Springer Transactions in Civil
and Environmental Engineering

Fumihiko Seta
Arindam Biswas
Ajay Khare
Joy Sen *Editors*

Understanding Built Environment

Proceedings of the National Conference on Sustainable Built Environment 2015

Springer

Springer Transactions in Civil and Environmental Engineering

More information about this series at http://www.springer.com/series/13593

Fumihiko Seta • Arindam Biswas
Ajay Khare • Joy Sen
Editors

Understanding Built Environment

Proceedings of the National Conference on Sustainable Built Environment 2015

Springer

Editors
Fumihiko Seta
Department of Urban Engineering
The University of Tokyo
Tokyo, Japan

Arindam Biswas
Department of Architecture & Planning
IIT Roorkee
Roorkee, Uttarakhand, India

Ajay Khare
School of Planning and Architecture
Bhopal, MP, India

Joy Sen
RCG School of Infrastructure Design and Management
Department of Architecture and Regional Planning
IIT Kharagpur
Kharagpur, WB, India

ISSN 2363-7633 ISSN 2363-7641 (electronic)
Springer Transactions in Civil and Environmental Engineering
ISBN 978-981-10-2136-7 ISBN 978-981-10-2138-1 (eBook)
DOI 10.1007/978-981-10-2138-1

Library of Congress Control Number: 2016955548

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #22-06/08 Gateway East, Singapore 189721, Singapore

Preface

Built environment is regarded as a discipline which discusses human intervention that reshapes natural settings on earth. It is desired that human intervention is minimal and can coexist with nature, but the reality is somewhat different. At this moment when the global future is at stake with increasing population, random urbanization, threat of climate change, social and economic inequality, poverty, deprivation and violence, the response from human race is mediocre. The issues have been raised in several platforms but not in the magnitude which it deserves. Many times the issues are forgotten in the aftermath or even in the absence of a significant platform. But we were determined to follow up the deliberations of the august gathering for Sustainable Built Environment 2015 conference at the sprawling campus of IIT Roorkee during April 10–12, 2015. The aim was to garner more meaningful contribution towards the society and nature, which anchors our very existence. We have walked the extra mile during the difficult journey with lots of discussions, debate and argument and to finally come in a position to publish a document, which is a living manifestation of a divine bliss to enhance knowledge, capability and creativity among the readers. We hope that the ethos of this publication and every word printed in this book will further spread among the society to enhance more knowledge and built innovative ideas to achieve a sustainable and resilient built environment.

India is one of the countries which are at the centre stage of evolution and has all the plights of present global development concerns. Her population is 1.2 billion and rising fast; half of her population is going to be urban by 2030; 22 % of her population survives below $1.25 a day; it's very much prone to natural disaster and recognized as one of the countries to be severely affected due to climate change; and her citizen faces social, economic, gender, religious and political violence. Within this backdrop, the point of discussion for planners and architects needs to be responsive and socially responsible. And so is the sole aim of this book. It discusses Indian context in various dimensions of growth and development and our understanding towards built environment. Spatial patterns are influenced by various contextual parameters which in turn reflect in shaping the image of the city and its specific social, cultural and architectural expression. Long enduring division between urban

and rural region is gradually fading away, at least with the emerging extent of communication, networking and globalization. But the economic disparity still exists in developing countries like India. However, from the past couple of decades or so there is increasing urge in India to connect habitable environment more to achieve better quality of life. This is the era which experienced much focused attention towards comprehensive planning and designing built environment than ever before. Even legislative framework to back up the development process improved with globalization and decentralization. Urban reform, efficiency in service delivery, financing development projects, infrastructure development and resource utilization with smart initiatives are few of the hallmark initiatives in the recent times.

The editors ensure that the book critically endures every word and see that all the efforts by the contributors become audible to a greater society. The purpose of this approach is to make it more holistic rather focusing on only one dimension of built environment. We have piece together all the evidences from empirical study to theoretical argumentation and encourage critical views from the contributors. Therefore, it not only records the development process but also showcases careful critique of the focus areas of individual contribution. This book covers architectural advances and sustainable urban regeneration, which have profound impact in understanding built environment. It presents the spatial context which hosts human to survive, enrich, contribute and disseminate. Architectural expressions and urban regeneration are interrelated and have broader implication in cities. But somehow it is also connected in the very root of built environment. This book wishes to touch upon the whole network from small to large that connects built environment and human behaviour. The book receives overwhelming response from the contributors across the country, and they can combine all their ideas, thoughts and contribution in two volumes. A total of 26 contributors have made their marks in this book. Divided into two parts, the book presents their works (14 in part 1 & 8 in part 2) in a precise manner.

Bunkyo-ku, Tokyo, Japan — Fumihiko Seta
Roorkee, Uttarakhand, India — Arindam Biswas
Bhopal, MP, India — Ajay Khare
Kharagpur, WB, India — Joy Sen

Acknowledgement

Acknowledgement is conveyed with a sincere thanks to all of our family members and friends. A special thanks to Prof. Pradipta Banerji (Director IIT Roorkee) and Prof. Ila Gupta (Head, Department of Architecture and Planning, IIT Roorkee) for their encouragement to accomplish the outcome. The students, teachers and staffs of IIT Roorkee deserve all the accolades for being the strength of this platform and the book. Their hard work paved the way for today's culmination. We would particularly like to thank Ms. Rohita Sharma, the then research scholar at the Department of Humanities and Social Science IIT Roorkee, for serving in the conference secretariat, and Ms. Ankita Choudhary, the then MURP student of IIT Roorkee, who carried out secretarial assistance to the editors. At this very occasion, the financial supporters who provide the realistic strength need a special mention from us for enabling this event. We are extremely grateful towards our editor and the rest of the staff at Springer for their patience, continuous guidance, help and suggestion.

We have tried whole heartedly to contact and acknowledge copyright owners. If something or someone is left out, the authors and publisher would be extremely pleased to have any errors or omissions brought to their attention. We will make all the necessary corrections and have them published at a later printing.

Contents

About the Editors

Dr. Fumihiko Seta is currently an associate professor of the Department of Urban Engineering (DUE), Faculty of Engineering at the University of Tokyo. He was born in 1972 in Tokyo, graduated in the University of Tokyo in 1995 and worked at the University of Tokyo from 1998 to 2005 and Osaka City University from 2005 to 2012. His major is urban planning and regional development.

Dr. Arindam Biswas is assistant professor at the Department of Architecture and Planning. He holds a doctorate in Urban Planning from the University of Tokyo. He is the recipient of the DAAD Fellowship and the MEXT Scholarship. His research specializations are on urban and regional planning, inclusive growth, urban policy and governance, resilience and futuristic city planning. He is presently serving as a reviewer for *Development in Practice*, *World Development* and the *Journal of Architectural Engineering* (ASCE).

Professor (Dr.) Ajay Khare founder-director of School of Planning and Architecture, Bhopal, is a Fulbright Fellow and Charles Wallace Fellow. He was the first Indian recipient of Berkeley Teaching Fellowship. Professor Khare served as a member of the Planning Commission working group on Technical education for 12th plan of India. He is a member of the National Executive Committee of the International Council on Monuments and Sites (ICOMOS, India).

Professor (Dr.) Joy Sen is head of RCG School of Infrastructure and Design, IIT Kharagpur. His areas of research are Community and Regional Planning Analyses and Programming and Architecture and Planning. He holds a Ph.D. from IIT Kharagpur and a Master's from Iowa State University. He is currently involved in SandHI project sponsored by MHRD. He is a reviewer of the *Journal of Architecture* and associate editor of *CSVTU Journal*. He has authored five books on Indian Heritage and Iconographic Documentation.

Part I
Land, Housing, and Real Estate

Chapter 1
Accessibility to Health Infrastructure in Hill Settlements: A Case of Shimla

Adwitiya Patro

Abstract Urban areas are spreading their extents rapidly across different geographic conditions and simultaneously affecting the hill topographies. This rampant development brings inequity in terms of access to services, and accessibility being a major factor affecting the livelihoods need special attention. Indian Cities generally has concentration of services in their core, bringing friction for residents living across the city, when accessibility is concerned. In hill cities, the accessibility parameters take account of multiple factors and majorly, topographic factors. Study enquires the relationship between residential choice and accessibility to health amenities for city of Shimla (H.P). As evident in hills, degraded accessibility in such areas can lead to multiple social disorder and sense of insecurity, along with added economic cost. Study measures the network accessibility analysis for health infrastructure in hill areas using FlowMap® and GIS-based tools. In this study it has been tried to analyze how the different residential areas of Shimla perform in terms of network access to hospitals. Which can certainly be used in multiple urban planning decision and in diverse sectors.

Keywords Accessibility • FlowMap® • GIS • Health infrastructure • Shimla

1.1 Introduction

Effects of unplanned urban growth is evident in all major hill cities across India. Indian hills contain around 10% of India's total population, witnessing an unexpected growth largely due to industrialization which induces urbanization into these fragile ecosystems. Of all the hill settlements, once called Queen of Hills, Shimla has lost its pristine glory with rapid urbanization in recent times. As per the article

A. Patro (✉)
CEPT University, Ahmedabad, India
e-mail: adwitiya@live.com

F. Seta et al. (eds.), *Understanding Built Environment*, Springer Transactions in Civil and Environmental Engineering, DOI 10.1007/978-981-10-2138-1_1

by Manjeet Singh, a city earlier designed for 25,000 inhabitants now caters to seven times the number stated above and putting tremendous pressure to urban systems.

Individual travel choice due to lack of access, affect mode of travel which in turn lead to induced poverty as we see in the case of women users from economically backward classes in Delhi's case (Anvita and Geetam 2006).

Thus, as much as the physical infrastructure development in terms of technology and efficiency in urban transport, there is a high need of impetus to be put to the matter that "accessibility" is what we are aiming for, with all these investments.

1.2 Shimla: An Introduction

Shimla is the capital town of Himachal Pradesh with an average elevation of 2205 m (7234 ft) from mean sea level with an area of 25 km^2, having a population of approximately 1.7 lakhs, with a density of 120 per sq.km. Shimla lies in the lower ranges of the Himalayas in its southwest range with a coordinate of 31.61 ON and 77.10 OE (UNDP 2003). The city stretches itself in the east-west direction with a length of around 9.2 km. Shimla is embodied around seven hills, the highest being Jakhoo hills with an elevation of 2454 m. This geographical setup possesses hindrance for regional connectivity with the city. With rapid growth of population and lack of proper transport infrastructure in city and around, this issue of connectivity gets deteriorated progressively. Hospitals like Rippon Hospital and Walker Hospitals were constructed in 1885 and 1906, respectively, which are prominent in the city.

Being in hill topography, Shimla possesses a threat in terms of fragile ecosystem through the rampant development it is going under. So to ensure planned growth and development, GoHP[1] constituted Shimla Planning Area (SPA), as it is mentioned (Sekhar 2011) around 82 % of the population of SPA comes under SMC.[2] Shimla a city with tourism as its primary economic activity, also known for its role in administration, education, heritage city, etc.

As Sashi Sekhar (2011) highlights in his research, Shimla has experienced massive urban pressure as there has been ribbon growth along the roads. Also it has been seen that this population pressure is making built growth in steep slopes too which are unsustainable in many ways. As per the study (Sekhar 2011), he highlights that built-up area except roads in Shimla has grown by 7 %.

Unregulated development in turn affects the quality of life. With JNNURM, efforts have been made to improvise the public transport and housing infrastructure, seem to be futile with no drastic change happening until now (Carol 2012). In a recent study done by Mazta and Thakur (2012), it has been highlighted that due to the lack of accessibility to health infrastructure, villagers in Himachal Pradesh face a lot of health issues.

[1] Government of Himachal Pradesh.

[2] Shimla Municipal Corporation.

Looking at the scenario, study wants to focus on the network accessibility to health infrastructure in Shimla city.

1.3 Health Infrastructure in Hill Areas

As in the study done by Dev Nathan (2004), it has been highlighted that the level of health infrastructure available in hill is significantly poor in comparison to plains. Investments and standards are prepared but hardly has it seemed that factors like accessibility are taken care of. In the research done by Sapkota (2015), it has been found that with increasing time to health infrastructure, access to it decreases which eventually affects human health.

Since health infrastructure varies in scale, the study only considers public hospitals, large-scale private hospitals, and PHCs[3] in correspondence to standards prescribed by URDPFI[4] guideline (as highlighted in Table 1.1), which has been used for studying the requirement and capacity of each health facility.

1.4 Accessibility: Literature

Accessibility has a plethora of meaning and is derived from its Latin root, i.e., "accessus" which means "a coming near." But what we are talking in our context can be defined as "the ease with which services are approached within stipulated amount of time" (which can be a measure of distance). Further according to Geurs and van Eck (2001), accessibility is basically the effort or amount of time that is

Table 1.1 URDPFI standards for health infrastructure

Healthcare facilities			
S/No.	Category	Population served per unit	Distance between two facilities (KM)
1	Dispensary	2500	2–4
2	Health Sub-Centre	3000	2–4
3	Family Welfare Centre	5000	5–10
4	Maternity Home	15,000	5–10
5	Nursing Home	15,000	5–10
6	Primary Health Centre	20,000	16–20
7	Hospital (200–250 beds)	80,000	16–20

[3] Primary Healthcare Centre.

[4] Urban and Regional Development Plans Formulation & Implementation Guidelines.

given for a destination to be reached by a person or activities that can be reached from a particular location.

1.5 Methodology of Accessibility Analysis

For the study we have used activity-based accessibility measures as both space and time factors are taken care of in the study. In this the use of GIS tools and FlowMap®[5] has been used for modeling the areas. Before the analysis, first the data has been generated through many sources.

1.5.1 Road Network

To map the road network, 2.5 m Cartosat-1 imagery was used and elevation points has been given as an attribute. This consists of NH22, NH88, state highways, and other major roads. Local roads have not been captured due to the need of intensive surveying and data collection. The research intends to develop a methodological input, accordingly datasets have been created. As local roads could not be captured, an assist network has been developed with a 150 m grid. Then the values of elevation have been captured from DEM,[6] so as to calculate the slope for every road segment. Different network speeds have been assumed and then accordingly time has been computed with the following formula:

$$T = D * S^{-1}$$

where T = time
D = distance
S = speed

For the network speeds, assumptions have been taken into consideration (as Table 1.2), having a coherence with IRC[7] 73-1980, and assist network[8], primarily as a pedestrian network, was assumed and adopted into the scope of present analysis. Accordingly a city road network hierarchy map (as Fig. 1.1) has been generated in ArcGIS.

[5] Geographical information system and FlowMap® are registered software of the University of Utrecht which is an open ware and helpful for Land use-transport scenario analysis.

[6] Digital Elevation Model.

[7] Indian Road Congress.

[8] Assumed to be a pedestrian network primarily for which generic walking speed is considered, kindly refer to Table 1.2.

Table 1.2 Assumed network speeds

Road type	Speed assumed (kmph)
NH	40
SH	30
City	20
Assist	3

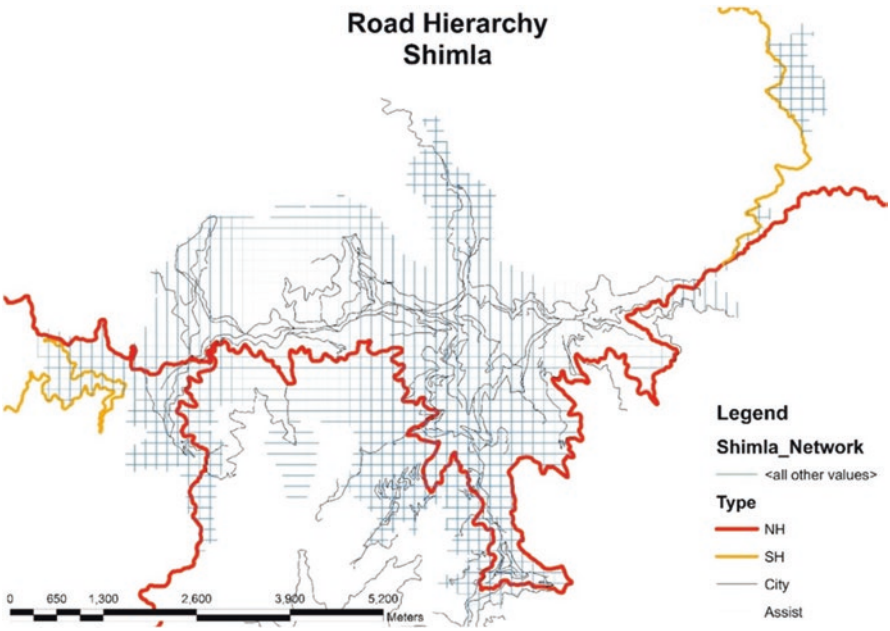

Fig. 1.1 Road hierarchy

For the required analysis, slope adjustment factor has been taken into consideration, so as to include factor of resistance into the analysis. For slope adjustment factor, formula has been adopted from a research by Mike Price (n.d.):

$$\text{Slope Adjustment Factor}(D) = 1 + (\text{Slope in Percentage}/10)^2$$

where

$$\text{SlopeinPercentage} = ((\text{EndElevation} - \text{Start elevation})/\text{Length of Segment}) * 100.$$

Then network resistance has been computed with the following formula, and in it slope adjustment formula acts as a decay function, thus increasing the resistance in exponential manner:

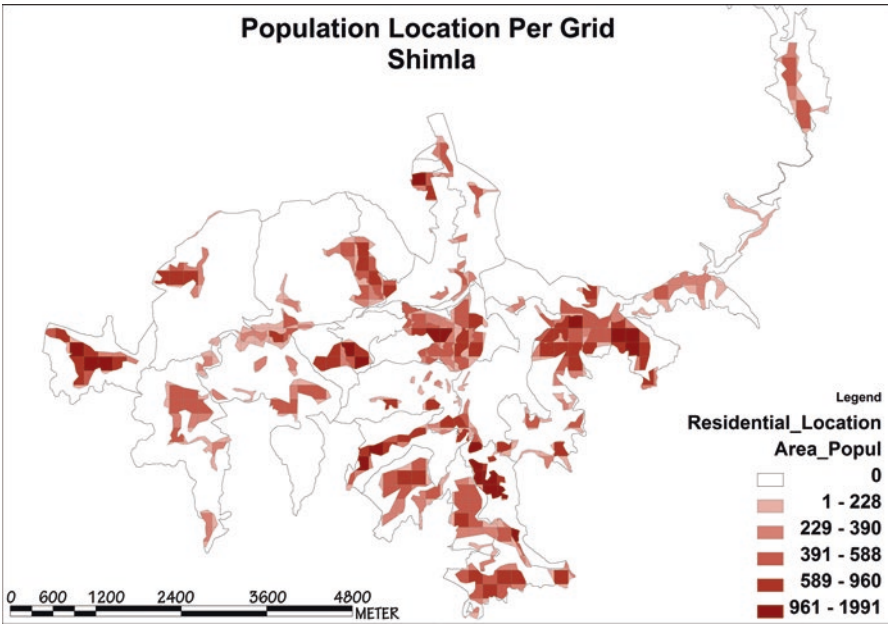

Fig. 1.2 Residential location and population distribution

$$\text{NetworkResistance} = T * D.$$

This network resistance is computed for every segment and becomes an input into network analysis.

1.5.2 Residential Cluster

For ease of analysis, only residential clusters have been identified with Cartosat-1 imagery, and then population has been given as input from Census 2011.[9] Also the grid of 200 m has been created within the demarcated residential clusters (as Fig. 1.2).

1.5.3 Hospital Locations

Mainly public hospitals have been identified of different scale, and their capacity as per URDPFI guidelines has been given as input into analysis, with their geolocation embedded in it and hereby highlighted (as Fig. 1.3).

[9] Census 2011 for Shimla urban area.

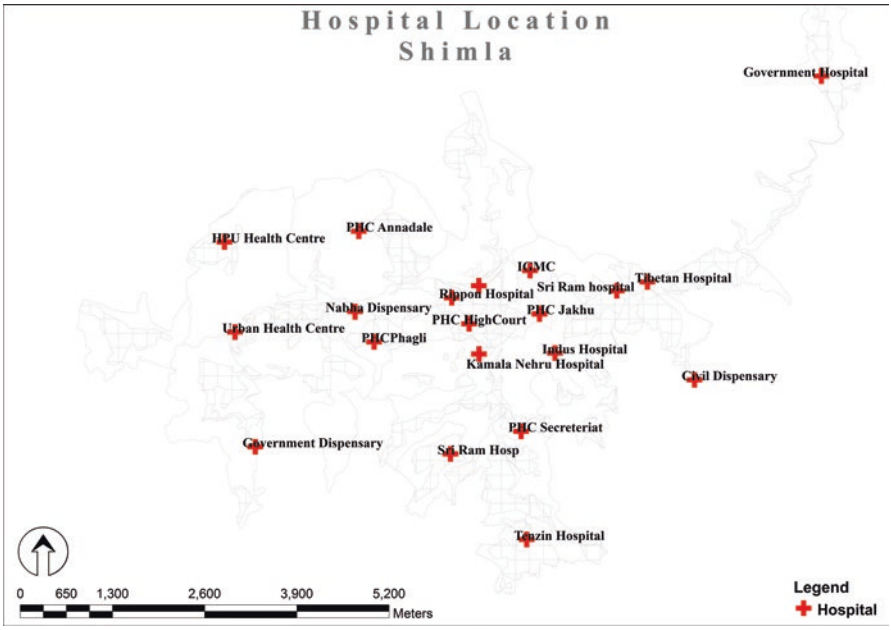

Fig. 1.3 Hospital locations

1.6 Analysis

1.6.1 Proximity Analysis

Proximity analysis for residential location to health infrastructure locations has been done with computed network speed[10] for time period of 10, 20, 30, and 45 min (as Figs. 1.4, 1.5, 1.6, and 1.7, respectively). The following are the output; lightest hue depicts least or no accessibility and dark blue shows the highly accessible zones[11] for which FlowMap® Software has been used.

1.6.2 Catchment Area Analysis

Catchment area analysis for each location of health infrastructure, with attributes of residential clusters and health infrastructure (as Figs. 1.8 and 1.9), according to URDPFI guidelines, has been studied. Thereafter gradation was done according to percentage of residents getting access within a fixed time period.

[10] Network speed has been adjusted for each of the segments which includes slope adjustment factor that has been highlighted beforehand.

[11] The yellow zones are those where there is no accessibility to health infrastructure, whereas the dark blue areas are those where one can at least have access to a city-level hospital.

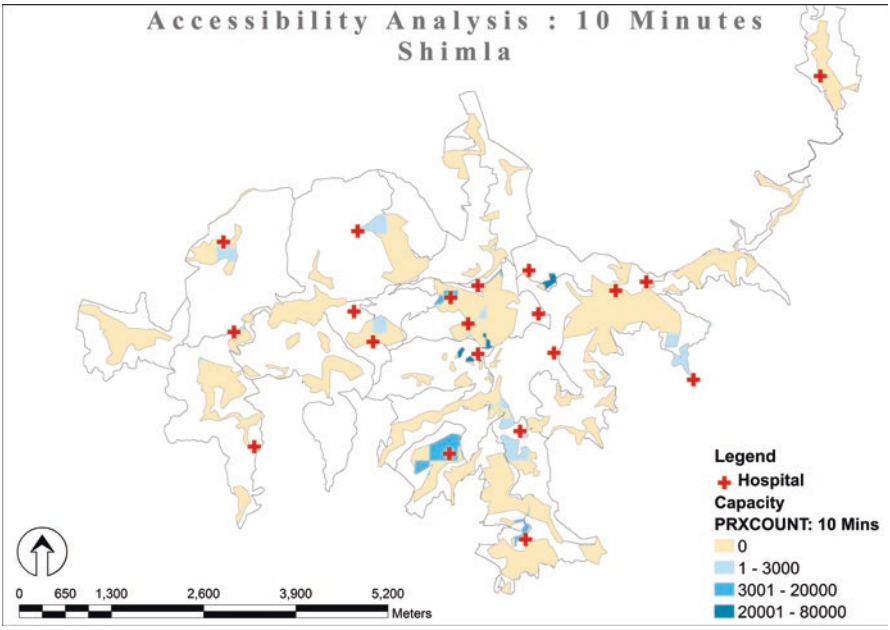

Fig. 1.4 Proximity analysis 10 min in network speed

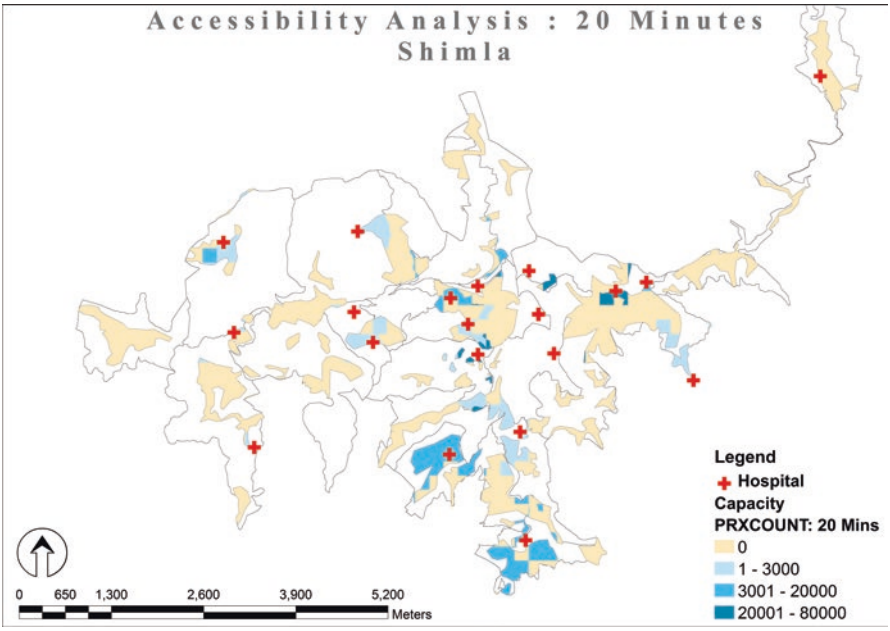

Fig. 1.5 Proximity analysis 20 min in network speed

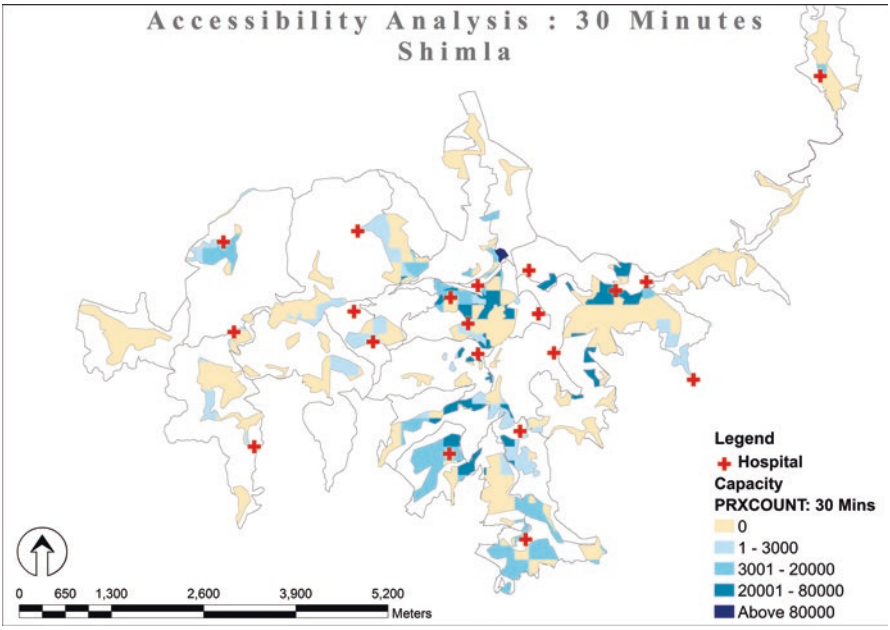

Fig. 1.6 Proximity analysis 30 min in network speed

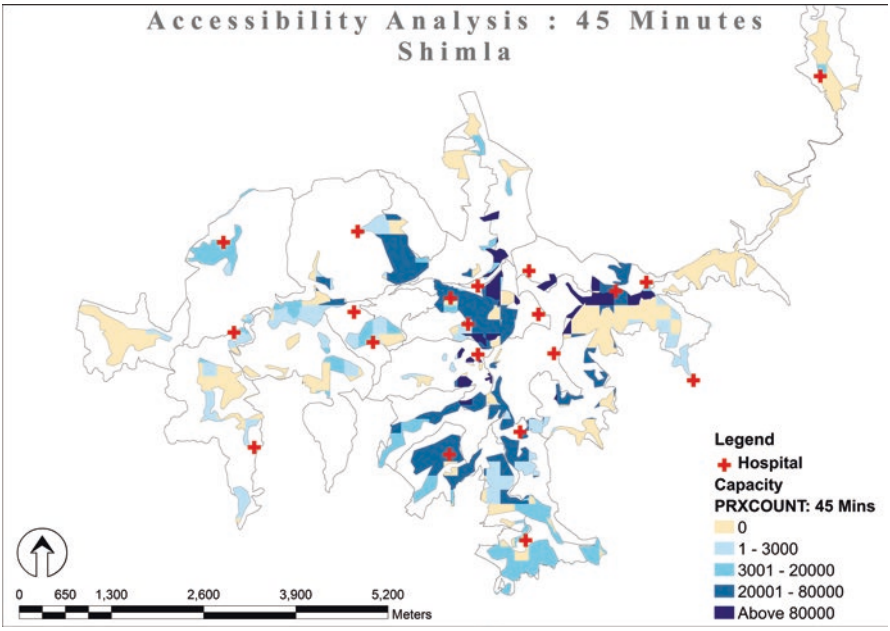

Fig. 1.7 Proximity analysis 45 min in network speed

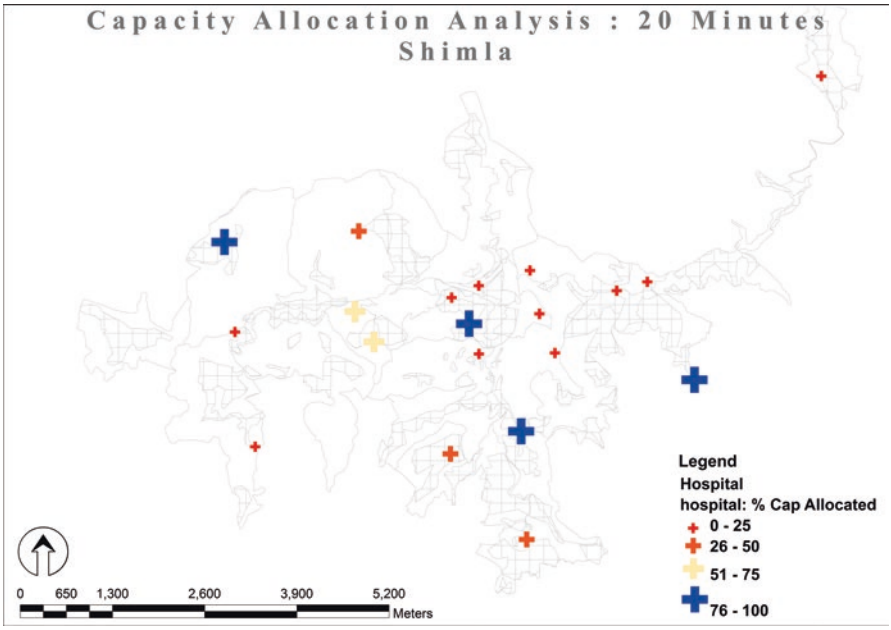

Fig. 1.8 Catchment analysis in 20 min

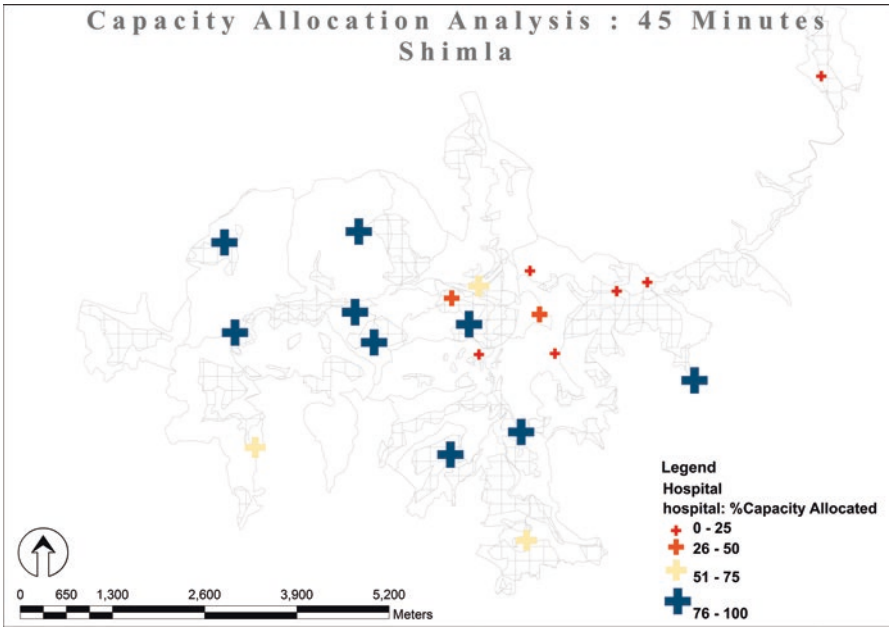

Fig. 1.9 Catchment analysis in 45 min

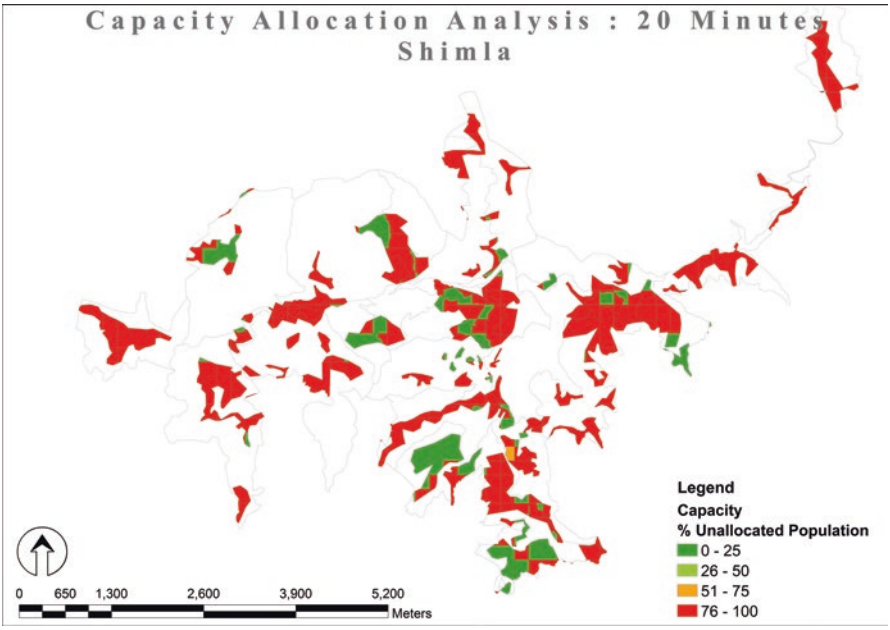

Fig. 1.10 Grid-wise percentage unallocated population in 20 min

1.6.3 Unallocated Areas

Unallocated areas in terms of percentage of population are computed and graded accordingly to its coverage (as Figs. 1.10 and 1.11), red being the least covered area and green being the most covered area.

1.7 Conclusion

The paper intends to present a more methodological way of looking into health infrastructure as a matter of service delivery in terms of social equity from urban planning perspective. This analysis can be developed in detail with a very structured and well-defined data set. And the analysis can be input to multiple policy level interventions, act as an input in development plan-making process, and can be utilised for infrastructure up gradation. Study exhibits that in Shimla has most of residential pockets are inaccessible within a time frame of 20 min. Most areas get accessible when the time limit is extended to 45 min. Looking at the outputs, recommendation will be further diagnose the problem and come up with

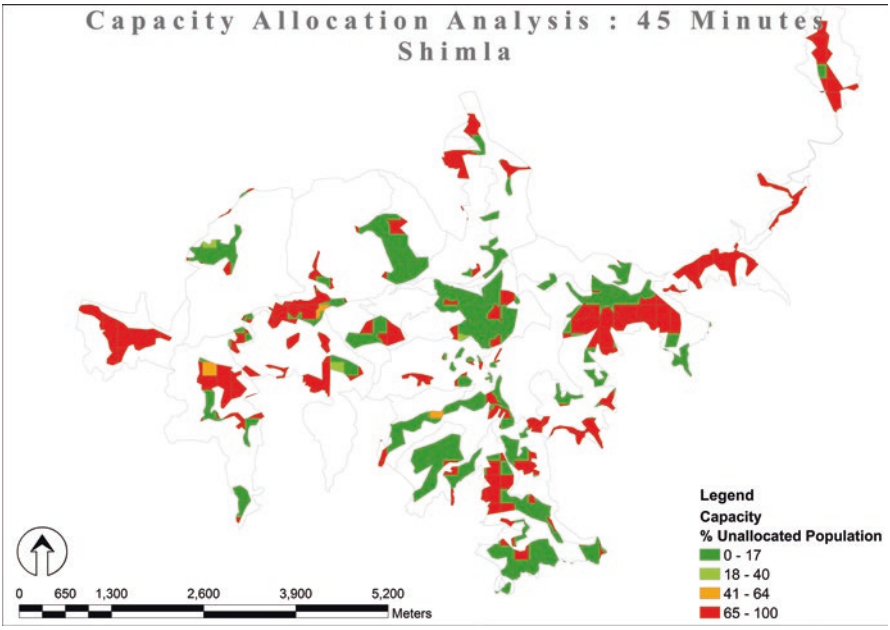

Fig. 1.11 Grid-wise percentage unallocated population in 45 min

measures so that accessibility parameters can be improved drastically atleast in the case of health facilities which is vital for prosperity of community. This study can be applied in the case of urban development, healthcare supply, provisioning, etc.

References

Anvita A, Geetam T (2006) A gendered perspective of the shelter–transport– livelihood link: the case of poor women in Delhi. Transp Rev 26(1):63–80

Carol A (2012) TerraUrban. Retrieved from https://terraurban.wordpress.com/2012/11/06/tangles-of-undelivered-jnnurm-housing-shimla/

Dev Nathan GK (2004) Globalization and indigenous peoples in Asia. Sage, New Delhi

Geurs KT, Eck JR (2001) Accessibility measures: review and applications, evaluation of accessibility impacts of landuse transport scenarios and related social and economic impacts

Mazta S, Thakur A (2012) Primary health care perspectives of village women in Himachal Pradesh. SEARO, WHO

Price M (n.d.) Slopes, sharp turns, and speed. ESRI 8

Sapkota, JB (2015) Human development impacts of access to infrastructure in hills and mountains: evidence from households of three remote villages of Nepal. ISANET. http://web.isanet.org/Web/Conferences/GSCIS%20Singapore%202015/Archive/86c64868-3e9e-40b1-9526-afe8d20c4a08.pdf

Sekhar S (2011) Urban sprawl and other spatial issues in Shimla Himachal Pradesh. ITPI 8:53–56

UNDP and the Planning Commission (2003) District Development Report. SHIMLA, Shimla

Chapter 2
Conservation of Cultural Heritage: The Necessities, Trends, and the Analysis of Current Practices

Ankita Choudhary and Mayank Mausom

Abstract India is a country of multitudes and multivalence, a country so diverse that language changes every quarter of a hundred kilometers. The country is as old as history itself and has some of the oldest cities by the time period over which they have been continuously inhabited like Varanasi, Madurai, Ujjain, etc. (Table 2.1). The country and its innumerable cities and antediluvian settlements have an astounding legacy in terms of heritage and culture.

Conservation and protection of these built as well as concomitant intangible heritage should be an integral part of urban planning, city development, and – importantly – urban design, incorporating architectural conservation, in our urban areas. Old conurbations and heritage built forms are enormously significant as they not only impart variety to our built-up environments, stimulating visual importance, but also give a sense of pride to inhabitants and enthusiasm within the urban settlement.

The current paper tries to help understand the meanings of the key terms in culture and heritage conservation. It explores the necessity and advantages of conservation of cultural heritage in terms of identity, unity, tourism, and economy and the principles that can be adopted for the same. Taking the example of various projects throughout the paper, Pondicherry in specific, the paper tries to develop an understanding as to what should be done and what shall be avoided in conserving the cultural heritage of the place.

Keywords Conservation • Cultural heritage • Tourism • Cultural identity • Culture • Heritage • Tourism

A. Choudhary (✉) • M. Mausom
IIT Roorkee, Roorkee, India
e-mail: ankita.choudhary20@gmail.com; mayankmausom@gmail.com

F. Seta et al. (eds.), *Understanding Built Environment*, Springer Transactions in Civil and Environmental Engineering, DOI 10.1007/978-981-10-2138-1_2

Table 2.1 Chronological list of some of the oldest continuously inhabited cities in India

City	Region old	State	Period	Source
Varanasi	Iron Age, North India	UP	ca. 1200 BC	Iron Age Foundation (Painted Grey Ware culture)
Ujjain (as Avanti)	Malwa	MP	800 BC	Rose to prominence in ca. 700 BC as capital of Avanti
Rajagriha (Rajgir)	Magadha	Bihar	600 BC	
Madurai	Pandyan Kingdom	Tamil Nadu	500 BC	There are accounts of Megasthenes (ca. 350–290 BC), a Greek ethnographer in the Hellenistic period
Vaishali	Magadha	Bihar	500 BC	
Patna	Magadha	Bihar	ca. 400 BC	As Pataliputra was founded by Ajatashatru
Thanjavur	Early Chola Kingdom	Tamil Nadu	300 BC	Some scholars believe that the city has been existing since the Sangam period

Source: Overy (1999). The Times History of the World

2.1 Introduction

Cultural heritage is the be quest of physical artifacts as well as the intangible features of a family, society, or settlement which are handed from past generations to the next, preserved in the contemporaneous and imparted for the value of forthcoming generations. Cultural heritage comprises the tangible culture components or the physical manifestations like the buildings, monuments, landscapes, books, works of art, relics, and artifacts and also includes the intangible culture such as folktales, legends, traditions, customs, language, and knowledge and also encompasses the natural heritage. This paper will deal with only the architecture and built-form component of cultural heritage. The Constitution of India under fundamental duties mandates the citizens to value and preserve the rich heritage of our composite culture.

2.2 Cultural Heritage as a Necessity

A city's cultural heritage bears evidence to its ethnic traditions, encourages the development of its modern civilization, as well as makes available monetary benefits such as income through tourism industry. These inherited artifacts are thus customarily looked upon as vital treasures, and conserving these treasures is important so as to sustain the cultural heritage. We, fortunately, have some very old surviving cities which have formed the centers for heritage and culture (shown in Fig. 2.1). If

Fig 2.1 Ancient India map; most of the cities have survived till date (Source: rbi.in)

we do not preserve what is left and conserve what has partially decayed, we might end up losing this wonderful inheritance of ours. Some examples have been shown in Figs. 2.2 and 2.3.

The various components of cultural heritage and their advantages are discussed below.

Fig. 2.2 Neglected site at Arikamedu (100 BC), near Pondicherry (Source: Author)

Fig. 2.3 The 144-year-old Mairie Building which was the town hall in Pondicherry (Source: Author) (INTACH had made a proposal for restoration of the town hall building, and a fund of 7.5 crores was sanctioned by the World Bank)