

Survey of pedestrian infrastructure at signalled intersections in Pune

Study conducted in July 2020

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1. Introduction

Save Pune Traffic Movement (SPTM) is a Non-Government Organization promoting transport projects that make it safe, convenient and attractive to use sustainable modes, viz., walking, public transportation and cycling.

Pune city is growing by leaps and bounds. Using these “sustainable” modes is becoming challenging day by day, largely because our transport planning does not focus on these modes as much as it should. As an example, even though walking is the most basic mode of transportation and a fundamental right, facilities for pedestrians are largely unsafe, inconvenient and unattractive.

Data from fatal road crashes in Pune shows that about 30% of the victims of road crash fatalities in Pune are pedestrians. This amounts to about 75-80 pedestrian fatalities annually. Some of these fatalities happen when people cross roads and some when people are simply walking along roads.

Pedestrians can cross roads at intersections (whether controlled by signals or not) as well as mid-block. Grade separated facilities like foot-overbridges or underpasses are provided at a handful places. However, they largely remain unused because pedestrians find it inconvenient to use them. Much has been discussed about this issue, which is outside the scope of this survey.

Talking about at-grade facilities to cross a road, signal controlled intersections are among the relatively safer facilities available in Pune. The following infrastructure contributes to the safety of pedestrians at signal controlled intersections:

1. Clean and conspicuous zebra and stop line markings, which clearly indicate where exactly the vehicles need to stop.
2. Working pedestrian signal aspects (lights).
3. A sufficiently long “pedestrian phase” in the signal cycle, so that pedestrians can complete crossing the road before vehicles get a green signal.
4. Some mechanism that indicates to pedestrians whether it is safe to start crossing a road now, or whether they should wait for the next signal cycle.
5. Audio indication for visually challenged persons.

SPTM supports data-driven decisions for transportation projects. Therefore, instead of relying on statements like “The zebra markings in Pune are better now”, SPTM decided to conduct a survey to see which of this infrastructure is provided at signal controlled intersections in Pune, with an attempt to assess how safe these intersections were for pedestrians.



2. Objectives of the study

1. To assess whether intersections in Pune provide basic infrastructure for pedestrians to cross roads safely.
2. To establish a benchmark, against which the infrastructure may be assessed periodically.

3. Methodology

About 250-260 intersections in Pune have traffic signals. It was understood that about 25-30 of these signals were kept switched off by PMC at the request of Pune Traffic Police (although there may or may not have been any objective reason for this action).

Since the number of signals is not extremely high, in March 2020, SPTM had planned to survey all these signals rather than taking a random sample. However, a lockdown was imposed in the city due to the COVID-19 pandemic, because of which the survey could not be undertaken at that time.

When the lockdown was partially lifted, the traffic on the streets was still low to medium. The signals were turned on only at 100-120 or so intersections. Since these are the most important intersections, SPTM decided to use this opportunity to survey all these intersections in July 2020.

3.1. Data collection

The data required for this study was collected using observations. An online survey form was used to record quantitative data, including the GPS location of the intersection. The surveyors filled in the form from their mobile phones from the site. This method ensured that no further data entry was required. The data was then exported to MS-Excel for easy processing.

The surveyors also photographed this infrastructure at some of the intersections.

3.1.1. Road markings

The data collection form required the surveyors to rate the road markings (Zebra and stop line) on each arm of the intersection in one of the 3 options below:

1. Perfect: Bright zebra and stop line.
2. Just ok. Might need paint in a few weeks.
3. Too faint or no zebra / stop line.

Respectively, the form automatically assigned 2, 1 and 0 points to that arm.



3.1.2. Pedestrian signals

The form required the surveyors to count the number of installed and working pedestrian signal aspects. Pedestrians need 2 sets of working pedestrian signal aspects on each arm of the intersection (one in each direction in which they may cross the road). Thus a 4-way intersection needs 16 pedestrian signals (8 red and 8 green).

The surveyors were also required to measure the duration of the “pedestrian phase” in the signal cycle, in seconds. The pedestrian phase is defined as the duration for which all vehicular signals (including any signals for left turn) remain red.

The pedestrians ideally need a way to understand whether it is safe to start crossing a road now, or whether they should wait for the next signal cycle. However, as on date, only 4 signals in Pune provide a mechanism to determine this. Therefore no data regarding this issue was collected, but this is still considered in the analysis.

Likewise, audio indication is needed to tell a visually challenged person whether it is safe to cross the road. Since such audio indication is missing at all intersections in Pune, no data was collected in this regard; but this point is also considered in the analysis.

3.2. Method of analysis

3.2.1. Scoring the infrastructure

The 5 types of infrastructure pedestrians need to make the intersection safer to cross, were assessed as under:

1. Road markings (Good zebra and stop line): These prompt vehicles to stop in a disciplined manner, and pedestrians can cross roads in a dignified way instead of having to find their way through stopped vehicles. Each arm received a score of 2/1/0. The road marking score of the junction was calculated as:
$$(\text{Total score of all arms}) / (2 * \text{number of arms})$$
2. Working pedestrian signal aspects: These highlight that pedestrians exist and need some time to cross the roads. Since each arm needs 4 working signals, the pedestrian signals score of the junction was calculated as:
$$(\text{Total number of working pedestrian signal aspects}) / (4 * \text{number of arms})$$
3. Sufficient pedestrian phase timing: This allows an average person to cross the road before vehicles are again granted a right of way. The IRC guideline IRC:93 provides a formula for determining the duration of the pedestrian phase. According to that formula, a typical 3+3 road needs a pedestrian phase of ~25 seconds if there is no pedestrian refuge, or 16 seconds if well designed pedestrian refuges exist. To simplify the issue, this survey assumes that a pedestrian phase of 20 seconds provides sufficient safety for pedestrians. Thus the pedestrian phase score of the junction was calculated as:
$$(\text{Existing pedestrian phase}) / 20, \text{ with a maximum value of } 1.00 \text{ if the pedestrian phase is more than } 20 \text{ seconds.}$$



4. A mechanism that tells a pedestrian whether it is safe to start crossing now: As a pedestrian starts to cross a road even when the pedestrian signal is green, s/he needs to know how many seconds remain before vehicles get a green. This can be achieved by installing pedestrian signals with timers. Alternatively, the signals should be programmed in such a way that even as the red pedestrian signal starts blinking, vehicles will not get a green signals for a duration prescribed by IRC:93. This will ensure that a pedestrian who has started crossing the road as the steady green turns blinking red, will be able to cross the road safely.

Whether a given signal has this feature or not is a binary function, hence the score for an intersection was determined as 1 or 0.

Since signals at only 4 intersections in Pune give such an indication to pedestrians, those 4 intersections scored 1. The remaining intersections scored 0.

5. Audio indication to tell a visually challenged person whether it is safe to cross the road. Here too, whether a given signal has this feature or not is a binary function, hence the score for an intersection was determined as 1 or 0.

All intersections in Pune score 0 in this column today.

3.2.2. Weightage of the infrastructure

Certain weightage was assigned to the 5 types of infrastructure, which was determined using the following reasoning.

The infrastructure can be categorized in 2 major "buckets":

- A. Road markings
- B. Signals

At the outset, let us say that their weightage could be 30:70. All minor attributes within these buckets should be accommodated within their respective weight.

For signals, one important attribute is the existence of pedestrian signal aspects themselves. However, the signal aspects are a rather basic infrastructure, like the thermoplastic paint for road markings. Most new chowks anywhere in India would have this infrastructure. Hence we said that this "basic" infrastructure together need not have a weightage of more than 50%. This basic infrastructure consists of

1. Zebra and stop line markings
2. Pedestrian signal aspects

If road markings have a weightage of 30%, the pedestrian signals would have 20%.

The remaining 3 attributes are:

3. Pedestrian phase, or sufficient time for pedestrians to cross roads.
4. Timers or proper programming or any mechanism that gives a visual indication to pedestrians about whether it is safe to start crossing the road when the pedestrian signal is green.
5. Audio indication for visually challenged persons (required by the People With Disabilities Act, 1996).



These 3 attributes need an application of mind, and can make pedestrian safety in Pune stand out. The following issues were considered while assigning weightage to these attributes:

- It is extremely important that pedestrians get sufficient time to cross the roads, regardless of visual or audio indications.
- Although people in India are more used to visual indication, those who have experienced audio indications abroad think that it is more effective. It could be because even drivers of vehicles (especially in the front row) receive this indication without having to look at the pedestrian signals.
- Further, since visual indication is new to India, assigning it more weight would fetch more attention to the need to install such indication.

Considering these points, #3 was given more weightage, and #4 and #5 were given equal weightage. Therefore a weightage of 20-15-15 was assigned to these 3 attributes.

That gives us a weightage distribution of 30-20-20-15-15 for the 5 types of infrastructure required. This sounds reasonable, and in turn the initial choice of assigning a relative weightage of 30:70 to the major buckets of road markings and signals also sounds reasonable.

These 5 weightages may seem a bit subjective, and they are. Yet, we believe this method creates a benchmark for the intersections today, against which Pune's progress can be assessed periodically.

4. Processing survey findings

4.1. Data entry and calculations

No data entry was required since the survey form was online. The data collection table was exported to MS-Excel for data processing.

The following quotients were calculated for the 5 types of infrastructure mentioned earlier:

1. Road markings quotient
2. Pedestrian signal aspects quotient
3. Pedestrian phase quotient
4. Proper indication quotient
5. Audio alert quotient

Each quotient has a maximum value of 1.00. Each quotient was multiplied by its respective weight to obtain its respective score. All scores were added to arrive at a total score out of 100 for each intersection that reflected how safe the infrastructure in that intersection is for pedestrians.



5. Findings of the survey

The following 3 maps show scores of all intersections covered by the survey. In all maps, red indicates 0% to 33%, yellow indicates 33% to 67% and green indicates 67% to 100%.

Figure 1: Overall score of the intersections

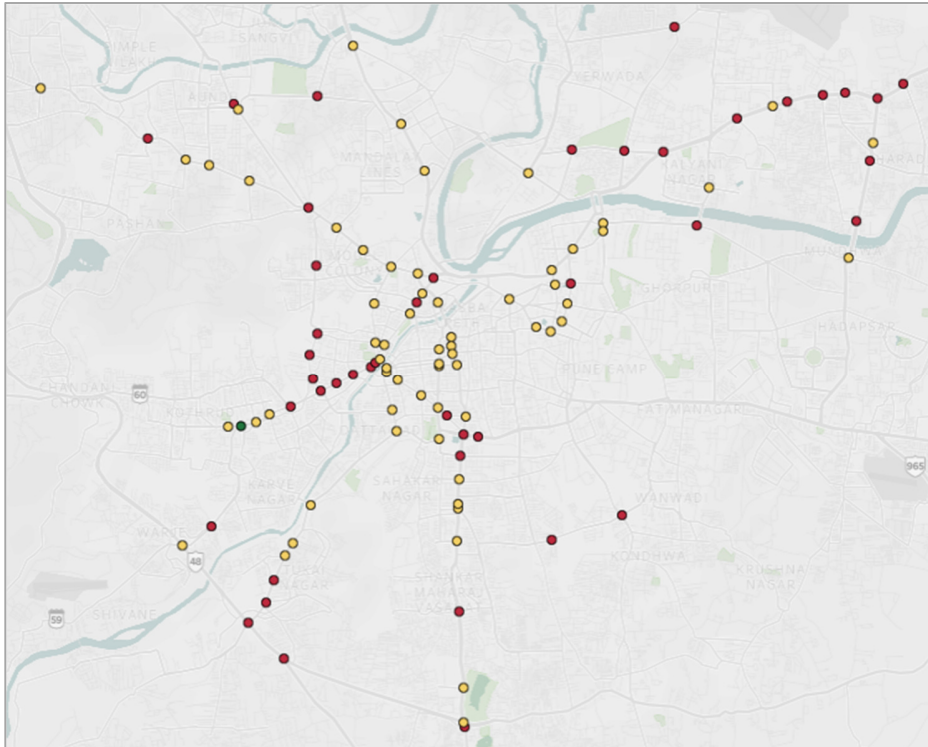
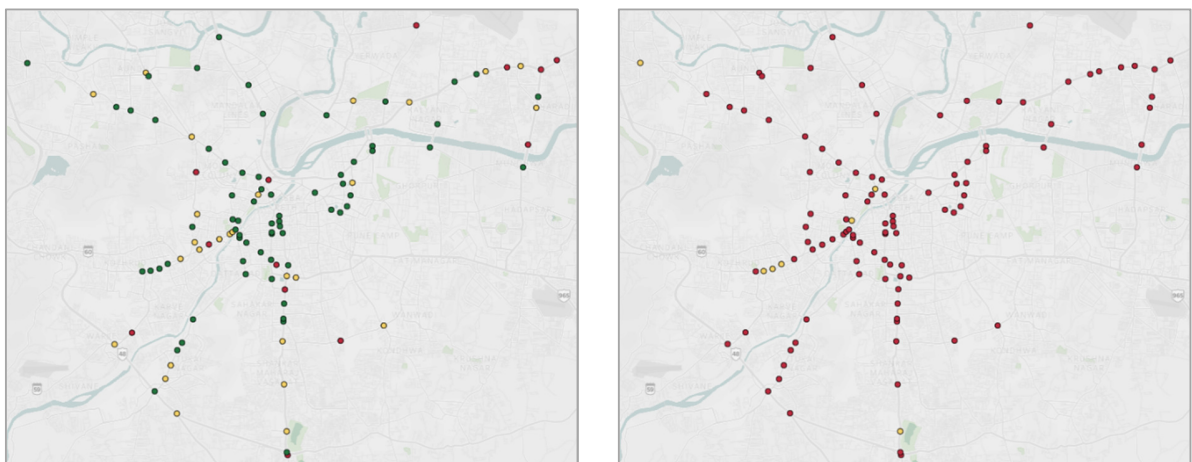


Figure 2: Road markings score (left) and Pedestrian signals score (right)



Some observations from the findings are summarized in the table below:

Table 1: Summary of pedestrian safety scores of the intersections surveyed

	Overall score	Road markings score	Pedestrian signals score
Pune average	35%	74%	19%
High scores	1 intersections scored 67% or more	58 intersections scored 100%	3 intersections scored 50% or more
Intersections with high scores	Mrityunjayeshwar on Karve Road	Several	Mrityunjayeshwar, Karve Putala on Karve Road, Balewadi High Street on Baner Road
Low scores	1 intersection scored 0	8 intersections scored 0	11 intersections scored 0
Intersections with low scores	Katraj Jakat Naka scored 0 on both counts	Several	Several

5.1. Interpreting the findings

5.1.1. Road markings

As can be easily seen from the maps, the road markings required for pedestrians' safety (zebras and stop lines) in Pune seem to be in a much better condition than the pedestrian signals. However, we would like to note the following in this regard-

1. The location of these markings (e.g., whether these zebra striped lead a pedestrian on a divider) were not examined in this survey.
2. Experience and observation suggests that the road markings have improved noticeably in the last 2-3 years. However, there are no quantified observations in the recent past to substantiate this statement. Therefore, instead of commenting on whether 74% is a good or acceptable or bad score, we would like to say that this survey has established a benchmark in July 2007. We would like to see Pune improve this score quickly and maintain it once it improves.



5.1.2. Pedestrian signals

The condition of the pedestrian signals needs substantial improvement.

1. Only about 6% pedestrian signal lights were working. This shows a complete lack of concern for pedestrians' safety on part of the Traffic Police as well as PMC's Electrical Department and their contractors. If Traffic Police cared about pedestrians' safety, they would lodge complaints for missing pedestrian signal aspects. Likewise, if PMC personnel and their contractors cared about pedestrians' safety, they would notice and repair these signals whenever they repaired any vehicular signals in the same chowk.
2. On an average, signals in Pune provide about 56% of the time required for people to cross the roads safely. For information, SPTM's efforts in 2010-12 timeframe have contributed to this number being at least this high. Historically, increasing the timing of pedestrian phase had generally been resisted by Traffic Police in those days and we hope the situation has changed.

5.1.3. Overall scores

It should also be noted that this survey covered only 107 intersections out of approximately 250-260 signalled intersections in Pune. These happen to be the more prominent and important intersections. It could be expected that the road markings and pedestrian signals at these intersections would be in better condition than the others. It is quite possible that these scores could be even lower for the remaining intersections, or if all intersections were surveyed.



6. Conclusion and recommended steps

Based on the findings of these survey, the concerned authorities need to take certain actions to improve pedestrians' safety at signalled intersections.

1. PMC Road Department and Ward offices should continue painting and maintaining the zebra and stop line markings, improving their score continuously.
2. Pune Traffic Police should promptly report malfunctioning pedestrian signals to PMC.
3. PMC Electrical Department should also proactively repair failed pedestrian signal aspects.
4. PMC Electrical Department should ensure that the signals are programmed to provide at least the minimum pedestrian phase duration, derived using formulas provided in IRC:93. They must do this regardless of any opinion to the contrary, whether by general public or Traffic Police or any other entity.
5. In spite of the above, pedestrians will need some indication to tell them whether it is safe to start crossing the road at a given instant. PMC should invest in pedestrian signals with timer, which seems to be the best among the available options. If required, the signal controllers would have to be changed to provide such indication.
6. PMC should ensure that audio indication is supplied so that visually challenged persons can know whether it is safe to cross a road. This is a mandatory requirement as per the Rights of Persons with Disabilities Act, 2016. Such indication must be installed in all new signals, or retrofitted in old signals if possible – else the signal controllers would have to be changed to provide audio indication.

And of course, NGOs like SPTM and others should relentlessly push these authorities to take the required steps.

7. Acknowledgement

SPTM would like to thank the surveyors who spent their valuable time to ensure that the survey gets completed during the gap between the lockdowns imposed because of the COVID-19 pandemic. Their work will go a long way in determining steps that our city should take to make our pedestrians safer.



Annexure 1: Photos

Photographs of some road markings and pedestrian signals.

Figure 3: Bad or missing markings (left, 0 points), just OK markings (right, 1 point)



Figure 4: Good markings (2 points)



Figure 5: Non-functional pedestrian signal



Figure 6: Working pedestrian signal (left), with timer for pedestrians (right)



Annexure 2: Data table

Note: The points awarded for "Status of road markings" can be 2, 1 or 0. Description and examples are provided earlier in this report.

Table 2: Summary of pedestrian safety scores of the 107 intersections surveyed

Sr no	Name of the intersection	No of arms	Working pedestrian signals	Pedestrian phase, seconds	Status of road markings				
					Road 1	Road 2	Road 3	Road 4	Road 5
1	509 Lohagaon	4	2	9	1	0	0	0	0
2	ABC Farm	4	0	0	2	2	1	1	0
3	Abhimanashree	3	1	7	2	2	2	0	0
4	Abhinav College Chowk	3	0	15	2	2	2	0	0
5	Agriculture College	4	0	15	2	2	2	2	0
6	Ahilyadevi	4	0	0	1	1	1	1	0
7	Alankar Theatre	4	0	12	2	2	2	2	0
8	Alka Talkies	3	0	17	2	2	2	0	0
9	All Saints Church	4	0	10	2	2	2	2	0
10	Ambedkar Jn Warje	3	0	7	0	0	0	0	0
11	Ambedkar Jn Yerawada	4	0	8	2	0	0	2	0
12	Appa Balwant Chowk	4	0	10	2	2	2	2	0
13	Athavale Junction	3	0	17	1	1	1	0	0
14	Baji Pasalkar Chk (Wadgaon Bridge)	4	0	0	2	2	2	0	0
15	Zashichi Rani	4	0	10	2	2	2	2	0
16	Baner Aundh T Junction	3	1	10	2	2	1	0	0
17	Belbag (Samadhan Chowk)	4	0	15	2	2	2	2	0
18	Balewadi High Street	5	2	18	1	1	1	2	2
19	Blue Diamond	3	0	10	2	2	2	0	0
20	Blue Nile	4	0	11	2	2	1	1	0
21	Bopodi Ambedkar Nagar	3	0	0	2	2	2	0	0
22	Bopodi KOEL	3	0	8	2	2	2	0	0
23	Brahma Hotel	4	0	12	2	2	0	0	0
24	Bremen Chowk	3	0	12	2	2	2	0	0
25	Chandan Nagar	3	2	11	2	0	0	0	0
26	Chandrama Hotel BEG	3	2	18	2	2	2	0	0
27	Chitale Bandhu Shanipar	3	0	10	2	2	2	0	0
28	Council Hall	4	0	15	2	2	2	2	0
29	Dandekar Pul	3	0	15	1	2	2	0	0
30	Dargah (Nagar Road)	3	0	13	0	0	0	0	0
31	Dattamandir	3	3	13	0	0	0	0	0



Sr no	Name of the intersection	No of arms	Working pedestrian signals	Pedestrian phase, seconds	Status of road markings				
					Road 1	Road 2	Road 3	Road 4	Road 5
32	Dagadusheth Ganpati	4	8	10	2	2	2	2	0
33	Gangadham	4	0	0	2	0	0	0	0
34	Gera Jn	4	0	0	2	2	0	0	0
35	Gold Adlab	4	0	10	2	2	2	2	0
36	Golf Club	4	0	0	2	2	2	2	0
37	Goodluck Cafe	5	3	15	2	2	2	2	0
38	Goyal Ganga Chowk, Sinhgad Rd.	3	0	10	1	1	0	0	0
39	Hingane Khurd	3	0	12	2	2	2	0	0
40	Hirabag Chowk	4	0	15	2	0	0	0	0
41	Hotel Mahabaleshwar	3	0	10	1	1	1	0	0
42	Hotel Panchami	3	0	15	2	2	2	0	0
43	IB Bungalow	4	0	8	2	2	1	0	0
44	JM Mandir Ped	3	4	20	2	2	2	0	0
45	Jahangir Hospital	3	0	8	2	2	2	0	0
46	Range Hill Road	3	1	17	2	2	2	0	0
47	Jedhe Chowk (Swargate)	4	0	10	1	2	1	1	0
48	Jijamata Chowk	4	0	10	2	2	2	2	0
49	Hutatma Rajguru (Karishma)	4	0	15	2	2	2	2	0
50	Karve Statue	3	2	20	2	2	2	0	0
51	Katraj Bypass	4	0	15	2	2	2	0	0
52	Katraj Dudh Dairy	3	6	15	1	1	1	0	0
53	Katraj Jakat Naka	3	0	0	0	0	0	0	0
54	Keshavnagar Mundhawa	4	0	12	2	2	2	2	0
55	Khanduji Baba Chowk	3	1	10	2	2	2	0	0
56	Kharadi Jn	3	1	5	0	0	0	0	0
57	Law College - Bhandarkar Rd	3	0	15	1	1	1	0	0
58	Law College - Prabhat Rd	3	0	10	2	2	0	0	0
59	Laxminarayan Talkies	4	0	10	0	2	0	0	0
60	Mahesh Lunch /NIV	3	2	7	2	2	2	0	0
61	Maldhakka	4	0	13	2	2	2	2	0
62	Mangala Talkies	4	0	10	2	2	2	2	0
63	Mangaldas	3	0	8	2	2	2	0	0
64	Market Yard	4	0	25	2	2	2	2	0
65	Marriot SB Road Bhosale Chowk	4	1	5	2	0	0	0	0
66	Modern College JM Road	3	0	15	1	0	2	0	0



Sr no	Name of the intersection	No of arms	Working pedestrian signals	Pedestrian phase, seconds	Status of road markings				
					Road 1	Road 2	Road 3	Road 4	Road 5
67	Mrutyunjay Mandir	3	2	18	2	2	2	0	0
68	Nal Stop	3	0	17	1	1	0	0	0
69	Natraj Ped	3	4	20	2	2	2	0	0
70	Navale Bridge	4	5	10	1	1	1	1	0
71	Nehru Memorial Hall	3	0	10	2	2	2	0	0
72	North Main Road Petrol Pump	4	0	10	2	2	2	2	0
73	Paud Phata	4	0	0	2	2	1	0	0
74	Poultry Farm	4	0	9	2	2	2	2	0
75	Pushpamangal	3	0	35	2	2	2	0	0
76	Radisson Blue Kharadi	4	4	12	2	2	2	0	0
77	Rajaram Bridge	3	0	10	2	2	2	0	0
78	Rajwada Hotel	3	3	5	2	2	2	0	0
79	Rameshwar	4	2	17	2	2	2	2	0
80	Rasa Shala Karve Road	4	0	15	1	1	1	1	0
81	Rashtra Bhushan Chowk	4	0	10	2	2	2	2	0
82	Rawat Brothers	3	1	20	1	1	1	0	0
83	Reliance Mart Kharadi	4	0	12	2	0	1	2	0
84	Rishi Malhotra	3	0	15	2	0	0	0	0
85	SP College	4	0	10	2	2	2	2	0
86	Sahitya Parishad	4	3	10	2	2	2	2	0
87	Sancheti	4	0	15	0	0	0	0	0
88	Sanjeevan Netralay (Near Swargate)	3	0	15	1	1	1	0	0
89	Santosh Hall	4	0	25	2	2	2	2	0
90	Sarasbag Savarkar Chowk	3	0	10	2	2	2	0	0
91	Senadatta LBS Road	3	0	15	2	2	2	0	0
92	Shanipar	4	0	12	2	2	2	2	0
93	Shastri Jn	3	1	0	2	0	0	0	0
94	Shelar Mama Chowk	3	0	15	1	0	1	0	0
95	Shimla Office	4	2	15	2	2	2	2	0
96	Somnath Nagar	3	2	8	1	2	0	0	0
97	Suryamukhi Datta Mandir	3	1	15	2	2	0	0	0
98	Swatantrya Chowk	4	0	10	0	0	0	0	0
99	Tata Guard Room	3	3	18	0	0	0	0	0
100	Tilak Chowk Near Alka Talkies	5	0	15	2	2	2	2	2
101	Tukaram Paduka	3	4	15	2	2	2	0	0



Sr no	Name of the intersection	No of arms	Working pedestrian signals	Pedestrian phase, seconds	Status of road markings				
					Road 1	Road 2	Road 3	Road 4	Road 5
102	University	3	0	0	1	1	1	0	0
103	Vadgaon Sheri Phata	4	0	0	2	2	2	0	0
104	Warje Flyover	4	0	18	2	2	0	1	0
105	Viman Nagar	3	2	5	2	2	2	0	0
106	Yashwantrao Natyagriha Chowk Ped	3	0	25	2	2	2	0	0
107	Yashwantrao Chavan Pul	3	0	15	1	1	1	0	0

