tanbin et al. 2021).
Second, we designated as the users, or beneficiary group, of the project those persons with reduced mobility (PRMs) or encumbered persons living in the area of influence. Calculation of this number was based on data at the neighborhood subunit, or rukun tetangga (RT), level from the Ministry of Public Works and Housing (MPWH), and it resulted in a population of 155 persons. A second calculation, based on 2022 data from WorldPop, produced a larger sample of 398 residents.

**Map 4.2. Graphic Analysis of the Population Living in the Buffer Zone**

---

12. “Person with reduced mobility” refers to any person whose mobility when using transportation is reduced by any physical disability (sensory or locomotor, permanent or temporary), intellectual disability or impairment, any other cause of disability, or age, and whose situation requires appropriate attention. The definition is applicable to the built environment.


14. Demographic data at the RT level were obtained by MPWH field facilitators by means of a direct survey. The calculations based on WorldPop’s 2022 data included the aggregated population of all demographic groups (e.g., male, female, children, elderly), and the number of persons with disabilities was estimated based on the percentage of each group at the kecamatan level (assuming demographic group distribution was even within a kecamatan).

15. Intervention Area Source: Based on Yogyakarta’s 2020 Community Plan (RPLP) (RW 17/ RT 76).
Photos 4.1 and 4.2, respectively, show the condition of the toilet facility before and after the renovation.

And figure 4.1 shows the main UA features included in the renovation.

Figure 4.1. UA Improvement Diagram (Before and After)

The renovation included the exterior and interior improvements that are listed below. Figures 4.2 and 4.3 are graphic representations of the main accessible features suggested.
EXTERIOR

- Door designed to open outward, with an opening width of 900 millimeters (minimum), for ease of operation and to ensure the door panels would not obstruct maneuvers in the toilet facility’s interior space and that doorways would be wide enough for wheelchair users to go through
- Railing applied continuously from the entry point of the public toilet area, along the accessible ramp, and up to the accessible toilet stall
- Accessible ramp installed from the street to the doorway of the facility, with inclination of less than 8 percent to allow independent access by wheelchair users and equipped with railings and tactile tiles
- Outdoor lighting added to improve visibility and promote a sense of safety and security for residents engaging in activities in the early mornings or using the toilets in the late evenings
- Terrace designed to be wide enough to allow for 360-degree maneuvering of wheelchairs
- Environment surrounding the facility rehabilitated to ensure continuity of the “accessible mobility chain”\(^{16}\)
- Consistent implementation of tactile tiles and pavement leading to and around the facility to ensure continuity of nonvisual guidance and access for persons with visual impairments

Figure 4.2. General Overview of UA features Implemented to the Exterior of the Toilet Facility

---

\(^{16}\) The principle of an “accessible mobility chain” (AMC) refers to the connection of activities in a seamless and accessible way, such that any person with functional impairments can reach the final objective of an action—in this case, using the toilet—autonomously. This cannot be achieved if one of the links fails and the accessibility chain is broken.
INTERIOR

- Accessible toilet stall designed to be wide enough to allow for 360-degree maneuvering of wheelchairs (see figure 4.3)
- Jet spray provided to assist users who may otherwise have difficulties using the conventional pails for washing\(^{17}\)
- Stationary hand rails provided continuously on three sides of the accessible stall’s interior

**Figure 4.3.** UA Design Features of Accessible Stall Interior

- L-type door handles used rather than round doorknobs for ease of operation
- Sitting toilet prioritized (as opposed to a squat toilet) for the accessible stall (figure 4.4)
- Bathroom sink installed at a height that is easily reached, with leg space for wheelchair users

**Figure 4.4.** 3D Representation of the Sitting and Squatting Toilets Provided

- Level difference between facility interior and outdoor terrace floors eliminated to reduce access barriers for wheelchair users as they move from outdoor to indoor areas

---

\(^{17}\) A jet spray is a nozzle installed inside or outside a toilet fixture that delivers a spray of water for washing after toilet use.
Traditional and UA toilet facility costs compared

Table 4.1 compares the costs for the two alternatives for the toilet facility—with or without UA features—in kelurahan Baciro, Yogyakarta. The costs of improvements to the facility were valued at a total of US$2,417, of which the UA features accounted for US$687, or 28 percent. As the table shows, the installation of the bars and fittings added most to the cost, representing more than 71 percent of the UA investment. It must be highlighted that those costs were very high compared to any international standard, probably because the fittings may have been imported to Indonesia at significant added cost.

Table 4.1. Comparative Costs for Toilet Facility, With and Without UA Features

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>Original cost (inaccessible) US$</th>
<th>Accessible infrastructure cost US$</th>
<th>Cost difference US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate free space (interior)</td>
<td>1,145</td>
<td>1,177</td>
<td>32</td>
</tr>
<tr>
<td>Adequate free space (exterior terrace)</td>
<td>97</td>
<td>174</td>
<td>78</td>
</tr>
<tr>
<td>Accessible ramp</td>
<td>-</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Continuous railing (exterior)</td>
<td>-</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Tactile tiles</td>
<td>21</td>
<td>18</td>
<td>(3)</td>
</tr>
<tr>
<td>Door widening</td>
<td>154</td>
<td>190</td>
<td>36</td>
</tr>
<tr>
<td>Accessible door accessories</td>
<td>19</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Accessible bathroom fittings</td>
<td>35</td>
<td>523</td>
<td>489</td>
</tr>
<tr>
<td>Washing space floor area reduction</td>
<td>260</td>
<td>22</td>
<td>(45)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,730</strong></td>
<td><strong>2,417</strong></td>
<td><strong>687</strong></td>
</tr>
</tbody>
</table>

Since little technical expertise is required to produce these fittings, they could have been manufactured in Indonesia, which would have reduced the costs dramatically.

Cost-effectiveness analysis of UA versus personal assistance in toilet use

Any cost-effectiveness analysis (CEA) starts with the formulation of a main hypothesis. In this case, the hypothesis was that personal assistance would provide a degree of welfare to encumbered persons similar to that provided by autonomous use of a toilet facility.
The objective of the CEA was to gain an understanding of how the economic result of introducing UA was positive relative to the actual situation of encumbered persons needing help to use a toilet facility. For that to happen, the extra cost of the adapted facility had to be less than the annualized savings it would produce—savings measured in terms of the cost of personal assistance that would no longer be needed. In both alternatives, the final outcome for the user would be the same—in other words, both options would be equally useful, with only the costs differing.

UA improvement produces savings in a number of ways. Some of these are tangible, including reduced prevalence of illness and mortality, along with savings in time and resources—through, for instance, reduced work absenteeism, care expenditures, and public welfare costs. Intangible savings are conferred through gains in self-confidence, well-being, and comfort. For the purpose of the CEA estimations presented here, however, most of these savings were ignored because they were out of the reach of our calculations, and data were unavailable. To calculate the savings introduced by accessibility, we had to resort to measuring the extra time used to help an elderly person or a person with disability use a non-accessible toilet facility and associating it with the minimum wage in the area, regardless of who provided the service—either a family member or a professional caregiver. The idea was that enabling the person to reach and use the toilet autonomously could reduce to zero (at least in a good number of cases) the time devoted to taking the person to a non-accessible toilet.

The feasibility of this valuation framework began with the acceptance of several assumptions, some of them already mentioned:

- Our main assumption was that encumbered users could just as effectively make use of the toilet facility autonomously as they would when using it with additional help because their level of welfare would be the same in both cases.
- Second, the effectiveness of improving accessibility was measured only as time saved; all other outcomes are left out of the calculations.
- Third, the barriers preventing a person with disabilities or other beneficiary from using the toilet autonomously that we considered were those present only at the facility itself and not on the path connecting the person’s home to it, which was assumed to be accessible.
- Fourth, the opportunity cost of the caregiver was valued at a minimum wage rate or part of it, and that rate would not change over the time in which the investment is recouped.
- Last, the operation and maintenance costs of the two options (with and without accessibility) would not differ significantly, and so they were left out of the analysis.

**How was effectiveness defined?**

For an encumbered person, use of a non-accessible toilet facility requires a certain amount of time from an assistant or caregiver. The same outcome can be achieved by providing a facility that is accessible to the person without assistance. To be efficient in economic terms, the cost of the assistance hours saved by the project would need
to be higher than the investment in it, in which case the UA option would prove cost effective relative to the alternative (a traditional, non-accessible toilet).

**How many users were considered?**

We assumed that an undetermined number of disabled persons living in the area of influence for our analysis—that is, the area where potential users of the toilet facility lived—would need assistance in using the facility. Other, less dependent, household members, such as the elderly and children (who often struggle to maintain their balance and position themselves over squat holes designed for adults) might also be affected by non-accessible designs. The potential beneficiaries of the project were those persons who presumably would not need assistance if the toilet facility became fully accessible.

As already stated, we considered the area of influence of the project to include those living inside a circle with the facility at its center and a radius of 100 meters, supposing the population in the area to be homogeneously distributed. Table 4.2 presents population data for this area of influence, including the numbers of persons with reduced mobility (PRMs) residing there.

Calculating the proportion of persons affected by accessibility restrictions in toilet use is not straightforward. Three groups of PRMs living in the area of influence were considered, as shown in the table: persons with physical disabilities, children, and older persons. Their total numbers depended on the source of population data used: 44 if MPWH or 108 if WorldPop 2022.

**Table 4.2. Estimation of General Population and PRMs Living in the Facility’s Area of Influence**

<table>
<thead>
<tr>
<th>Numbers living in area of influence</th>
<th>Data from MPWH (neighborhood subunit/RT)</th>
<th>Data from WorldPop 2022 (100 m radius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>155</td>
<td>398</td>
</tr>
<tr>
<td>Households</td>
<td>43</td>
<td>NA</td>
</tr>
<tr>
<td>Persons with physical disabilities</td>
<td>3</td>
<td>NA</td>
</tr>
<tr>
<td>Children (ages 0–14)</td>
<td>27</td>
<td>71</td>
</tr>
<tr>
<td>Older persons (ages 65+)</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>Total PRMs</td>
<td>44</td>
<td>108</td>
</tr>
<tr>
<td>Population density (p/sq.km.)</td>
<td>NA</td>
<td>126.66</td>
</tr>
</tbody>
</table>

Other potentially affected groups, such as pregnant women and temporarily encumbered persons, were not considered.
The next step was to estimate the number of additional hours needed daily to help encumbered persons use the toilet if it were not accessible and determine how to value the time that would be saved if it were made accessible.

Calculation of the cost of personal assistance to help encumbered residents use a non-accessible toilet needs to be based on a number of assumptions and considerations:

1. **Number of visits to the toilet.** Two possible conditions were considered for daily use of the toilet facility per encumbered person. One assumed a single visit, based on the toilet's being used for defecation once a day, while the other assumed three visits, with two visits added for voiding or washing. There was no average number of visits to the toilet that could be used in this case because, according to the academic literature, many factors can affect sanitation behaviors and frequency of toilet use in slum areas, including social and cultural influences, waiting times, environmental conditions (such as privacy, cleanliness, and safety), and so on. Voiding seven times a day, for example, can be considered normal for continent women and eight to ten times for those who are incontinent (Wang and Palmer 2010).

2. **Time to complete the toileting operation (from home and back).** Again, two assumptions were considered. The first allotted a very modest 15 minutes of the caregiver’s assistance for each visit to the toilet. In most slum areas, according to the literature, queuing around 20 minutes for the use of the communal toilet are normal, so for the second assumption we allotted 30 minutes’ time for completing the toileting operation.

3. **Time savings from having an accessible toilet.** The efficiency in terms of time saved from having an accessible toilet facility was valued as a percentage of the local minimum wage for home care professionals. In Yogyakarta, this was US$148.55, per month at the time of the study (Governor of DIY Decree No. 372/KEP/2021 on Establishment of Kabupaten/Kota Minimum Wage in 2022). Based on 160 effective working hours per month over 11.5 months in a year (assuming 15 days’ vacation), the hourly rate for those services comes to $0.97.

4. **The number of potential users.** As already seen, the number of encumbered persons living inside the 100 meter area of influence ranged between 44 and 108.

5. **Assistance provided by family members.** Presumably, only a few (if any) of the encumbered persons would have professional assistance. In most cases, help would be provided instead by family members. For this reason, a second scenario was introduced for the calculations, as family can be available at any time of day, every day, including weekends. Hence, we valued the opportunity cost of their time as 25 percent of the salary of professionals—that is, at $0.24 per hour. This can be considered as a reasonable lower limit, as family caregivers would probably value their free time more highly or have options to use that time in more productive ways (for instance, by earning money from any other activity or studying for school).
Additional assumptions or data to take into account included the following:

6. The discount rate or interest rate for the investment can vary. For simplicity, given the many assumptions involved, a fixed rate of 5 percent was considered.

7. The extra cost of the accessible features introduced was estimated by the local teams at an average of US$687. Many circumstances influenced this amount, but only this average cost was used for the calculations.

8. In terms of the time to amortize the investment, a five-year period was considered.

What was the final verdict about the effectiveness of investing in UA for the Baciro toilet facility?
As mentioned in section 1, above, investment in universally accessible features in kelurahan Baciro’s toilet would become cost effective when the net present value of the investment (NPV) equaled 0. This would depend on having a minimum number of users of the accessible toilet that could amortize the investment in the number of years considered so that the present value of averted costs minus the investment costs equaled 0. Any additional encumbered person using the accessible toilet facility would take the investment into positive returns, or social benefits. The opposite would happen (negative returns) if less than that number would finally use the accessible toilet.

We have considered two scenarios, based on the assumptions already mentioned:

- Professional and conservative assistance: users make only one 15-minute visit to the toilet per day, and the cost considered for personal assistance is equal to the full hourly salary of professional caregivers.

- Family and intensive assistance: users make three 30-minute visits to the toilet per day, and the cost considered for personal assistance (provided by family members) is 25 percent of the hourly salary of professional caregivers.

In the first (conservative) scenario, the personal assistance cost, calculated at professional value, was higher and the number of uses and time devoted to sanitation lower. The second portrayed a situation in which at least one member of the family could provide more intensive assistance and the opportunity cost was lower. The results are presented in table 4.3.
Table 4.3. Two Scenarios for Calculating the Effectiveness of UA investment in the Baciro Toilet Facility

<table>
<thead>
<tr>
<th>Variables</th>
<th>Professional (conservative) assistance</th>
<th>Family (intensive) assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of daily services</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>No. of minutes of assistance per service</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>No. of hours of personal assistance saved by UA per person-year</td>
<td>91.25</td>
<td>547.5</td>
</tr>
<tr>
<td>Annual professional assistance salary</td>
<td>US$1,783</td>
<td>US$1,783</td>
</tr>
<tr>
<td>Hourly cost</td>
<td>US$0.97</td>
<td>US$0.24</td>
</tr>
<tr>
<td>Investment (cost of UA features)</td>
<td>US$687</td>
<td>US$687</td>
</tr>
<tr>
<td>Discount rate</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Amortization</td>
<td>5 years</td>
<td>5 years</td>
</tr>
<tr>
<td>No. of daily users for NPV = 0</td>
<td>1.59</td>
<td>1.06</td>
</tr>
</tbody>
</table>

What can we conclude from the analysis?
The cost-effectiveness analysis of the UA pilot project in Baciro found that, under the cost conditions mentioned, only about two encumbered persons needed to use the accessible toilet facility daily to make it cost effective when compared to the option of requiring personal assistance. Obviously, under real conditions, the encumbered persons living near the facility could differ greatly in their needs and family circumstances, so the costs avoided by having an accessible toilet would differ accordingly. Also, the area of influence needed to conduct the analysis was larger than would actually be desirable, as most persons demand that a shared toilet facility be within 30 meters of their homes. In any situation, however, and assuming the costs for the UA implementation to be around US$700, the calculations show that a very small number of encumbered users would make the investment cost effective if full autonomy were achieved through it and personal assistance could be fully avoided.

In terms of policy recommendations, the following can be highlighted:

- To make the right choice among different alternatives for the installation of UA toilet facilities, the analysis of demand (considering the density and types of the population of potential beneficiaries, pathways to the location of the facility, barriers to quick access around it, and so on) is important. Nonetheless, the presence of only a very few encumbered dwellers is needed to make the additional investment cost efficient.
• Reducing the cost of the UA features is key and should be addressed in parallel to the deployment of accessible toilets. Based on the data used in the analysis, finding an economic justification for adding 40 percent to the regular costs of toilet facility construction due to the UA features may seem difficult. By using local technologies and productive resources, however, inputs can be considerably reduced. Also, through economies of scale, the generalization of the accessibility of toilets can help to improve knowhow and normalize designs and construction techniques, which will help bring about a sensible reduction of unit prices.

• An added priority should be to create awareness regarding the relevance and benefits for all the population of having accessible toilet facilities. People in the area need to understand the reasons for incorporating the different features and how to make a good use of them so the benefits are not lost to bad management or inappropriate use.
5. Pilot Project B: Street Rehabilitation in Kelurahan Kemijen, Semarang

Those cities that have failed to integrate the multi-functionality of streets tend to have lesser infrastructure development, lower productivity, a poorer quality of life [and] social exclusion and [they] generate inequalities in various spheres of life.

— UN-Habitat 2013, iv

The second project to be valued, pilot project B, was the rehabilitation of a local connecting street in Kemijen, Semarang, mainly involving the addition of new pedestrian infrastructure (see figure 5.1). The main purpose of the intervention was to provide a safe and accessible sidewalk on one side of the street, ramped or raised crosswalks, a roadway with defined edges for cars, installed lighting, and accessible pedestrian signals.

**Figure 5.1. Road and Sidewalk Design for Kelurahan Kemijen**

Some of these features were not directly or solely intended as accessibility improvements; rather, they were to improve safety, provide alternatives to private cars, promote good health through walking and biking, create a sense of place, increase...
Streets and street networks are major contributors to neighborhood walkability. Improved health is, to some extent, a fortunate byproduct of decisions that make neighborhoods more walkable and, ultimately, more livable.

Social interaction, and improve adjacent properties. The purpose of the study, however, was to develop a cost-efficiency analysis of the intervention from the perspective of the accessibility improvements. It focused exclusively on those features directly associated with potential use of the street by all persons, regardless of their functional capacities.

Public space mobility: UA versus personal support services for PRMs

Although the obvious function of a street is to move people and vehicles along from point A to point B, it relates to a great many other functions and outcomes, widely covered in the scientific literature. Walking is probably the most significant function, particularly in terms of its implications for health and activity. Streets and street networks are major contributors to neighborhood walkability. Improved health is, to some extent, an externality or fortunate byproduct of decisions that make neighborhoods more walkable and, ultimately, more livable (Veermann et al. 2016).

But streets serve a variety of purposes besides providing access for either motorized or nonmotorized transportation. A critical component of street life is how streets are used as public venues for exchange—social exchange, economic exchange, even political and cultural exchange (Carmona et al. 2017). Persons with disabilities are excluded from those exchanges when they are not allowed to use the streets in a proper and safe way.

Working is probably the first activity that comes to mind when considering an adult person going out of the home. Street infrastructure is very relevant to finding and keeping jobs. A 2010 survey conducted by researchers at the Alan M. Voorhees Transportation Center of New Jersey found that infrastructure issues between home and the nearest public transit station or stop were a concern of many respondents with disabilities who were actively seeking employment. The proportion of those dissatisfied with infrastructure conditions exceeded those reporting satisfaction by 10 to 15 percentage points for each of the environmental conditions reviewed: sidewalks, street crossings and intersections, and street lighting (DiPetrillo et al. 2016). This might
Impact of Universal Accessibility in Tertiary Infrastructure Projects of Indonesia and the KOTAKU Project

partially explain the fact that only 44.6 percent of persons with disabilities (compared to 70 percent of those without disabilities) try to engage in the formal labor market, according to the International Labour Organization (ILO 2017).

A significant proportion of citizens need personal assistance to travel on foot. Some are older persons; others are younger persons with disabilities or those who are temporarily encumbered. All seek to pursue activities that are key in their lives, whether to improve their health, work, seek jobs or study, or simply buy food. Getting out of the house and moving along the street is, therefore, deemed a functional goal, an activity of daily living (ADL) that most people simply take for granted but others require help to carry out. The need for help—or assistance—will depend on the quality of the street environment, the barriers to mobility and orientation and the safety issues that can be found along the way.

The key to assessing the cost effectiveness of UA improvements in the Semarang street was to understand their impact with respect to those encumbered neighbors who required full assistance to move along it. Once the improvements were done, a certain number of those neighbors would be able to use the street on their own (in some cases using mobility support devices, such as wheelchairs or crutches), and the need for personal assistance would be reduced. For the assessment, the savings in assistance cost over time were compared to the initial UA investment. The NPV of the investment depended on the number of beneficiaries, or users of the street, whose need for personal support was reduced by the improved accessibility. As with the toilet facility project in Baciro, the key measure of effectiveness was the number of users that would make NPV equal 0.

Description of the project: Location and UA features

The kelurahan Kemijen local street that was renovated under the KOTAKU-DFAT project links houses and small businesses and also provides access to narrow alleys that reach the inner part of the neighborhood. In addition, the diversity of activities that take place along it also demonstrates the street’s importance to living in the neighborhood, shopping for groceries and other goods, running small local services there, such as mechanics’ workshops, and so forth.

The street is currently used mostly by motorbikes and pedestrians, but increasing motorization in the area was expected to lead to more traffic from cars or heavier vehicles that would have made its use by pedestrians, particularly those with functional limitations, more difficult or unsafe if the street had remained unimproved. Despite its smallness, the inclusion of sidewalks equipped with tactile paving along the whole street, as well as other accessibility features, was important to prevent accidents and create a separate, continuous, barrier-free and safe area for those members of the population in greater need of protection.
Maps 5.1 and 5.2 show the exact position of the project and the different municipal divisions.

**Map 5.1.** The Kelurahan Kemijen Accessible Street Location in Semarang

**Map 5.2.** Graphic Analysis of the Population Living in the buffer zone
The renovations carried out under the project included the addition of paved sidewalks along some parts of the street (see photo 5.1). Since the street is bordered on one side by a water canal, people walk (and a sidewalk was needed) only on the other side. Tactile paving was installed on the renovated strips of the street, including directional and warning tiles wherever necessary. Decorative poles and lamps were also installed for night lighting (Figure 5.2).

**Photo 5.1.** Part of Kelurahan Kemijen Street after the Intervention

![Part of Kelurahan Kemijen Street after the Intervention](image)

**Figure 5.2.** UA Improvement Diagram (Before and After)

![UA Improvement Diagram](image)

---

18. A 2014 study has suggested that to increase walking by residents of low-density cities, retrofitting cities by installing at least one sidewalk on all streets is more cost effective than installing sidewalks on both sides of each street (Gunn 2014).
The costs of UA in the Kemijen Street

The main cost items for UA implementation in the project were sidewalk construction, signage, and street lighting. In all three cases, these elements were new—that is, no previous infrastructure of that kind had previously existed along the street.

Table 5.1 presents the two options for renovation considered. One was a basic paved sidewalk with no UA elements, which we included for comparison purposes, and the other a UA comprehensive renovation. The cost difference between them was almost US$4,000. The difference covered infrastructural features, such as streetlights and signage, that would serve general purposes in addition to addressing UA needs. Since the renovation as a whole went beyond the limits of UA implementation, our analysis of it was associated with the concept of the “complete street,” as described by Burlacu and Tărîţă-Cîmpeanu:

The “Complete Streets” concept was implemented first in North America, where streets are designed and operated to enable safe, attractive and comfortable access and travel for all users, including pedestrians, bicyclists, motorists and public transport users of all ages and abilities.

— Burlacu and Tărîţă-Cîmpeanu 2012, 1

Table 5.1. Costs for the Kemijen Street Project, With and Without UA plus Complete Streets Features

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>Original cost (basic paved sidewalk) US$</th>
<th>Complete streets infrastructure cost US$</th>
<th>Cost difference US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalk addition</td>
<td>3,538.45</td>
<td>4,584.84</td>
<td>1,046.40</td>
</tr>
<tr>
<td>Signage and wayfinding</td>
<td></td>
<td>24.14</td>
<td>24.14</td>
</tr>
<tr>
<td>Street lights and lamp</td>
<td></td>
<td>2,877.11</td>
<td>2,887.11</td>
</tr>
<tr>
<td>Total</td>
<td>3,538.45</td>
<td>7,496.09</td>
<td>3,957.64</td>
</tr>
</tbody>
</table>

The idea behind using the Complete Streets concept here is to emphasize that the costs of some particular features were not solely related to accessibility because the scope of the intervention was wider. Proponents of Complete Streets policies claim they improve safety, lower transportation costs, provide alternatives to private cars, encourage health through walking and biking, create a sense of place, improve social interaction, and generally improve values of properties adjacent to the roads (Burlacu and Tărîţă-Cîmpeanu 2012).
Cost-effectiveness analysis of UA on street used by encumbered persons

As with the toilet facility project analyzed previously, a valuation framework needs to be set to determine the cost effectiveness of introducing UA criteria to the renovation of a local street. In this case, it starts with the consideration that the elderly and encumbered people living in the area of influence (within 100 meters of the street) are regular users of that street, for one reason or another: walking, shopping, social life, work, schooling, and so on. To perform these regular routines, they walk an average of 300 meters along the street per day (based on estimations in the academic literature of distances walked daily by older people). And they move at speeds averaging 0.5 to 0.8 meters per second.

With UA criteria included in the renovation project, elderly and encumbered neighbors would be able to use the street on their own (in some cases, with the help of assistive devices or technologies, such as wheelchairs). Otherwise, they would need the help of professional caregivers or family members to cover the same distance. Since both options—autonomous or assisted use of the street—lead to similar outcomes, the utility they provide is considered equivalent.

In practice, what increased UA would mean is that personal assistance would not be necessary anymore, and that would produce savings—that is, the cost of the hours of assistance no longer needed. Those savings would contribute to the amortization of UA investments. Hence, when the NPV (net present value) of UA improvement equals 0 or a positive value, that improvements become cost effective.

The following summarizes the necessary assumptions underlying this valuation framework:

- Encumbered persons need assistance when they walk along the street, except when barriers to UA are suppressed. This assumption is quite logical, considering the purpose of the research: to isolate the effects produced by UA so as to evaluate its costs and benefits. The main consequence of UA is to achieve equality of opportunity to perform different activities and gain the freedom to perform them autonomously.
- To use the street and obtain from it a similar degree of utility, all encumbered persons need the same UA features included in the intervention.
- The average distance to cover daily and the time devoted to it are fixed. Obviously, this may vary, but to cover most situations the amounts of assistance time used for the calculations are set at very low levels.
- The opportunity cost of the caregiver is valued at a fraction of the minimum wage rate. That rate is presumed not to change over the course of the investment redemption.
- Last, the costs of operation and maintenance of the street to retain its UA features through the years are not included in the analysis. They are considered residual.
**How many users were considered?**
The beneficiaries of UA improvement include all those who can benefit from a more user-friendly environment. It has been discussed already how a great many citizens can benefit directly or indirectly from universal designs and better usability of streets and their elements, such as urban furniture, curb cuts, or lighting. As also was previously explained, persons with reduced mobility (PRMs) are particularly sensitive to such improvements. Table 5.2 presents population data for the area of influence for the Kemijen street project, including the numbers of PRMs residing there.

**Table 5.2. Estimation of General Population and PRMs Living in the Street’s Area of Influence**

<table>
<thead>
<tr>
<th>Numbers living in area of influence</th>
<th>Data from MPWH (neighborhood subunit/RT)</th>
<th>Data from WorldPop 2022 (100 m radius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>288</td>
<td>627</td>
</tr>
<tr>
<td>Households</td>
<td>80</td>
<td>NA</td>
</tr>
<tr>
<td>Persons with physical disabilities</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>Children (ages 0-14)</td>
<td>54</td>
<td>121</td>
</tr>
<tr>
<td>Older persons (ages 65+)</td>
<td>27</td>
<td>61</td>
</tr>
<tr>
<td>PRMs</td>
<td>44</td>
<td>108</td>
</tr>
<tr>
<td>Population density</td>
<td>NA</td>
<td>93.9</td>
</tr>
</tbody>
</table>

In practice, only a fraction of those represented in the table may have needed assistance. To gain a better understanding of the real need, we also referred to previous research. Shumway-Cook and others (2002), for example, found that older adults with mobility disabilities require more assistance, and they travel unaccompanied less than 24 percent of the time. This observation led to our next question:

**How much time is needed to help PRMs or encumbered persons move along a street that is not accessible? And how do we value that time?**

Our calculations of the time devoted by personal assistants to helping encumbered persons walk certain distances at certain speeds needed to be consistent with the calculations appearing in other studies, such as those included in the systematic review of the literature on older adults by Salbach and others. The results reported were highly variable, depending on functional and environmental conditions:
Walk distance requirements range from 16 to 677m, depending on the community destination. Walk distances from 20 to 381m are required to reach community sites that older adults report frequently visiting, compared with distances exceeding 560m for club warehouses, superstores, or hardware stores. Crosswalk speed requirements range from .44 to 1.32m/s, appear to vary by country, and increase with increasing population size. Findings are directly relevant to judging the capacity for community ambulation.

— Salbach et al. 2014, 127

In consideration of the urban conditions and length of the renovation in kelurahan Kemijen, our analysis used the walking distance values reported by Shumway-Cook and others (2002), according to whom older adults (with or without disabilities) walk, on average, 300 meters (900–1,000 feet) while performing such IADL tasks as shopping or visiting health care providers.

For walking speeds, we relied on empirical studies by Romero-Ortuno (2010) for the European statistical project SHARE.20 They showed that among people ages 75 and older, 17.2 percent of men and 26.6 percent of women walked at speeds below 0.4 meters per second.

Based on those values—300 meters at 0.4 meters per second—we calculated that 12.5 minutes would be needed for an old or disabled person to walk the length of the street under renovation with the help of a personal assistant. Another 10 minutes was added to roughly cover the time needed to walk from home to the street.

As with the toilet facility analysis, we also had to consider that the costs would differ depending on whether the encumbered persons were helped by professional assistants or family members. We calculated the costs under both circumstances, based on the assumption that professional assistants were paid the full salary, while for family assistance only the opportunity cost should be considered. We hypothesized that this opportunity cost would be 25 percent of the full salary.

Table 5.3 summarizes all the data needed for the calculation of the number of users that can take the NPV of the project to equilibrium (NPV = 0).

**Table 5.3. Two Scenarios for Calculating the Effectiveness of UA Investment in the Kemijen Street**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Professional assistance</th>
<th>Family assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average walking distance for IADLs (shopping/visiting health care providers)</td>
<td>300 m</td>
<td>300 m</td>
</tr>
<tr>
<td>Walking speed of frail older person</td>
<td>0.4 m/s</td>
<td>0.4 m/s</td>
</tr>
<tr>
<td>Walking time/day (time of service)</td>
<td>12.5 minutes</td>
<td>12.5 minutes</td>
</tr>
<tr>
<td>Walking time/year (time of service)</td>
<td>76 h</td>
<td>76 h</td>
</tr>
<tr>
<td>Annual professional assistance salary Semarang</td>
<td>US$2,069</td>
<td>US$2,069</td>
</tr>
<tr>
<td>Per hour professional assistance salary</td>
<td>US$1.12</td>
<td>US$1.12</td>
</tr>
<tr>
<td>Hourly cost adjusted for family assistance</td>
<td>US$1.12</td>
<td>US$0.28</td>
</tr>
<tr>
<td>Investment (cost of accessibility)</td>
<td>US$3,958</td>
<td>US$3,958</td>
</tr>
<tr>
<td>Discount rate</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Amortization</td>
<td>15 years</td>
<td>15 years</td>
</tr>
<tr>
<td><strong>No. of daily users for NPV = 0</strong></td>
<td><strong>5.74</strong></td>
<td><strong>22.98</strong></td>
</tr>
</tbody>
</table>

In summary, our analysis found that investment in UA improvements (bundled with other “Complete Streets” features) would be economically effective if the numbers of encumbered persons using the street on an average day were greater than the values showed at the bottom of the table: more than six or more than 23 users, depending on the hourly cost of assistance considered (at professional versus family levels).

Obviously, if the opportunity cost for family members were higher, the number of daily users needed to make the UA investment effective would be lower. Other variables, such as average speed of walking, would have a direct impact as well, because they determine the time and total cost of the assistance services. The time assigned to cover the 300 meter distance is very conservative and does not include the time used on instrumental activities (shopping, working, speaking with neighbors, and so on) carried out on the street. The only time considered is that needed to reach—using the sidewalk with the help of the assistant—the places where those activities take place.

In the end, what the analysis shows is that the most important factor for effectiveness is urban density, as the largest number of regular users will produce the highest return on investments made to improve the walking and safety conditions of the street.
6. Graphic Description of the Process Followed

Figure 7.1 summarizes the problem approach, methodology, and solutions used to examine the economic rationale for investing in UA improvements in KOTAKU tertiary infrastructure projects. It shows the process that was followed and demonstrates how UA solutions can be cost effective even if only a small number of users is considered. The outcomes shown for the two pilot projects are similar: the cost of UA solutions is low relative to the costs of assistance time needed when these solutions are not provided.

**Figure 7.1.** Cost Effectiveness of UA Implementation in Two Pilot Projects: Flowchart of the Process

Note: Cost-effectiveness analysis compares the costs and other effects of an intervention to assess the extent to which it can be regarded as providing value for money. This informs decision makers who have to determine where to allocate limited resources.
Final Comments After the CEA of Both Pilot Projects

We should not forget the final purpose of this analysis: Where universal accessibility is lacking, the vulnerable community—the elderly, persons with disabilities, and others—is discouraged from using shared facilities. Providing UA to facilities and infrastructure might cost more than not providing it, but, from a social value perspective, the benefits or increased effectiveness that result from those costs can also be higher. This work sought to prove that assertion.

The economic benefits resulting from the implementation of UA measures in KOTAKU projects throughout Indonesia could not be measured directly, so we set out instead to analyze two different projects that might be representative of many others in the areas of sanitation facilities and urban infrastructure. Such analysis of pilot projects can provide a straightforward way to assess the economic impact of UA.

For both pilot projects, we were able to perform cost-effectiveness analysis (CEA) by considering UA implementation along with another option—that of providing personal assistance to persons with disabilities—which, in practice, provides a comparable result in terms of individual utility. The measure of effectiveness is the possibility of achieving the same outcome at a lower price, with the outcome being the ability to use the toilet or walk along a street to reach a destination in the neighborhood autonomously. The UA alternative is the one that enables users to carry out the activities on their own, while the other alternative (or doing nothing) presents environmental barriers that necessitate being assisted by someone else to get the same outcome.

The results are expressed as the minimum number of encumbered users of the UA solution needed for the savings—counted as the costs of personal assistance avoided—to compensate for the additional investment. This means that the net present value of the investment would need to equal zero (NPV = 0). As it happens, in the first case, one or two encumbered persons (depending on assumptions regarding the cost of personal assistance) would need to be using the accessible toilet regularly for cost effectiveness to be reached. In the case of the local street, six or twenty-three encumbered neighbors (also depending on those assumptions) would be needed to be using it. Higher numbers than these would result in positive returns of the UA option against the alternative (all the other conditions being equal).

Whether those numbers are high or low depends on the reader’s perspective, but, considering the number of residents in the areas of influence, they do not seem high—in other words, UA implementation has been cost effective in both pilot cases. Of course, the results of such analysis depend on the series of assumptions made. The demographic expectations go in the direction of an increasing need for UA
improvements from now on. Based on the limited knowledge available about the local communities around the renovated facilities, the numbers of users generated from these CEAs do not reflect all those who will benefit from the projects. And, as has been discussed, other benefits related to UA provision have not been considered here.

This double case analysis offers some indications of how we might scale up the positive elements of these small-scale projects and improve the conditions under they can provide positive CEA results—that is, the ways in which UA innovations can be expanded and institutionalized or otherwise promoted and managed. An effective scaling-up strategy must be based on a careful assessment of the innovation (the UA features), the number of potential users (the urban density), and the conditions for its correct implementation, including the training of designers and administrative staffs and the improvement of the institutional environment.

At the same time, the strategy must address key choices, such as the type of scaling up intended, the dissemination and advocacy approach, and the instruments needed to replicate good practice. Choices must also be made regarding resource mobilization and monitoring and evaluation. One limiting factor of urban interventions (such as those of KOTAKU and other urban renewal programs) may be that they occur in relatively uncertain and unstable environments, with few repetitive decisions (Maculan and Dal Moro 2020). In such environments, many agencies, departments, governments, and other entities are at work, together with a variety of end users. Standardization of processes, user participation, and training are good remedies to apply.

As a final thought, it is to be expected that any modernization of the urban infrastructure will result in better conditions of access, connection, and integration of the renovated environments for the final users. But what sometimes is forgotten, in the practice of urban planning or project design and execution, is that the word “user” does not define a person but, rather, an idealized end recipient of the project. Only with an understanding and knowledge of the diverse conditions of the persons behind the “users” can the end results be optimal. UA provides the context and technical solutions to make inclusive environments, in which functional conditions and the diversity of users are considered from the start.
## Annex

### Detailed UA Investment Cost Assumptions (Toilet Facility, Baciro)

<table>
<thead>
<tr>
<th>#</th>
<th>Intervention Type</th>
<th>Intervention Details</th>
<th>Accessible Volume (m³)</th>
<th>Volume Change</th>
<th>Unit Price (IDR)</th>
<th>Unit Price Changes</th>
<th>Original Costs</th>
<th>Accessible facility costs</th>
<th>Individual Feature/Component Cost Difference</th>
<th>Total Cost (Original)</th>
<th>Total Cost (UA)</th>
<th>Total Cost Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adequate free space (interior)</td>
<td>Roof beam extension (concrete &amp; steel)</td>
<td>0.382</td>
<td>0.408</td>
<td>0.026 m³</td>
<td>IDR 1,115,079.00</td>
<td>IDR 1,115,079.00</td>
<td>IDR -</td>
<td>IDR 454,952.29</td>
<td>IDR 17,841.26</td>
<td>IDR 17,841.26</td>
<td>IDR 454,952.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wall surface expansion</td>
<td>0.120</td>
<td>0.125</td>
<td>0.020 m²</td>
<td>IDR 48,900.00</td>
<td>IDR 48,900.00</td>
<td>IDR -</td>
<td>IDR 22,565.00</td>
<td>IDR 70.00</td>
<td>IDR 70.00</td>
<td>IDR 22,565.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional floor finish (carpet)</td>
<td>0.09</td>
<td>0.10</td>
<td>0.01 m²</td>
<td>IDR 229,000.00</td>
<td>IDR 229,000.00</td>
<td>IDR -</td>
<td>IDR 94,366.10</td>
<td>IDR 94,366.10</td>
<td>IDR 94,366.10</td>
<td>IDR 94,366.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional wall finishes (interior &amp; exterior point)</td>
<td>0.07</td>
<td>0.08</td>
<td>0.01 m²</td>
<td>IDR 32,000.00</td>
<td>IDR 32,000.00</td>
<td>IDR -</td>
<td>IDR 13,966.00</td>
<td>IDR 13,966.00</td>
<td>IDR 13,966.00</td>
<td>IDR 13,966.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roof beam extension (concrete &amp; steel)</td>
<td>0.785</td>
<td>0.811</td>
<td>0.026 m³</td>
<td>IDR 880,999.00</td>
<td>IDR 880,999.00</td>
<td>IDR -</td>
<td>IDR 319,204.15</td>
<td>IDR 7,256.55</td>
<td>IDR 7,256.55</td>
<td>IDR 319,204.15</td>
</tr>
<tr>
<td>2</td>
<td>Adequate free space (exterior terraces)</td>
<td>Floor beam extension (concrete)</td>
<td>0.0</td>
<td>0.027</td>
<td>0.007 m³</td>
<td>IDR 48,500.00</td>
<td>IDR 48,500.00</td>
<td>IDR -</td>
<td>IDR 87,882.75</td>
<td>IDR 87,882.75</td>
<td>IDR 87,882.75</td>
<td>IDR 87,882.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional floor finishes (paving - concrete)</td>
<td>0.096</td>
<td>0.097</td>
<td>0.01 m²</td>
<td>IDR 229,000.00</td>
<td>IDR 229,000.00</td>
<td>IDR -</td>
<td>IDR 46,612.96</td>
<td>IDR 46,612.96</td>
<td>IDR 46,612.96</td>
<td>IDR 46,612.96</td>
</tr>
<tr>
<td>3</td>
<td>Accessible ramp</td>
<td>Earthworks</td>
<td>0.0</td>
<td>0.075</td>
<td>0.007 m³</td>
<td>IDR 48,500.00</td>
<td>IDR 48,500.00</td>
<td>IDR -</td>
<td>IDR 47,726.30</td>
<td>IDR 47,726.30</td>
<td>IDR 47,726.30</td>
<td>IDR 47,726.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indirect access (plaster - concrete working surface)</td>
<td>0.0</td>
<td>0.125</td>
<td>0.01 m²</td>
<td>IDR 48,500.00</td>
<td>IDR 48,500.00</td>
<td>IDR -</td>
<td>IDR 134,236.88</td>
<td>IDR 134,236.88</td>
<td>IDR 134,236.88</td>
<td>IDR 134,236.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional floor finishes (paving - concrete)</td>
<td>0.0</td>
<td>0.273</td>
<td>0.01 m²</td>
<td>IDR 48,500.00</td>
<td>IDR 48,500.00</td>
<td>IDR -</td>
<td>IDR 663,100.08</td>
<td>IDR 663,100.08</td>
<td>IDR 663,100.08</td>
<td>IDR 663,100.08</td>
</tr>
<tr>
<td>4</td>
<td>Continuous railing (interior)</td>
<td>Stainless steel railing</td>
<td>0</td>
<td>0.249</td>
<td>0.029 m²</td>
<td>IDR 89,000.00</td>
<td>IDR 89,000.00</td>
<td>IDR -</td>
<td>IDR 619,750.40</td>
<td>IDR 619,750.40</td>
<td>IDR 619,750.40</td>
<td>IDR 619,750.40</td>
</tr>
<tr>
<td>5</td>
<td>Tactile tiles</td>
<td>Concrete floor finish - tactile tiles</td>
<td>1.294</td>
<td>1.333</td>
<td>0.026 m²</td>
<td>IDR 239,000.00</td>
<td>IDR 239,000.00</td>
<td>IDR -</td>
<td>IDR 384,746.72</td>
<td>IDR 249,778.84</td>
<td>IDR 104,967.88</td>
<td>IDR 104,967.88</td>
</tr>
<tr>
<td>6</td>
<td>Door widening</td>
<td>Door beam extension (concrete)</td>
<td>0.395</td>
<td>0.408</td>
<td>0.013 m³</td>
<td>IDR 1,115,079.00</td>
<td>IDR 1,115,079.00</td>
<td>IDR -</td>
<td>IDR 454,952.29</td>
<td>IDR 17,841.26</td>
<td>IDR 17,841.26</td>
<td>IDR 454,952.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Door replacement</td>
<td>1.193</td>
<td>1.212</td>
<td>0.019 m²</td>
<td>IDR 1,115,079.00</td>
<td>IDR 1,115,079.00</td>
<td>IDR -</td>
<td>IDR 454,952.29</td>
<td>IDR 17,841.26</td>
<td>IDR 17,841.26</td>
<td>IDR 454,952.29</td>
</tr>
<tr>
<td>7</td>
<td>Accessible door accessories</td>
<td>Door knob + handle, include 1 set of key</td>
<td>1</td>
<td>1</td>
<td>0 per unit</td>
<td>IDR 279,100.00</td>
<td>IDR 279,100.00</td>
<td>IDR -</td>
<td>IDR 279,100.00</td>
<td>IDR 279,100.00</td>
<td>IDR 279,100.00</td>
<td>IDR 279,100.00</td>
</tr>
<tr>
<td>8</td>
<td>Accessible bathroom fittings</td>
<td>Squeaking toilet + sitting toilet</td>
<td>1</td>
<td>1</td>
<td>0 per unit</td>
<td>IDR 502,500.00</td>
<td>IDR 502,500.00</td>
<td>IDR -</td>
<td>IDR 585,376.50</td>
<td>IDR 585,376.50</td>
<td>IDR 585,376.50</td>
<td>IDR 585,376.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grip bars / interior handrails (horizontal &amp; vertical)</td>
<td>0</td>
<td>5</td>
<td>0.5 m</td>
<td>IDR 1,000.00</td>
<td>IDR 1,000.00</td>
<td>IDR -</td>
<td>IDR 1,000.00</td>
<td>IDR 1,000.00</td>
<td>IDR 1,000.00</td>
<td>IDR 1,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bathroom sink</td>
<td>0</td>
<td>1</td>
<td>1 per unit</td>
<td>-</td>
<td>-</td>
<td>IDR 1,111,790.00</td>
<td>-</td>
<td>1,111,790.00</td>
<td>1,111,790.00</td>
<td>1,111,790.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shower / jet spray</td>
<td>0</td>
<td>1</td>
<td>1 per unit</td>
<td>-</td>
<td>-</td>
<td>IDR 1,111,790.00</td>
<td>-</td>
<td>1,111,790.00</td>
<td>1,111,790.00</td>
<td>1,111,790.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light points</td>
<td>0</td>
<td>2</td>
<td>2 per unit</td>
<td>IDR 272,945.00</td>
<td>IDR 272,945.00</td>
<td>IDR -</td>
<td>IDR 545,890.00</td>
<td>IDR 545,890.00</td>
<td>IDR 545,890.00</td>
<td>IDR 545,890.00</td>
</tr>
<tr>
<td>9</td>
<td>Washing space floor area reduction</td>
<td>Concrete finish</td>
<td>13.99</td>
<td>13.263</td>
<td>2.737 m²</td>
<td>IDR 239,000.00</td>
<td>IDR 239,000.00</td>
<td>IDR -</td>
<td>IDR 3,791,088.10</td>
<td>IDR 3,791,088.10</td>
<td>IDR 3,791,088.10</td>
<td>IDR 3,791,088.10</td>
</tr>
</tbody>
</table>

**Notes**
- **Internal cost increase**: Roof beam reinforcement unit price IDR 145,800.00 / m²
- **Internal cost decrease**: Roof beam reinforcement unit price IDR 145,800.00 / m²
- **Internal references used**: [IDR 145,800.00](https://www.tokopedia.com/bbrv85trok-road-odezaw-safety-rubber-tile-binder-tactile-paving-tile/renteza)
- **approx. midpoint price from tokopedia**: Tactile tiles (30x80x4 cm) IDR 29,000.00 / m²
- **approx. midpoint price from tokopedia**: Round handle IDR 279,100.00 / piece
- **approx. midpoint price from tokopedia**: L-type door handles IDR 295,000.00 / piece

---

Impact of Universal Accessibility in Tertiary Infrastructure Projects of Indonesia and the KOTAKU Project
### Detailed UA (Complete Street) Investment Cost Assumptions (Street, Kemijen)

<table>
<thead>
<tr>
<th>#</th>
<th>Intervention Type</th>
<th>Intervention Details</th>
<th>Original Volume (est)</th>
<th>Accessible facility Volume (est)</th>
<th>Unit Volume Changes</th>
<th>Unit price (IDR)</th>
<th>Unit Price Changes</th>
<th>Original costs (IDR)</th>
<th>Accessible facility costs (IDR)</th>
<th>Total Cost (IDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Sidewalk addition</td>
<td>Earthworks (soil grade, incl. compaction)</td>
<td>20</td>
<td>10 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 175,180.00</td>
<td>IDR 175,180.00</td>
<td>IDR 175,180.00</td>
<td>IDR 3,456,360.00</td>
<td>IDR 3,456,360.00</td>
<td>IDR 3,456,360.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plastic cover base for concrete works</td>
<td>100</td>
<td>10 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 2,222,000.00</td>
<td>IDR 2,222,000.00</td>
<td>IDR 2,222,000.00</td>
<td>IDR 4,444,000.00</td>
<td>IDR 4,444,000.00</td>
<td>IDR 4,444,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steel reinforcement (4 mm dia 35 x 35 cm wiremesh)</td>
<td>300</td>
<td>100 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 1,416,715.00</td>
<td>IDR 1,416,715.00</td>
<td>IDR 1,416,715.00</td>
<td>IDR 4,249,145.00</td>
<td>IDR 4,249,145.00</td>
<td>IDR 4,249,145.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concrete working surface K-175</td>
<td>100</td>
<td>1,0 m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>IDR 3,998,200.00</td>
<td>IDR 3,998,200.00</td>
<td>IDR 3,998,200.00</td>
<td>IDR 7,996,400.00</td>
<td>IDR 7,996,400.00</td>
<td>IDR 7,996,400.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Street paving (colored street paving)</td>
<td>100</td>
<td>10 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 3,296,096.00</td>
<td>IDR 3,296,096.00</td>
<td>IDR 3,296,096.00</td>
<td>IDR 6,592,192.00</td>
<td>IDR 6,592,192.00</td>
<td>IDR 6,592,192.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Curb stones</td>
<td>100</td>
<td>100 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 8,944.75</td>
<td>IDR 8,944.75</td>
<td>IDR 8,944.75</td>
<td>IDR 17,889.50</td>
<td>IDR 17,889.50</td>
<td>IDR 17,889.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tactile tiles</td>
<td>0</td>
<td>30 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 516,796.02</td>
<td>IDR 516,796.02</td>
<td>IDR 516,796.02</td>
<td>IDR 1,541,390.06</td>
<td>IDR 1,541,390.06</td>
<td>IDR 1,541,390.06</td>
</tr>
<tr>
<td>2</td>
<td>Signage &amp; wayfinding</td>
<td>Signage (no vehicles allowed on sidewalk)</td>
<td>0</td>
<td>1 unit</td>
<td>IDR 2,000,001.00</td>
<td>IDR 2,000,001.00</td>
<td>IDR 2,000,001.00</td>
<td>IDR 4,000,002.00</td>
<td>IDR 4,000,002.00</td>
<td>IDR 4,000,002.00</td>
</tr>
<tr>
<td>3</td>
<td>Street lights</td>
<td>Street lights + lamps</td>
<td>0</td>
<td>100 m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>IDR 2,222,000.00</td>
<td>IDR 2,222,000.00</td>
<td>IDR 2,222,000.00</td>
<td>IDR 4,444,000.00</td>
<td>IDR 4,444,000.00</td>
<td>IDR 4,444,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concrete works K-175</td>
<td>0</td>
<td>1,0 m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>IDR 3,416,455.57</td>
<td>IDR 3,416,455.57</td>
<td>IDR 3,416,455.57</td>
<td>IDR 6,832,911.14</td>
<td>IDR 6,832,911.14</td>
<td>IDR 6,832,911.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steel reinforcement</td>
<td>0</td>
<td>532 kg</td>
<td>IDR 17,889.50</td>
<td>IDR 17,889.50</td>
<td>IDR 17,889.50</td>
<td>IDR 35,779.00</td>
<td>IDR 35,779.00</td>
<td>IDR 35,779.00</td>
</tr>
</tbody>
</table>

Total UA Improvement Costs: IDR 51,307,472.50

(IDR 1,066,282.07)  (IDR 57,380,809.57)
References


Impact of Universal Accessibility in Tertiary Infrastructure Projects of Indonesia and the KOTAKU Project


