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Smart Solution to Design Shimla as Smart City

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Abstract: *Urbanization is the integral part of the development process, especially for those nations who are rapidly growing. It brings about the social transformation, from traditional societies to present modern urban communities. Recently government launched an ambitious programme for the development of urban and rural areas by creating 100 smart cities.These smart cities is a collaboration of technology into strategic approach of sustainability. The programme will provide the city where information technology is the principal infrastructure and the basis for providing the essential services to the residents. The need of the smart city arises with the huge migration of the rural population to cities. The project focuses on the contributions of the techniques in accordance to civil engineering like solid waste management, transportation system. The solid waste management plan with emphasis on the putting the waste to beneficial work. The breakdown of waste generated in huge amount can be utilised for generating energy. The pre- occupied landfill can be cleared and be put to use for other work.*

Keywords: *Smart city, Swedish waste management, Degree of conflict between pedestrians and vehicles.*

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I. Introduction

Cities are encroaching the advancement at the fastest pace. Each technology comes up with the challenges in terms of demography, social and economic conditions. Sustainable urban development is the current global priority; however, most cities lack the capacity and resources to ensure that the city develops in a sustainable manner.

The economy of every nation depends on the development of its cities. In India approximately 31 % of the population comes from urban society and gives a huge contribution of about 63 % to Indian GDP. With the expansion in the human population in the years to come, India requires to accommodate the maximum with accommodation and takes the Indian GDP to the hike of 75 % by the year 2030. Thus the development at every level like physical, social, institutional and economical infrastructural is required. The very important aspect lies in providing better lifestyle to the nation with quality investments. Therefore, the idea with improved city under the project "smart city" is just the beginning of the new era.

II. Defining A Smart City

The concept of the smart city means differently to the different people. A smart city have different view point in India, to any other country such as Europe. As such no new way of fully defining the smart city is available. The imaginary picture of smart city consist of a long wish list of development with huge infrastructural facilities. A proper guidance across from every sphere would render a notable helping hand to the success of the mission of smart city. To live up to the aspiration of each individual, the proper growth is required at physical, social, institutional and economical grounds. The overall growth aims at the developing the entire ecosystem that stands on the four aspects as stated above.

III. Core Elements Of Smart City

The ministry of urban development has specified some core element for design of smart city which are as follow:

I. Affordable accommodation to the increasing urban population.
II. Regular water supply
III. Improved sanitation and solid waste management
IV. Efficient transportation
V. Assured electricity.
VI. Health care centers.
VII. Digitalization with connected IT robust.
VIII. Sustainable environment.

IX. Safety and security of the citizens.

IV. Problem Statement

The main focus of present study was to investigate the different feature of smart city in hilly region and to find out the different step taken to develop Shimla as smart city and also to suggest different technique or strategies for smart city in Shimla. However, there are various methods and techniques for development of smart city. The assistance of administrative authority and welcoming nature of local people are some of the techniques. Some feature or technique, suitable in a accordance to civil engineering point of view were considered in the present study.

V. Municipal Waste Management

Waste generation is an inevitable consequence of industrialization and urbanization.

Shimla is India's one of the most popular and biggest hill-stations, is located in the northwest Himalayas in Himachal Pradesh. It is located at latitude of 21° 13 'N and longitude of 81° 26' E, having an altitude of 2130 - 2205 meters above mean sea level. For devising an appropriate solid waste management system in a town, it is important to know the quantity and characteristics of solid waste generated. For quantifying MSW generation in Shimla, per capita waste generation factor was arrived through following steps:

a) Solid Waste management Manual prepared by Ministry of Urban Development, Govt. of India was referred and per capita generation factor corresponding to the present population of Shimla is being identified. (Table 1)

Table 1: Per Capita Waste Generation as Per Manual on Solid Waste Management by Ministry of Urban Development, Govt. Of India

Population Range	Average per capita waste generation (kg/day)	Remarks
<10,000	0.21	
10,000-50,000	0.21	
50,000-1,00,000	0.25	
1,00,000-2,00,000	0.27	
2,00,000-5,00,000	0.35	
>5,00,000	0.5	0.6 kg /day is observed in some

b) Based on the data on waste generation for the year 2013, 2014, 2015 as given by MC, Shimla, Per capita waste generation factor is being calculated using projected population for corresponding years.(Table 2)

Table 2: Per Capita Waste Generation as per Information Provided by MC Shimla

Description	Year 2013	Year 2014	Year 2015
Quantity of waste generation as given by MC, Shimla(in tons)	197	206	212
Total Population	324354	333564	343035
Per Capita waste generation factor	0.60	0.61	0.61

(c) Based on the total quantity of waste reaching the existing waste processing site (year 2015)

According to MC Shimla about 134 ton waste quantity per day reaches the existing waste processing site. Based on the discussion with various NGOs working in Shimla and MC, Shimla officials, it has been concluded that the existing waste collection is only 65 %. The total waste generation then can be estimated as (134 /0.65 t/day) or 206 t/day. Per capita waste generation factor = 206000/343053 = 0.6004 kg/capita/day

For design purpose, higher per capita waste generation factor has been considered. As per capita generation factor of 0.65 kg/day is considered here. Based on this factor, the projected waste generation for the year 2021, 2026, 2031 and 2036 in Shimla is estimated to be 271, 313,360 and 413 tonnes per day respectively.

Shimla generates about 206 tons of MSW per day. At present, MC, Shimla is managing MSW generated from MC area and SADA areas of Dhalli, Kasumpti and Tutu only. Total waste generation from these areas is around 60 tons per day. Out of which tons per day (65 %) is collected and processed at the existing waste processing site in Darni ka Bagicha. For collection of waste, MC, Shimla has provided dustbins and dumper placer containers at different places in the city. However, only the Mall and the Ridge areas appear cleaner. Remaining areas predominantly residential and commercial localities namely, Subzi Mandi, Lower Bazaar, Jakhu, Kaithu, Sanjauli, Kasumpti, Boileauganj and Summer Hill witness acute solid waste problem.. As more than 80 % areas are not accessible by vehicles, therefore it is imperative to enforce the Door-to-Door collection scheme strictly.

VI. Collection Of Waste From Residential & Commercial Areas

Presently, in Shimla door-to-door waste collection system is operational in only 2300 houses out of a total of around 40,000 households in Shimla. This accounts for around 8 % of the total number of houses. In remaining 92 % of the area, residents directly place their waste in nearest concrete dustbins or dumper placer bins placed by MC, Shimla. Door to door waste collection is being carried out by three NGOs in Shimla, namely, Green Carpet, Sulabh International, Pragati Sudhar. Green Carpet also collects waste from commercial areas like Mall road, Subzi Mandi.the green carpet vehicle picking up waste from commercial area.

Currently, waste collected by NGOs through door step collection system is either placed in the nearest concrete dustbin or nearest dumper container. Similarly, waste collected through street sweeping is placed in these dustbins. There are about 206 dumper placer container placed in Shimla. Out of the total, 142 containers are placed in MC area and 64 dumper containers in SADA areas. In addition to the above there are 93 small dustbins placed for disposal of waste by residents in Shimla.

There are seven Health Care centres and 39 nursing homes, dispensaries and clinics in Shimla The biomedical waste generated from these Health Care centres is stored separately in different colour coded bags and domestic waste is stored in buckets. The domestic waste is placed in the nearest dumper container by safai karamchari of the health Care Centre. A NGO called 'Green Carpet' is engaged by MC, Shimla to collect and transport Bio-medical waste in covered Cargo-Maruti Van to the centralized Incinerator facility in Shimla.

VII. Traffic Management

The inventory data for road network was analyzed in terms of parameters like type of road, carriageway, road classification, type of pavement, kind of on-street parking, footpath, street light facilities, road markings etc. Shimla Urban Agglomeration Area (which covers the area within municipal limit) about 25.20% is under Traffic & Transportation, however the Shimla Planning area (the study area) in a whole has allocated with 3.75 % of land under Traffic & Transportation (Draft Master Plan 2021) which is less than required for a large hill town (6 - 8%, as per UDPFI guidelines).

Cart Road or Circular Road or Motor Round Road starting from Railway Tunnel No. 103 to Dhalli Tunnel and traversing round the Shimla Hill which is a part of NH 22. This is a main arterial road. Initially this road was designed for the carts, hence named as Cart Road. Over the time, development has led the same road to be used by Motor vehicles naming it has a Motor Round Road. The average road width is about 8 m. The length of Cart road is 18 km,hence, delimiting the Core Area. Pedestrian's footpaths are built at critical locations on Cart Road on the valley side in form of cantilever structures that hold the footpaths with hand railings.

Roads connecting to Cart Road are looked after by Shimla Municipal Corporation, thus known as municipal roads.The total length of roads for vehicle movement under the Municipal Corporation as per data available with the SMC is 74.6 kms.

The central market place in the core area and houses a number of heritage sites and buildings lies on Mall Road. The major tourist attraction of Shimla is the Mall.The road from Boileauganj to Scandal point and from Scandal point to Secretariat and from Scandal Point to Sanjauli Chowk forms the Mall road. The road along the Mall is basically for pedestrian movement and entry is restricted for vehicles except for vehicles with permits and emergency vehicles.

Municipal paths along with stairs for pedestrian movement are in the form of backlog pedestrian. These stairs are used for manual transportation of goods/payloads by porters. The total length of walk paths under SMC is 73 kms.

The Mall road and the Ridge are used for only pedestrian movement. The accessibility to these areas is through pathways/staircases and the lift. The mechanized transport system available for vertical mobility between Cart road and the Mall road is through the Lift. Total road length of Shimla city is 193.65 kms. Footpath are available at 30.09 kms road and remaining 163.56 kms road has no footpath. Only 16 % of the road network has footpath while 84% of the road network do not have footpaths. Street lighting are available at 30.09 kms road and remaining 163.56 kms road has no Street lighting. 74.5% of motor able roads under Shimla Municipal Corporation (SMC) or 36% of total roads under SMC have Street lighting facility.
Figure 1 gives a description about the road network of Shimla.

Figure 1: Road network in Shimla area

In Shimla Planning Area the number of registered vehicles has increased from 16,450 vehicles in 1995 to 48,000 vehicles in 2011. The Current population of the four wheelers constitute 50 % of total registered vehicles, while two wheelers constitute 20 % of total registered vehicles, together with the share of private vehicles is 70 %. Van or maxi cab used for rage purpose for tourist taxi constitute 13 % of total registered vehicle. Only 3 % of total registered vehicle are buses.

VIII. Conflicts Between Vehicles And Pedestrians

The movement of pedestrians on carriage way of road cause traffic hindrance and increase the journey time, wastage of fuel and impact on traffic flow. Inadequate/unspecified pedestrians crossing cause traffic hazards leads to many accident. As per traffic police Shimla information about 149 minor/major accident occurred during year 2016.

The degree of conflict between pedestrians and vehicles is determined by PV^2 where V is the two way total hourly flow of vehicles and P is the two-way total hourly flow of pedestrians crossing the road within 50 m on either side of the site during peak hours. If the value of PV2 exceeds 108 (or 1 =PV2/108) for an undivided road or 2 x 108(or 2 = PV2/108) for a divided road, then there is requirement of pedestrian crossing facility. (Figure 2)

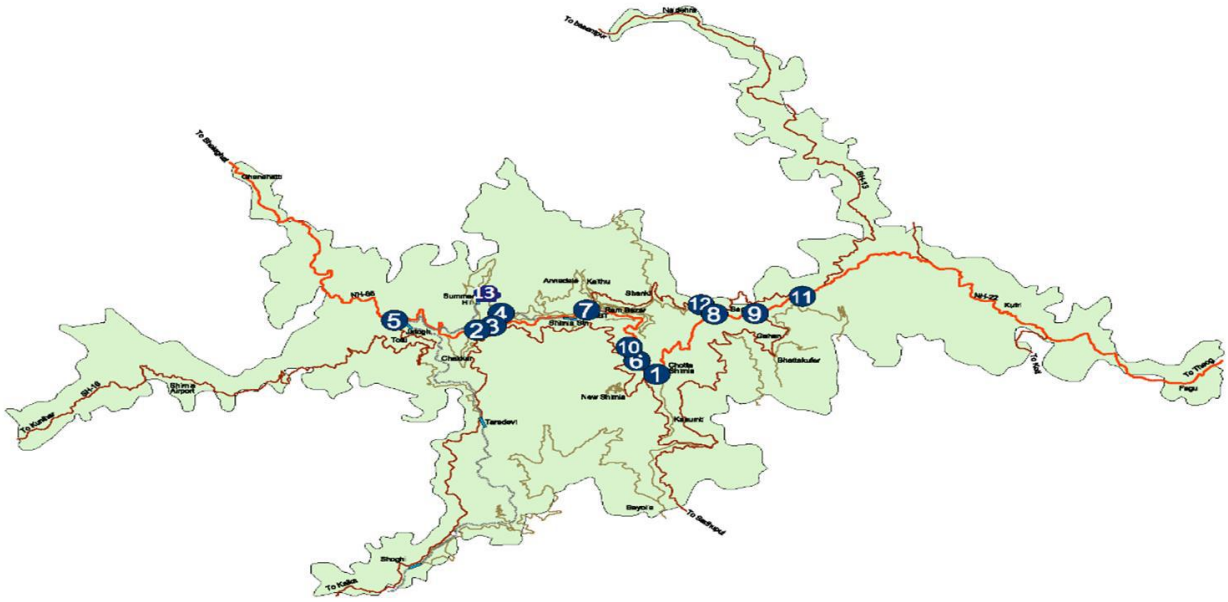

Figure 2 : Map showing survey locations.

Pedestrian volume surveys were conducted at all major intersections and mid-block locations to assess the pedestrian volume and flow across and along the intersections or mid-block for designing of pedestrian facilities at 13 location. (Table 3)

Table 3: Pedestrian Volume Count

S.NO	Name of Location	Peak Hour(am)	Along	Across	Total
1	Chota Shimla	09:45-10:45	627	178	805
2	Boileaugunj	08:30 – 09:30	534	89	623
3	Tutikandi bypass chowk	09:00 – 10:00	221	54	275
4	Bilaspur chowk	09:30 – 10:30	351	169	520
5	Totu chowk	09:15 – 10:15	1160	160	1320
6	Khallini chowk	10:00 – 11:00	2099	70	2169
7	Victory tunnel chowk	09:00 – 10:00	2456	101	2557
8	Sanjauli chowk	09:00 – 10:00	9570	1602	11172
9	Dhalli tunnel by pass chowk	08:30 – 09:30	1666	410	2076
10	Kusumpti chowk	09:45 – 10:45	835	409	1244
11	Dhalli bus stand chowk	09:00 – 10:00	1039	72	1111
12	IGMC chowk	09:15 – 10:15	556	12	568
13	University chowk	09:15 – 10:15	1185	376	1561

The traffic counts both in terms of numbers of vehicles and passenger car units (PCUs) have been computed at various 13 locations and shown in Table 4.

Table 4: Traffic Volume at 13 Different Intersection

S. No.	Name of Location	Peak Hour(am)	(PCU's)
1	Chota Shimla	09:45-10:45	1561
2	Boileaugunj	08:30 – 09:30	283
3	Tutikandi bypass chowk	09:00 – 10:00	1373
4	Bilaspur chowk	09:30 – 10:30	1188
5	Totu chowk	09:15 – 10:15	1170
6	Khallini chowk	10:00 – 11:00	865
7	Victory tunnel chowk	09:00 – 10:00	3577
8	Sanjauli chowk	09:00 – 10:00	1517
9	Dhalli tunnel by pass chowk	08:30 – 09:30	932
10	Kusumpti chowk	09:45 – 10:45	1779
11	Dhalli bus stand chowk	09:00 – 10:00	1045
12	IGMC chowk	09:15 – 10:15	1023
13	University chowk	09:15 – 10:15	671

As both the pedestrian volume and traffic volume has been calculated we have to calculate the degree of conflict between pedestrians and vehicles by PV2 as shown in Table 5 where V is the two way total hourly flow of vehicles and P is the two-way total hourly flow of pedestrians crossing the road.

Table 5: Degree of Conflict between Pedestrians and Vehicles

S. No.	Name of Location	P	V	$V2$	$PV2$	$PV2/108$
1	Chota Shimla	178	1561	2436721	433736338	4.33738
2	Boileaugunj	89	283	80089	7127921	0.07121
3	Tutikandi bypass chowk	54	1373	1885129	101796966	1.01796
4	Bilaspur chowk	169	1188	1411344	238517136	2.38516
5	Totu chowk	160	1170	1368900	219024000	2.19024
6	Khallini chowk	70	865	748225	52375750	0.52375
7	Victory tunnel chowk	101	3577	12794929	1292287829	12.9228
8	Sanjauli chowk	1602	1517	2301289	3686664978	36.8666
9	Dhalli tunnel by pass chowk	410	932	868624	356135840	3.56135
10	Kusumpti chowk	409	1779	3164841	1294419969	12.9441
11	Dhalli bus stand chowk	72	1045	1092025	78625800	0.78625
12	IGMC chowk	12	1023	1046529	12558348	0.12558
13	University chowk	376	671	450241	169290616	1.69296

The cost of one Overpass/Underpass Wooden Bridge is Rupees 79 lakhs approx. If we have to construct 9 Overpass/Underpass Wooden Bridge in Shimla the amount required is Rupees 7 cores. The cost of one Overpass/Underpass Pre-Fab Steel Bridge is Rupees 1 core. If we have to construct 9 Overpass/Underpass Pre-Fab Steel in Shimla the amount required is Rupees 9 cores.

IX. Conclusions And Recommendations

The idea of the smart cities revolves around the compact areas, creating a reliable plan. If by installing modern waste plant for Shimla city as per the case study of this project we found that the energy of about 0.3698 MWh per capita per year can be produced. Study also helped that if this modern plant continues the profitable sum of Rs. 4470064183 can be achieved in coming next 21 years.

Before the introduction of smart modern waste plant, the generation of the waste contributes about approximately 129.028 kg waste per capita per year. Adopting the technique benefitted us by providing 0.3698 MWh energy. Therefore it is important to know the quantity and characteristics of solid waste generated, before designing the appropriate solid waste management system in a town.

Benefits drawn from the modern waste plant to putting the environment waste to production of energy, at the same time minimizing the impact on, and risk to, health and the environment.

Reduced landfilling and increased recovery and recycling can largely be achieved by household sorting of waste at source. By incineration, many harmful substances break down and the residual substances are bound in ash, which makes them easier to control, handle and recycle. The environmental factor can be saved. The landfill occupied placed by be utilized in other better.

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[11]. way. The study case with the concept of smart waste disposal not only contributes to drawn benefit from the waste and make our city economically sound.

[12]. For smart city the smooth flow of traffic play very important role, hence planning of city/smart city the free flow of traffic plays very important role, being a hilly station and having number of redistricted road. The overpasses and underpasses are essentially required for pedestrian. At least 50 % population/tourist move to their destination point. The number of pedestrian crossing is required. It is observed that at least 9 place required overpasses/underpasses to pedestrian so that traffic moment could not hinder.

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