

This document is a draft prepared with the intent of formalizing a policy for uniform installation / implementation of road traffic signals.

To help inform this as a first step I am attempting to provide a summary of the IRC norms relating to this matter – as pedestrian safety is the prime agenda, the summary covers points more pertinent to pedestrians rather than vehicles.

IRC guidelines on design and installation of road traffic signals (IRC: 93-1985)

The code begins with an account of definitions / jargon buster. I am detailing the terms likely to be used in this document –

1. Signal face: Part of the actual signal facing the approaching traffic
2. Primary signal face: set of lights nearest to the approaching traffic
3. Secondary signal face: set of lights placed at far end of the junction for the above approaching road.
4. Time cycle: time period for one complete sequence of signal indicators
5. Phase: part of cycle – may be vehicular phase or pedestrian phase
6. Clearance interval: amber following right of way (green)
7. All red period: a part of clearance interval when no one has right of the way
8. Coordinated signals: same as synchronized signals

Part II: Technical aspects

Basically the sequence is as under –

Green → Amber (clearance amber) → Red → Amber (Initial amber) → Green

This section also describes flashing red (= stop), flashing amber (proceed with caution) and the red/green pedestrian signal indicators.

Then there are pages that relate to physical infrastructure of the traffic lights (height, location, lenses etc) – will not go in to detail here but the guide does suggest use of arrows to indicate direction of travel.

Within this section point 22 looks at cycle lengths and green period in signal phasing.

Its sub section 22.1 covers the pedestrian green phase -

The IRC recommends that pedestrian phase timing is adjusted presuming the speed of walking is 1.2meters per seconds. Thus it takes ten seconds to cover 12 meters. Additionally IRC norms recommend addition of 7 seconds as reaction time needed by pedestrians to start walking after phase changes.

22.2 – maximum recommended cycle length = 120 seconds

22.4 – preferably not more than 4 phases in a cycle

Part III: Warrants (I understand this as criteria – one or more need to be fulfilled to install signal)

IRC guide recommends detailed traffic counts to be available to determine above, but the warrants are as under –

minimum vehicular volume warrant: volume of intersecting traffic for each of any 8 hours of an average day is as under No. of lanes		Vehicles per hour on major street (total for both approaches)	Vehicles per hour on minor street (one direction only)
Major road	Minor road		
1	1	650	200
2	1	800	200
2	2	800	250
1	2	650	250

Similar to above, there is another table where interruption to continuous flow i.e. traffic on major road is so high that traffic on the minor street experiences delays.

Next criteria deals with pedestrian volumes

This criteria is satisfied when for each of any 8 hours of an average day the following traffic volume exists –

1. On major street – 600 vehicles / hour (1000 if street is grade separated with pedestrian refuge of 1.5m or more width) in total enter an intersection which attracts 150 pedestrians per hour
2. When average speed of vehicles is 60kph or more or when intersection is in a built up area of an isolated community of less than 2.5 lakhs, the pedestrian volume is adjusted to 70 percentile of above (70th centile of 150)
3. Mid-block (non intersection) traffic lights should be push button and may be installed if the given crosswalk is not closer than 300 meters from an established crosswalk.

Criteria 4 relates to accidents – 5 or more in 12 months

Criteria 5 = if none of the above are met, signals may still be installed if two or more of the criteria 1,2 & 3 are satisfied to 80th percentile of defined volumes.

Appendix of the IRC guide – gives examples and formulae for calculating optimal signal cycle length based on vehicle density. I am not summarizing this as calculation of pedestrian phase is as described above.

Issues in Pune

1. Not all junctions have stop lines, cycle advance areas, 1 meter buffer as recommended in IRC norms and wide zebras in keeping with IRC norms.
2. Inadequate pedestrian phases – pedestrians have to cross 4 to 6 lanes (or more) in 6-8 seconds at many set of traffic lights and free left on red turns.
3. Poor road layouts with Zebra stripes ending abruptly in middle of roads or on narrow and high medians (please refer to documentation by Prashant Inamdar in this matter).
4. Lack of pedestrian refuges
5. Established set of traffic lights are being removed (e.g. LC road – Bhandarkar Road junction without reference to warrants / criteria mentioned in IRC).
6. Traffic phases move randomly – please refer to slide 15 where sequences observed at 3 junctions are detailed by Mr. Ganesh Gaikwad <http://gaikwadgv.googlepages.com/TrafficSignalDesignModificationV3Upl.ppt>
7. Traffic cycle lengths
8. Inappropriate use of signal timers
9. Location of traffic lights conducive to drivers stopping on or beyond zebra crossings (rather than before stop lines).
10. Lack of initial amber phase and all-red phase as described in IRC
11. Most crossings are not disabled friendly and are without dropped kerbs
12. Lack of mid block pedestrian refuges (push button signal and non-signal controlled).
13. Misplaced investment of resources (including time, man power) in planning skywalks / pedestrian subways instead of providing the above.

Solutions suggested and expected by stake holders for each of the above –

1. PMC maps prevailing / planned traffic light controlled junctions and gives a road map / time table for ensuring point one is implemented across the city
2. In keeping with the IRC norms, timings need adjusting as per measured road width pedestrians are expected to cross at a given point in time. This should be calculated as 1 second for every 1.2 meters + 7 additional seconds. Further PMC and Police should discourage and proactively stop the practice of allowing free left turns as this interfered with the pedestrian ROW phase and compromises safety.
3. Points 3 / 4 – please refer to documentation compiled by Shri Inamdar on this matter. Additionally several examples of staggered crossings by way of pictures acquired from London streets have been submitted to the PMC previously. The links below provide access to the latter –
 - <http://better.pune.googlepages.com/Majorintersectionsandpedestriancross.pdf>
 - <http://better.pune.googlepages.com/Moreexamplesofstaggeredcrossings.pdf>
 - Video: <http://uk.youtube.com/watch?v=u77oHBRWhZw>
4. Point 4 covered above
5. Any traffic lights / pedestrian phases removed without evidence to whether or not they meet warrants of IRC norms should be reinstated. Further a proper survey along with public consultation should be made mandatory before removal of established set of traffic lights. The NMT cell, Pedestrians First and SPTM / PTF should be involved in acquiring stake holder views.
6. PMC should make traffic phases within a cycle move in a uniform manner – we suggest that phases switch in a clockwise manner (but phase lengths may differ based on traffic / pedestrian density for each of the approach roads).

7. Cycle lengths in Pune are long (well beyond the IRC norm detailed above). This causes significant waiting times and tailbacks. This coupled with random switching between phases makes the drivers restless leading to them gradually keep progressing towards / beyond the zebra.
8. It is observed that traffic timers also cause restless progression of drivers beyond stop lines in an unsafe manner and that they should be removed. It is appreciated that perhaps the timers were installed with a view to informing drivers how long before they have the ROW (green signal), allowing them to shut off engines there by saving of fuel and reducing pollution. Slide 16 and 17 <http://gaikwadgv.googlepages.com/TrafficSignalDesignModificationV3Upl.ppt> presented by Mr. Gaikwad provides a better alternative to the use of timers. A clockwise uniform rotation of phases at all sets of traffic lights across the city will help drivers learn with experience to predict the approximate time they are due to get ROW and switch off engines when needed.
9. While we appreciate that IRC recommends use of secondary face along with primary face of traffic lights, it is observed that this encourages bad practice of drivers stopping well past stop lines. The problems and solutions in this regard are covered by Mr. Gaikwad in his presentation; please refer to slides 5 to 12 <http://gaikwadgv.googlepages.com/TrafficSignalDesignModificationV3Upl.ppt>. This is common international practice and perhaps not included in IRC norms due the guidance not having had a recent update. This document compiles examples <http://better.pune.googlepages.com/TrafficSignalsPics.pdf> from intersection on London roads and further affirms the above.
10. It is best practice to have an amber phase not just between transition from green to red but also from red to green. The IRC describes these as clearance amber phase (along with all red phase) and initial amber phase respectively.

	<p>We suggest that PMC incorporates this safety mechanism and also ensures an all red phase when between change of phases there is no ROW to anyone (including pedestrians) to avoid accidents inside the intersection. This should help stop the prevailing bad practice of red jumping to green immediately allowing ROW to a different set of vehicles even as clearance amber phase of the previous set of vehicle in process of losing its ROW.</p>
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A demonstration of the above is available on this video - <http://uk.youtube.com/watch?v=bD8yh6EJY4I>

11. Covering issues raised in points 11 -12 we suggest that PMC improves its record on providing adequate number of mid-block pedestrian refuges on lengthy roads as per IRC norms. Further with increasing longevity due to medical advancement, senior citizens will constitute a significant proportion of Pune's demographics. Keeping this in mind it is vital that PMC provides pedestrian facilities that may be used by people with all levels of abilities.
12. Finally, as stated in last but not least of our concerns, it is sensed that rather than using simple well established methods of improving road safety of pedestrians, the PMC (as suggested in the CMP) is spending far too much of its human as well as material resources in planning and prioritizing skywalks / pedestrian subways. These measures are usually used where density of pedestrians is high enough to obstruct traffic for prolonged periods. Such locations are typically around railway stations / major bus stations and not on typical set of cross-roads.

Given that traffic lights are needed for safe passage of vehicles at cross-sections, it is instead better to integrate the pedestrian movement during the ROW phases for the vehicles on the different approach roads. This is shown diagrammatically below. It's rather simple whether at a junction (crossroads or a T) – pedestrian crossings and movement can be integrated within traffic lights cycle by use of pedestrian refuges by allowing pedestrians to cross over small segments of the road at a time. This actually is better than having a separate pedestrian phase where people are expected to cross 6 lanes at one time (needing 25-30 seconds) as crossing 3 lanes at a time means vehicular traffic is stopped for lesser periods, easing off the congestion / tailbacks.

	<p>Now let's presume the traffic lights cycle is 20 seconds for each direction. The traffic is moving from A to B, D and F. This means pedestrians can cross half way on H, G, E and C sections. Now let us presume, that next, all cars coming along C were given a green light (in keeping with the suggestion of phases moving in clockwise direction) to go to F, H and D. This means pedestrians on sections A, B, E and G can cross halfway. In short, during the traffic lights cycle it self pedestrians can cross over with safety, for some sections depending on what part of the cycle they arrive to cross, pedestrians may take a minute to cross over across two sections. This is the most cost-effective means of serving both the purposes. Even with skywalks or subways, traffic lights are going to be needed to coordinate vehicular movement anyway, so why not use the pedestrian refuges (grey rectangular boxes).</p>
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To further affirm the above, this document ends with a link to a video showing a collection of pedestrian refuges outside Hammersmith Tube Station in London; note the 3 closes pedestrian subways which have come in to complete disuse since implementing staggered pedestrian crossings integrated with signals controlling vehicular movement - <http://uk.youtube.com/watch?v=oyaHJ6SxV6U> .