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A STUDY OF WALKABILITY INDEX OF SOUTHEAST ASIAN CITIES

Gunjan*[1], Jimmy Gupta[1], Chetan Sachdeva[1], Kamalpreet Kaur[1], Manu Chaudhary[1], Vandana Gupta[2]

[1]Lovely School of Architecture and Design, Lovely Professional University, Phagwara, India.

[2]Department of Mathematics, Dashmesh Khalsa College, Zirakpur, India.

Corresponding author (*): ar.gunjan111@gmail.com

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Abstract

70% of the total population is a pedestrian at some point of the day whether he lives in a small town or city of any country, uses car or public transport. Therefore the needs of the pedestrians should be considered while designing the cities and its streets i.e. they should be walkable. Jalandhar City- one of Punjab's biggest and oldest cities faced 139 accidents in the year 2018 in which pedestrians were injured and crime index is 55.82 which are high. Hence the walkability of Jalandhar is deteriorating day by day in terms of safety, comfort and convenience level of pedestrians. The Model Town Area of Jalandhar is selected as a study area because it shows a clear picture of intense traffic and inadequate and improper planning of pedestrians. This paper talk about three methods i.e. MOUD method, Method by CAI-Asia and Global Walkability Index by World Bank which are used to analyze the walking conditions of a particular area and all of them have separate parameters which are considered. The major roads of the study area are selected to be surveyed which are divided in three areas (commercial, residential and educational) and survey of these areas are done according to the guidelines. The "walkability index" for Jalandhar City is calculated from all three methods and then they are compared. The findings tell us about the shortcomings of each method and the method best suited out of all is selected. Further while doing statistical analysis, the parameters having $p<0.05$ are more influencing.

Keywords – Walkability Index, Walkways, pedestrians, walking, safety, Asian Cities, Southeast Asia, Indian Cities

1. INTRODUCTION

Southeast Asian Cities are majorly known as cities of pedestrians and depends on cycling, walking or public transport. However, with increasing growth there has been significant increment in motorization and attention of pedestrians and public transport is decreasing resulting in declining number of pedestrians. In the area where pedestrians are still high in number, the number of pedestrian casualties and accidents are escalating. This has led to high levels of air pollution. The pedestrians are the ones which are majorly exposed to it.(James Leather, 2011)

Walkability is not only about physical walking but also about how friendly the area is to walking. It is also how walkable the built environment is, i.e. how secure, easy, pleasant, available, and healthy it is. "The General Theory of Walkability describes how a walk must meet four key criteria's to be preferred: it must be useful, safe, comfortable, and interesting."

Individual and social capital is also enhanced by walkability. Connectivity, conviviality, conspicuity (crime-free), comfortable, and convenient are the 5c's that define a location's walkability. (Rashid & Akram, 2017)

Earlier a lot of studies are done on this concept of walkability as this is need of the hour and necessary for neighbourhood sustainability as it is directly linked to public health, urban form and transportation. A study is done in China to compare the various research methods to measure and do research on walkability. It has highlighted the various measurable attributes and thresholds for a walkable city. (Xin Tong, 2016) Another research done on the Mediterranean city talks about the relationship between urban design and walkability using the Global Walkability Index. Various models for evaluating the relationship between a walk-score and urban design have been developed. (Ros-McDonnell, 2016)

In South East Asia, most cities are also easily accessible by walking or cycling, as the average daily distance travelled is between 1 and 7 kilometres. Motorcycles account for about 26% of all journeys in Bangalore that are less than 2 kilometres long, and nearly 26% of all trips are less than 5 kilometres long. (James Leather, 2011)A study was done to investigate the walkability of Mumbai city and outline the problems, challenges and scope for improving its walkability in the city. Recommendations were given to government, pedestrians as well as vehicle owners to improve the walkability of the city as the condition can only be changed if everyone takes a collective effort in this direction. (Bharucha, 2017)

The walkability index is a key performance measure of walkability or how walkable a particular area is and represents it in numeric value. It is calculated on the basis of certain given parameters which are physical, social and environmental. Its value ranges from 0 to 100.0 means no walkability in the area and 100 shows that the area is fully walkable. It can be used to compare cities and, as a result, find site-specific areas for change. Many pedestrian-centric initiatives are taken in Asia for promoting walkability in Asian cities. People, on the other hand, are not encouraged to walk on the streets because walking is about how walkable the built environment is, i.e. how secure, easy, comfortable, affordable, and healthy it is. The main objective of this Walkability Index Calculation is to create awareness among people and authorities regarding walkability and pedestrians as an alarming issue in developing cities. Moreover, it also helps the officials in addressing the walkability issues in a better way as it identifies most of the pedestrian related shortcomings of the area. Earlier the walkability index of major 30 cities of India by Clean Air Initiative was calculated. The average walkability index of India was reported as 0.52. The highest walkability in India came out to be of Chandigarh (value 0.91) according to this ranking. It was done using Global Walkability Method. (James Leather, 2011)The Global walkability index method was used to calculate walkability index values for the Nakhon Ratchasima Muang Municipality, one of Thailand's largest cities. (Chatdanai Luadsakul, 2013)

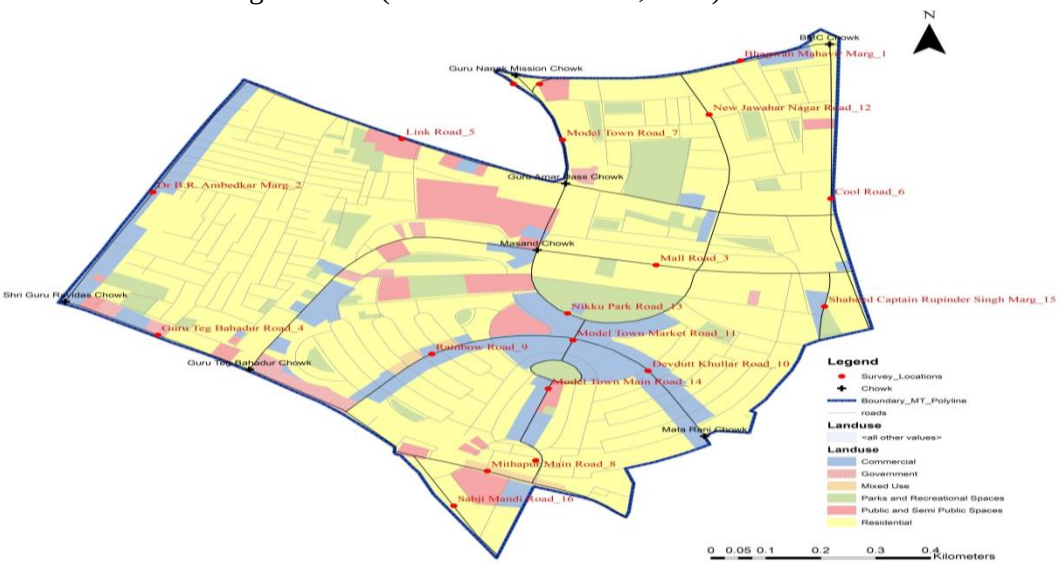

Figure 1 Selected locations of Model Town Area

Jalandhar, known as the sports city of India, is selected as a study city. It is seeing a lot of growth in the last few decades' mainly industrial growth which in turns leads to a lot of migrations from neighbouring states. The city is getting overpopulated and congested with a population of 8.62 lakhs (Census 2011). Walking has been neglected in transport network planning in Jalandhar. Although the road is designed to accommodate both pedestrians and motorists, pedestrians are forced to corner due to insufficient facilities. In the year 2018, around 100 accidents occurred in which

pedestrians are harmed and every year the number of pedestrians is increasing. Earlier also few studies are carried out on walkability of Jalandhar City and they have calculated the walkability index as 0.64 in 2016 and it needs a lot of improvement. Even during Smart City polls walkability was considered one of major concerns and it was polled as one of the priority sectors. However, until now, Jalandhar's Mobility Plan and Master Plan have prioritised vehicles over pedestrians. As a result, it is critical not only for city planners and transportation engineers, but also for car owners who ignore the cheapest and healthiest mode of transportation, namely cycling, as it is not the best solution to the problem. The area of the study area is 11.40 sq. km. The number of households in the area is 3890 and density is 15560 persons per sq. km.

2. METHODOLOGIES

The Walkability Index of Jalandhar City needs to be calculated. Hence some specific parts of Jalandhar are studied like Model Town, Dada Nagar, New Jawahar Nagar and Green Model Town etc. which is a mix of residential, commercial, public and semi-public spaces and recreational spaces. To calculate the walkability index, there are three methods available i.e method by the Ministry of Urban Development, method by Asian Development Bank (ADB)method by World Bank. Now we will calculate the walkability index of the Model Town Area of the Jalandhar by all the three methods so that we can properly understand the condition of the city and to also compare the findings of all the three methods. For this, out of the whole area 16 roads are selected to be studied as shown in Fig 1. The selected 16 roads are divided on the basis of their land uses- residential, commercial and educational. Road Stretch 1 and 8 are educational, 4, 6, 12, 16 are residential and rest all are commercial roads. The selected 16 road stretches are often blocked and congested in the city having no designated parking spaces, which is a major cause of concern. For survey, different parameters are considered for each method and they are rated from 1 to 5 by the pedestrians on all 16 selected locations. Around 10 pedestrians are surveyed on each of the 16 locations, out of which 3 are young males, 3 young females, 2 children and 2 old age or specially-abled people. The above-mentioned parameters are to be rated by the pedestrian on 5-point scale where '1' shows 'worst facility and not at all usable' and '5' define 'best facility and highly usable by people' After selecting the best suited method we will do the statistical analysis of the parameters of that method and find the parameters which are significant and non-significant for the area.

According to the Ministry of Urban Development (MOUD) method, the availability of footpaths and the ranking of pedestrian facilities determine the walkability index. We need to evaluate pedestrian facilities to determine the Walkability Index. In the survey, the parameters considered are walkway height, walkway width, availability of pedestrian crossing, cleanliness and maintenance, walkway placement, ramps for disabled people etc.

Walkability Index = [(w_1 x Availability of footpath) + (w_2 x Pedestrian Facility rating)]
Where,

- w_1 and w_2 are weights (assumed 50% for both)
- Availability of footpath = Footpath length / Length of major roads in the city
- Pedestrian Facility Rating = Score estimated based on opinion on available Pedestrian facility

At the Asia Level, the Walkability Index is calculated by the method given by CIA-Asia. (Clean Air initiative for Asian Cities). This method is used to rate the Asian cities and areas on the basis of some given parameters like walking path model conflict, availability of footpaths, presence of pedestrian crossings, safety of pedestrians on crossings, infrastructure for specially-abled people, pedestrian amenities etc. For each location the field survey and pedestrian interviews results in a "walkability ranking." All these nine parameters are rated from 1-5.
The Global Walkability Index by the World Bank is basically an evaluative technique in which the selected road stretches are evaluated or rated on the basis of certain parameters like safety, accessibility, security, convenience etc. Two types of surveys need to be done before calculating the walkability index by H Krambeck. (Krambeck, 2008)They both are pedestrian facility rating surveys. One is to be filled by a public agency dealing with walkability like Municipal Corporation, Traffic Police etc. and other by the surveyor and pedestrians themselves. The major components of GWI are safety and security, convenience and attractiveness and policy support which are further distributed under various indicators. In this survey the pedestrian count of 5 minutes is noted with the length of surveyed road in kilometres for each of the 16locations. This is one of the main factors which make it different from the GWI by Asian Development Bank. On a scale of 1 to 5; the surveyor rates the various parameters. The length of the surveyed road and the number

of pedestrians are multiplied by the ratings to normalise them. The average of the ratings of all the number of roads surveyed for all the locations is calculated which is then multiplied by a factor (x10).

3. DATA ANALYSIS

Walking Data collected from all the surveys is then further used to calculate the walkability index of the study area in Southeast Asian City by using the formulas given by the three organisations. Then firstly, Kolmogorov-Smirnov test was used for check the normality of the data and it was observed that data was normally disturbed. After that, one way repeated measured Anova was used to check the significance of the data, the results of which are shown in Table VI. The level of significance to be consider at $p<0.05$.

4. RESULTS

First analysis was done according to the method by Ministry of Urban Development. The average value of rating of all the locations is evaluated as shown in Table I.

Table I Ratings By Ministry of Urban Development (MoUD)

Parameters	**Location No.**															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Walkway height	3	2	3	3	3	3	3	1	1	1	3	1	1	1	1	1
Walkway width	3	2	4	2	3	4	4	1	1	1	3	1	4	1	1	3
Surface quality	3	2	4	3	4	3	3	2	1	1	4	4	3	1	1	4
Walkway network	4	2	3	3	5	3	2	2	1	2	5	1	3	1	1	4
Crossing	2	1	2	1	1	1	2	1	2	2	2	1	2	1	1	1
Maintenance and Cleanliness	3	3	3	2	3	4	2	2	2	3	4	2	3	4	2	3
Walkway placement	3	4	4	3	5	4	4	3	2	3	4	4	2	1	1	3
Public Amenities	2	2	1	2	2	2	2	2	1	1	3	1	2	2	2	1
Ramps	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
Obstructions	2	2	2	2	3	2	2	2	1	1	3	2	1	1	2	4
Streetlights	4	3	2	4	3	4	4	3	2	2	5	1	4	4	3	2
Rating of each location (on scale of 1 to 5)	2.7	2.2	2.6	2.4	3.0	2.8	2.6	1.8	1.4	1.6	3.5	1.7	2.4	1.6	1.5	2.5
Rating of Model Town Area (on scale of 1 to 5)	Overall								2.3							
	Commercial								2.24							
	Residential								2.35							
	Educational								2.25							

Then the derived valuation i.e. 2.3 is filled in the given formula to get the final walkability index.

Walkability Index = [(w_1 x Availability of footpath) + (w_2 x Pedestrian Facility rating)]

Where,

- w_1 and w_2 are weights (assumed 50% for both)
- Availability of footpath = Footpath length / Length of major roads in the city
- Pedestrian Facility Rating = Score estimated based on opinion on available Pedestrian facility

Walkability Index (w_1) (Overall) = $[(0.5 \times \frac{2857}{4593}) + (0.5 \times \frac{2.3}{5})]$

= 0.311+0.23 = 0.541

Walkability Index (Commercial) = 0.524
Walkability Index (Residential) = 0.635
Walkability Index (Educational) = 0.575

Therefore, from the above calculations, it is observed that walkability of commercial, residential and educational areas of Model Town Area, Jalandhar is 0.524, 0.635 and 0.575 respectively. This shows that the commercial streets need the maximum improvements and residential areas need the least improvement. The major difference between these; is because of the network of footpaths in those areas. Commercial areas have a broken and obstructed network of footpaths whereas the residential areas have more continuous one, whereas the WI for the whole Model Town Area of Jalandhar city by MOUD method comes out to be 0.541. This walkability index shows that the condition of streets of Model Town area, Jalandhar is satisfactory but still needs a lot of improvement in a lot of aspects. In this formula given by MoUD, the 50% weightage is of whether the footpaths are available or not and rest 50% of the parameters which are also mostly related to footpath or walkway condition and design. Hence if an area is having walkways then the Walkability Index of that area is bound to be good irrespective of other important parameters like signages, traffic separators, comfort, sitting spaces etc. If the streets of Model Town, Jalandhar are also improved with respect to the rest of parameters then it will become more pedestrian friendly which will result in more footfall and less accidents, congestion and pollution.
Then the Walkability Index is calculated by the method given by CIA-Asia. (Clean Air initiative for Asian Cities). The average of the ratings is calculated for the final Global Walkability Index of the Model Town Area as shown in Table II.
As per the ratings by CIA-Asia the Walkability Index of commercial, residential and educational areas is 45.5, 45.55 and 44.45 respectively. This shows that the conditions of commercial and residential areas are almost on the same level whereas the educational areas are most problematic and need a lot of improvement. The walkability index as per CAI-Asia of the whole study area is 45.4 which is fairly poor as all values below 50 are considered poor. This shows that the area still needs a lot of improvement. The major parameters where improvement is necessary are disability infrastructure, toilets, crossings and sitting facilities etc. This method covers most of the infrastructure network and design related parameters but lacking the parameters related to psychological human needs as highlighted by Jan Gehl in his books like “Cities for People” and “New City Life”

Lastly, the Global Walkability Index by the World Bank is used to calculate walkability index. The public agency survey was conducted in Municipal Corporation, Jalandhar. The questionnaire prepared by the CIA-Asia is related to funding, guidelines and available data on pedestrian fatalities, safety and reinforcement of laws and regulations. The questions were asked to officers of local urban planning authority i.e. Municipal Corporation, Jalandhar and accordingly ratings are done based on their responses as shown in Table III.

The rating of public agency surveys for commercial and educational streets is 11.8 and 11.0 respectively whereas for residential streets it is 9.4 which are the lowest. The difference is basically on the enforcement of rules and policies. Less rules and regulations are followed in residential streets as compared to commercial and commercial ones. The final

rating for public agency survey is taken as 11.8 which are followed by majority areas (Total 10 streets). For the field walkability survey, a final average which is used in the calculation of index is shown in Table IV.

Table II Ratings by CIA-ADB

Parameters	**Location No.**															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	14	15	16
Walking Path Modal Conflict	2	2	3	3	2	3	3	3	3	3	4	3	2	2	2	3
Availability of Walking Paths	3	2	3	3	4	2	3	1	2	2	4	2	3	1	1	3
Availability of Crossings	2	1	2	1	1	1	2	1	2	2	2	1	2	1	1	1
Grade Crossing Safety	3	3	3	3	3	3	2	3	3	2	4	2	2	2	3	3
Motorist Behavior	2	2	2	3	3	2	2	3	3	3	3	3	2	3	3	3
Public Amenities	2	2	1	2	2	2	2	2	2	2	3	1	2	2	2	1
Disability Infrastructure	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Obstructions	2	2	2	2	3	2	3	2	1	1	3	2	1	1	2	4
Security from Crime	4	3	3	4	3	4	4	3	4	3	5	3	4	4	3	3
Walkability Index of each location (on scale of 1 to 100)	46.7	40.0	44.4	48.9	48.9	44.4	48.9	42.2	46.7	42.2	64.4	40.0	42.2	37.8	40.0	48.9
Walkability Index of Model Town Area (on scale of 1 to 100)	Overall								45.4							
	Commercial								45.5							
	Residential								45.55							
	Educational								44.45							

The average field walk ability of Model Town Area, Jalandhar City is found to be 30.195 (30.2).

Global Walkability Index (GWI by H. Krambeck) = Average of public agency survey +
Average of field Walkability survey
= 11.8 + 30.2
= 42

Global Walkability Index (Commercial) = 47.09
Global Walkability Index (Residential) = 39.31
Global Walkability Index (Educational) = 42.47

Table III Public Agency Survey

Questions	**Point Assignments**	**Commercial**	**Residential**	**Educational**
Rate the degree of municipal funding and resources available for pedestrian planning	1-5, Non Existent=1	1.6	1.6	1.6
Tick the urban design guidelines available for the pedestrians.	One point for each box checked	2.6	2.6	2.6
Input the average percentage of pedestrian deaths in the previous years.	Divide percentage by 10	2.6	3.2	1.8
Have there been any public awareness campaigns to raise awareness of the importance of road and pedestrian protection among pedestrians and drivers?	Yes=5, No=1	1	1	2
Is there any regulation or policy in effect for the following? Is the rule or regulation being practised as it should be?	3 for each usually to 1 for each rarely, divided by 2	4	1	3
Total		**11 .8**	**9.4**	**11.0**

The Global Walkability Index (GWI) of commercial, residential and educational areas as calculated according to norms given by the World Bank is 47.0, 42.47 and 40.31 respectively. Here the GWI of commercial is highest but residential and educational have less difference. The major reason for high GWI of commercial areas is high pedestrian count found in these areas which is almost 4-5 times more than others. The overall Global Walkability Index (GWI) of Model Town Area, Jalandhar City comes out to be 42 (on a 100point scale). As a result, 00-50 is reserved for places that are inaccessible by foot. It indicates that only a small percentage of people walk for everyday needs, while the majority of trips are still made by bike, car, or public transportation. When the pedestrian count and walkability index values are compared, it is clear that walking is still a common mode of transportation in Jalandhar, but the facilities and amenities available are insufficient to meet the demands of the pedestrians. Another thing noted from ratings it that a lot of work needs to be done for people with special needs. Moreover the street stretch having commercial character has more pedestrian count than any other type. In this method, along with the parameters for rating the road stretch, the pedestrian count and policy framework of the area are also important aspects.

5. FINDINGS

The walkability Index of Model Town Area, Jalandhar City as calculated by all three methods comes out to be 0.541(54.1 on 1-100 scale), 45 and 42. These values describe the condition of Model Town Area, Jalandhar City at National, Asian and World Level respectively. The parameters in Indian method are mostly based on one main aspect of footpath availability, its condition and design. Out of 11 parameters, 7 parameters are related to footpath only and in the formula of Walkability Index, 50% weightage is given to footpath availability. On the other hand, the method by CIA at the Asia level has a lot of other important parameters like crossing, security, safety, motorist behaviour and walking path model conflict etc. and footpath is only one aspect of it. Out of 9, only 2 are related to footpaths. In the third method by the World Bank, three more aspects of pedestrian count, stretch length and policies and norms followed are added to the parameters of the previous method by CIA. In total it has 12 parameters and all are of different aspects. And as the more important parameters are being added in the calculation of walkability index, the calculated value is decreasing for Jalandhar City. As in the Jalandhar City, the basic necessity for walkability i.e. footpath are available in 60-70% of the surveyed area but the other parameters related to comfort, pleasantness, safety, security, attractiveness and accessibility are missing which are also important for making the area truly walkable.

Now, if the values of walkability of one type of area are compared to others, then a lot of disparity is noticed in it as shown in Table V.

Table IV Rating according to World Bank

Parameters	**Surveyed Road Stretch**																**(Z(x*Length*10*count))/16)/9)**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	
Walking Path Modal Conflict	2	2	3	2	3	3	3	3	3	3	4	3	2	2	2	3	60.23
Security from crime	4	3	3	3	4	4	4	3	3	3	5	4	4	4	3	3	79.72
Crossing Safety	3	3	3	3	3	3	2	3	3	2	4	2	2	2	3	1	57.81
Motorist Behaviour	2	2	2	3	3	2	2	3	3	3	3	3	2	3	3	3	57.84
Amenities(Covers, Benches, Public Toilets, Streetlights)	2	2	1	2	2	2	2	2	1	2	3	1	2	2	2	3	40.78
Disability infrastructure	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21.17
Maintenance and cleanliness	3	3	3	2	4	4	2	2	3	3	4	2	3	4	2	3	66.87
Sidewalk width	3	2	4	2	3	4	4	1	1	1	3	1	4	1	1	3	45.37
Obstructions	2	2	2	2	3	2	3	2	1	1	3	2	1	1	2	4	39.43
Availability of crossings	2	1	2	1	1	1	2	1	2	2	2	1	2	1	1	1	34
Pedestrian Count	10	7	5	6	9	15	23	8	39	26	52	13	13	48	11	4	
Length of Surveyed Stretch (km)	0.35	0.2	0.25	0.25	0.3	0.2	0.25	0.35	0.3	0.2	0.2	0.25	0.25	0.2	0.15	0.2	
Unweighted Average																	30.195
Commercial																	35.69
Residential																	32.07
Educational																	29.31

Table V Comparison of three methods of Walkability Index

Methods	**Commercial**	**Residential**	**Educational**
Method by Ministry of Urban Development	52.4	63.5	57.5
Method by CIA-Asia	45.5	45.55	44.45
Global Walkability Index Method by World Bank	47.09	39.31	42.47

By the Ministry of Urban Development (MoUD) Method, Commercial Area has the least walkability index amongst all areas whereas by the World Bank it has the highest walkability index. This difference is because of the parameter considered for calculating it. In the third method pedestrian count is considered, hence its walkability index is high because the percentage of pedestrians is higher in commercial areas. On the other hand, it is less in first method because all commercial areas do not have proper basic pedestrian infrastructure like footpath and sidewalks. The method by

Ministry of Urban Development (MoUD)is based on both qualitative and quantitative in nature but only one major aspect of footpath is mainly considered overlooking the other important parameters. The second method by CIA-Asia is only based on a rating system. Hence it is a qualitative analysis method and most of the parameters of physical pedestrian network and infrastructure are present in it. The third method is also a qualitative method but it also has pedestrian count and length of road stretch surveyed as important aspects in the formula. No one method out of all these is perfect as all of them have some drawbacks. But the best method specifically for Model Town Area seems like the third one followed by World Bank because it considers both field survey and public agency rating and tells their value but also talks about pedestrian count which shows roads with more pedestrian count needs to be dealt on priority.

Now further the parameters considered in the World Bank Method are statistically analysed using One Way Repeated Anova. This is basically done to check their significance in case of commercial streets as well as educational and residential streets of the selected area.

While calculating the P-value of parameters used to find walk index, the two parameters of walking paths model conflicts and disability infrastructure insignificant because these are the parameters which people think are not needed in the area as there is not much problem because of it. The most impactful parameters are 'crossing safety'. In future it should be unproved because it is important as per the walkers' other significant factors. In descending order of their significance are security from crimes, motorist behaviour, obstructions, maintenance and cleanliness, availability of amenities, sidewalk width and crossing availability. These are those parameters which are significant in Model Town Area in terms of walkability and have maximum impact on the walkers.

Table VI Statistical Analysis of parameters

	Results			
	Educational And Residential		**Commercial**	
Parameters	**Mean±SD**	**P Value**	**Mean±SD**	**P Value**
Walking Path Modal Conflict	2.73±0.33	0.874579922	2.57±0.64	0.165089994
Security from crime	3.47±0.64	2.4614E-08	3.67±0.61	8.20892E-08
Crossing Safety	2.88±0.40	7.68137E-10	2.63±0.65	6.52211E-08
Motorist Behaviour	2.68±0.71	1.1537E-05	2.6±0.61	0.000511349
Amenities(Covers, Benches, Public Toilets, Streetlights)	1.62±0.49	0.08126482	1.76±0.58	0.019490913
Disability infrastructure	1.03±0.08	0.45397549	1.01±0.03	0.446955034
Maintenance and cleanliness	3.18±0.83	0.001326279	2.76±0.81	0.033335152
Sidewalk width	2.35±1.21	0.026032933	2.38±1.29	0.107194612
Obstructions	2.33±0.73	0.000142227	1.99±0.76	0.034769675
Availability of crossings	1.25±0.42	0.02200268	1.79±0..68	0.01417204

Now while doing the analysis for commercial streets using P-value, it found that walking path model conflicts, disability infrastructure and sidewalks width are having P-value more than 0.05. Hence, they are insignificant in terms of need for the walkers of the defined area. According to the P-value the most significant one is security from crime, because if the area is safe and secure for the walkers then they will visit the area more frequently. After that another significant parameter is crossing safety and motorist behaviour. In these two aspects also safety and security of people is main concern for the people because both the parameters are important for their wellbeing and protection. The infrastructural

factors in descending order of their significance are availability of crossings, availability of amenities like benches, streetlights, toilets etc., obstructions and cleanliness.

The study emphasised on the major aspects of quantifying walkability and de-constructing all the parameters in terms of their significance. It takes the study of (Rashid & Akram, 2017) one step further to specify the mental mapping of the pedestrian's mind. In addition to that, it exudes a solution to the problem of pedestrian's exposure to accidents as mentioned by (James Leather, 2011)by giving a quantitative analysis of the significant parameters in terms of comfort and safety.

The indices as mentioned prove that World Bank Walkability Index is the most appropriate with a unifying set of parameters. From this statistical analysis of commercial, residential and educational areas, it is proved that people give more importance to the safety and wellbeing to the pedestrians than the infrastructure.

6. CONCLUSION

The commercial areas of Jalandhar City need maximum improvement because only few commercial road stretches have pedestrian infrastructure whereas others don't have. Moreover, the footfall of pedestrians in Commercial Area is highest which makes it an important area to be developed. The laws and policies related to pedestrians are available but the major issue is in their enforcement. According to conditions of Model Town Area, the method used to calculate Global Walkability Index by the World Bank is best out of three methods because it counts physical infrastructure network, its design, the policies and laws related to it, their enforcement and awareness of citizens. Moreover the citizens of Jalandhar City focus more on the safety and wellbeing of the pedestrians than the amenities and infrastructure.

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