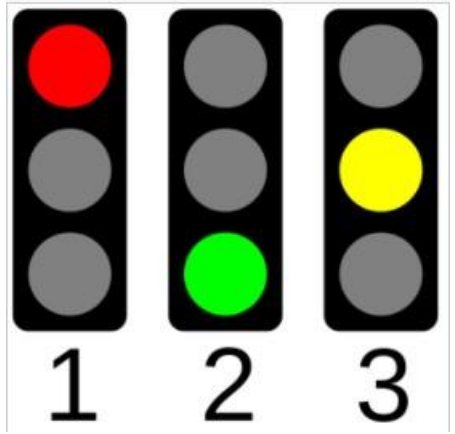
CE 354

PROJECT 3

SATURATION FLOW AT TRAFFIC SIGNAL

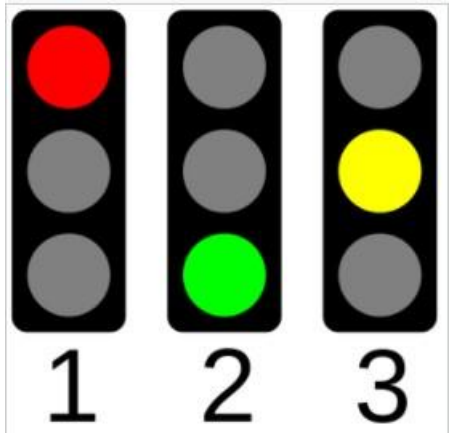
OBJECTIVE

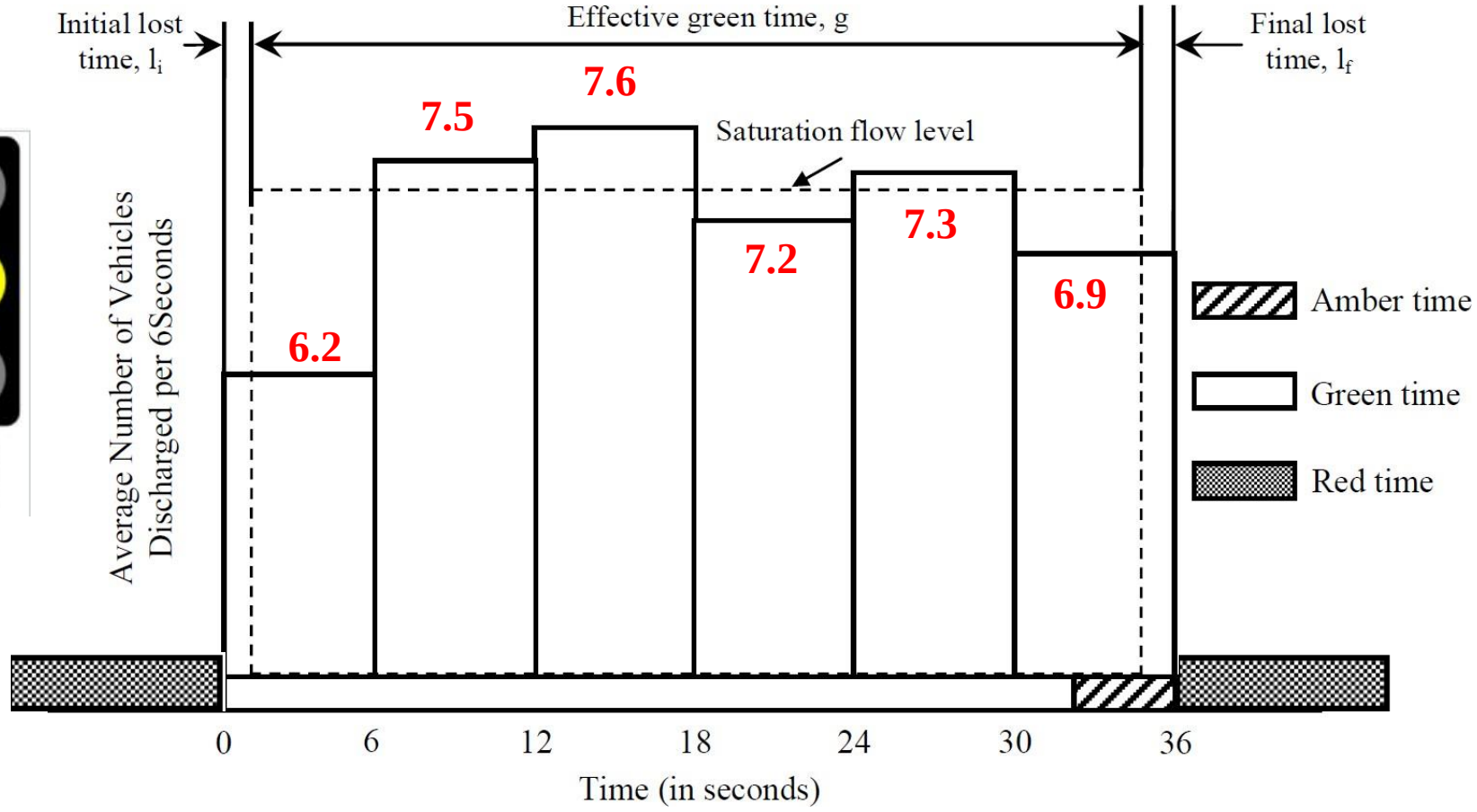
- Determination of Approach Capacity at an Intersection
- Approach capacity is measured in PCU per hour
- What happens at an intersection?
  - Queue forms during Red
  - Queue dissipates during Green and Amber
  - Cycle continues!



Queue at an Intersection

Saturation Flow Diagram





Data Collection Procedure (1)

- Take total cycle time and green + amber period. Divide the combined green plus amber time by 6 in order to find the number of 6 sec intervals and the duration of last interval
- Counting should be taken at the stop line (if there is no stop line a convenient reference line should be marked on the road) [Decide on a road mark and communicate that across the members of your group]
- Start counting at the commencement of green signal and continue till the end of amber period
- For each 6 sec interval, the **classified vehicle counts** should be recorded on the given form

Data Collection Procedure (2)

- For counting purpose, when **rear wheel** of a vehicle will cross the stop line, it should be included in the count for that interval.
- Recording of the flows should be discontinued, when the flow is no longer at the saturation level. [**End of saturation level means — when queue disappears, and vehicles discharge without stopping**].
- Although the counting must stop at the end of the amber, **any vehicle crossing on the red must be included in the last interval**.
- Repeat vehicle counts for 5 cycles.

Sample Calculation: PCU

A	B	C	D	E	F	G	H	I	J	K	L	M
No. of vehicles per 6 sec interval		**1**	**2**	**3**	**4**	**5**	No. of Vechicles in 5 cycles	PCU factor	Converted PCU in 5 cycles	Total PCU in 5 cycles	Cycles	Average PCU
							[Sum of columns C to G]	**[Read from Lecture Appendix]**	**[Column H x Column I]**	**[Sum of column J]**	**[No. of cycles counted]**	**[Column K / Column L]**
0	Car	4	0	0	1	0	5	1	5	31.1	5	**6.22**
	Auto rickshaw	3	2	1	3	1	10	0.5	5			
	Motor cycle	2	2	1	0	2	7	0.3	2.1			
6	Cycle rikshaw	6	5	3	1	4	19	1	19			
6	Car	4	0	0	1	0						
	Auto rickshaw	7	2	4	3	1						
1	Motor cycle	2	2	1	0	2						
2	Cycle rikshaw	23	9	3	1	17						

Sample Calculation: Saturation Flow

$$Saturation\ flow, S$$

$$= \frac{7.5+7.6+7.2+7.3}{4}$$

$$= 7.4 \text{ PCU per 6 sec}$$

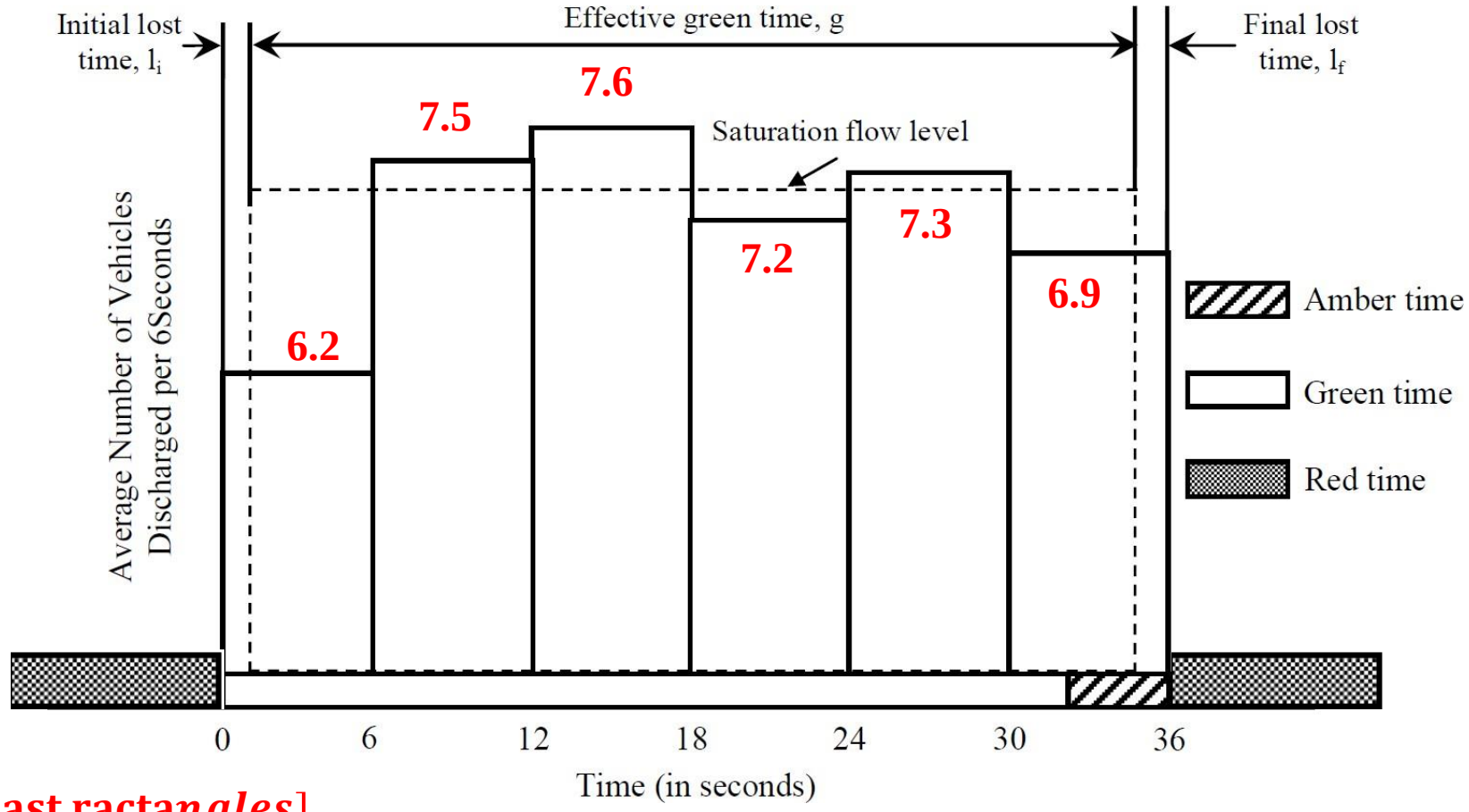
[Be careful about the unit]

$$= 1.233 \text{ PCU per sec}$$

(7.4/6)

$$= 4440 \text{ PCU per hour}$$

(1.233333*3600)



[Remeber to ignore the 1st and the last rectan*gles*]

Calculation (1)

- Convert vehicles to PCU values for each interval.

- Determine average PCU for each interval
  - $Average\ PCU = \frac{Sum\ of\ PCU\ across\ all\ cycles}{Number\ of\ cycles} = \frac{\sigma_{i=1}^{i=C} PCU_i}{C}$
  - [Here, C = total number of cycles, PCU_i is the PCU at the i^{th} cycle]

- Draw histogram (i.e., the discharge profile) **[Y-axis: PCU per 6 sec, X-axis: Time]**

- Determine saturation flow by taking the height of the rectangle in each interval (excluding the first and last)
  - $Saturation\ flow = Average\ hight\ of\ the\ middle\ rectangles$
  - **[Be careful about the unit – PCU/6 sec or 0.1 min -> Convert it to PCU per hour**]

Sample Calculation: Initial Lost Time

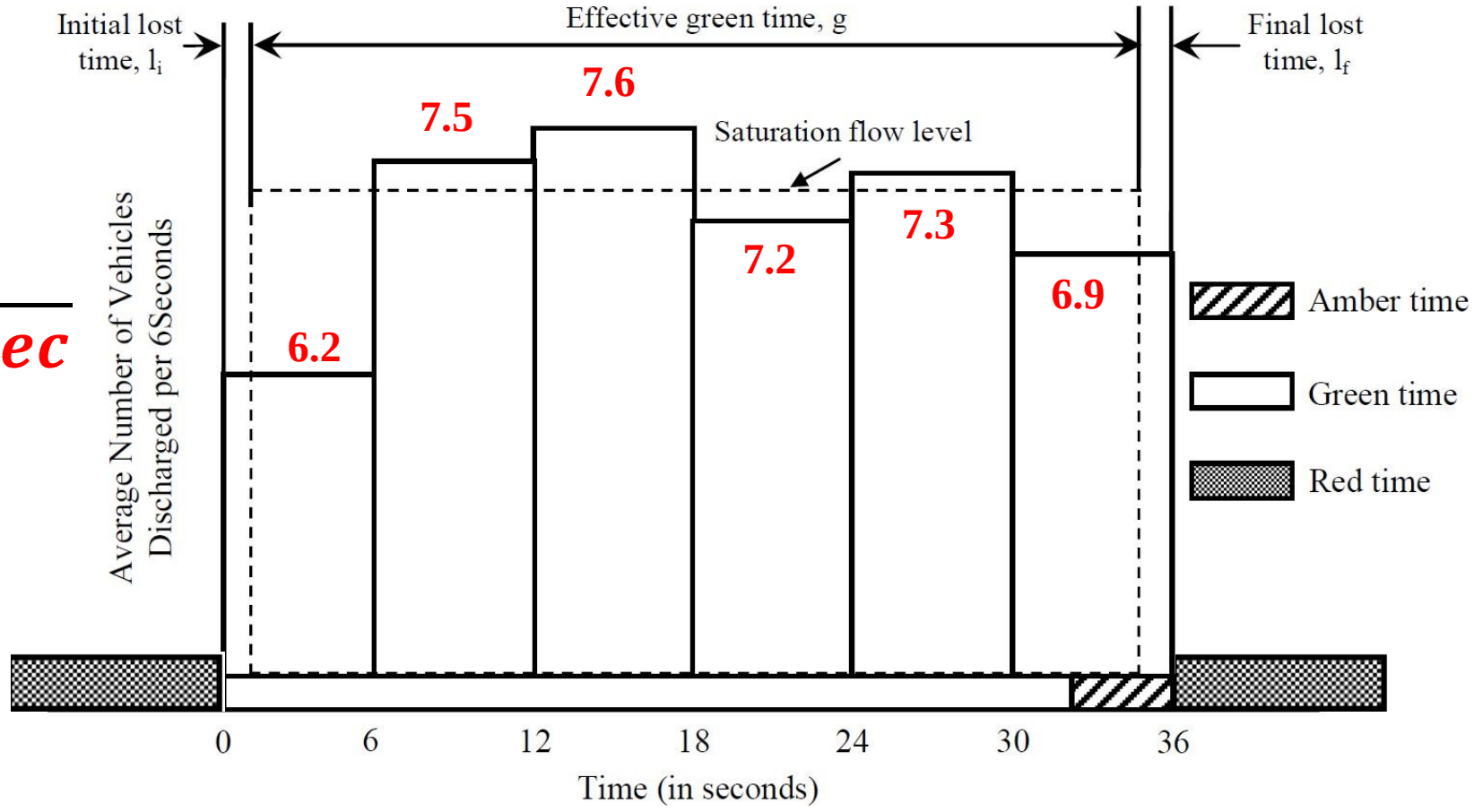
Initial Lost time:

$$l_i = t_i - \frac{n_i}{s}$$

$$= \mathbf{6}\ \text{sec} - \frac{6.2\ PCU}{1.2333\ \boldsymbol{PCU/sec}}$$

$$= 6\ \text{sec} - 5.027\ \text{sec}$$

$$= 0.97\text{sec}$$



Sample Calculation: Final Lost Time

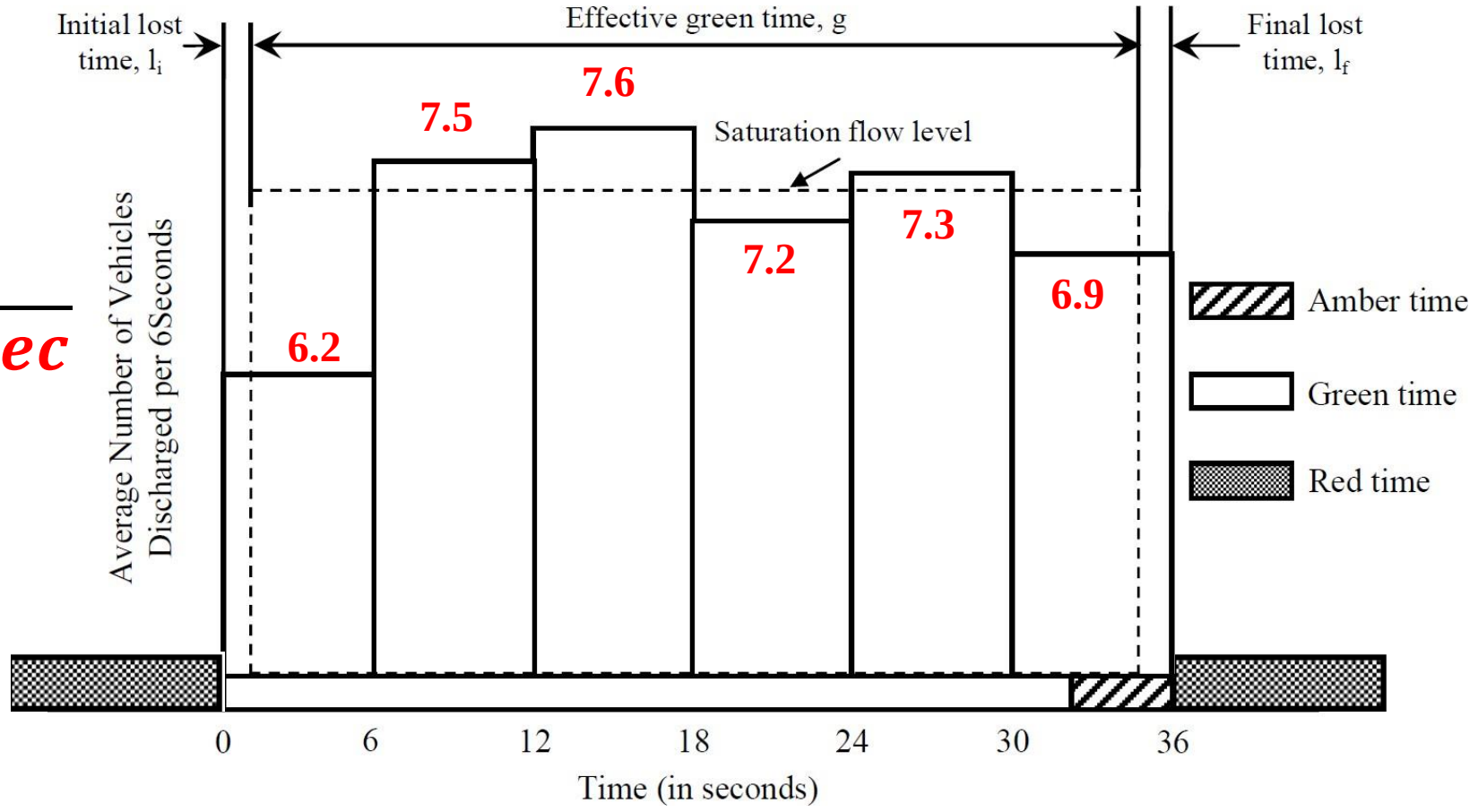
Final Lost time:

$$l_f = t_f - \frac{n_f}{s}$$

$$= \mathbf{6}\ \text{sec} - \frac{6.9\ PCU}{1.2333\ \boldsymbol{PCU/sec}}$$

$$= 6\ \text{sec} - 5.594\ \text{sec}$$

$$= 0.405\ \text{sec}$$

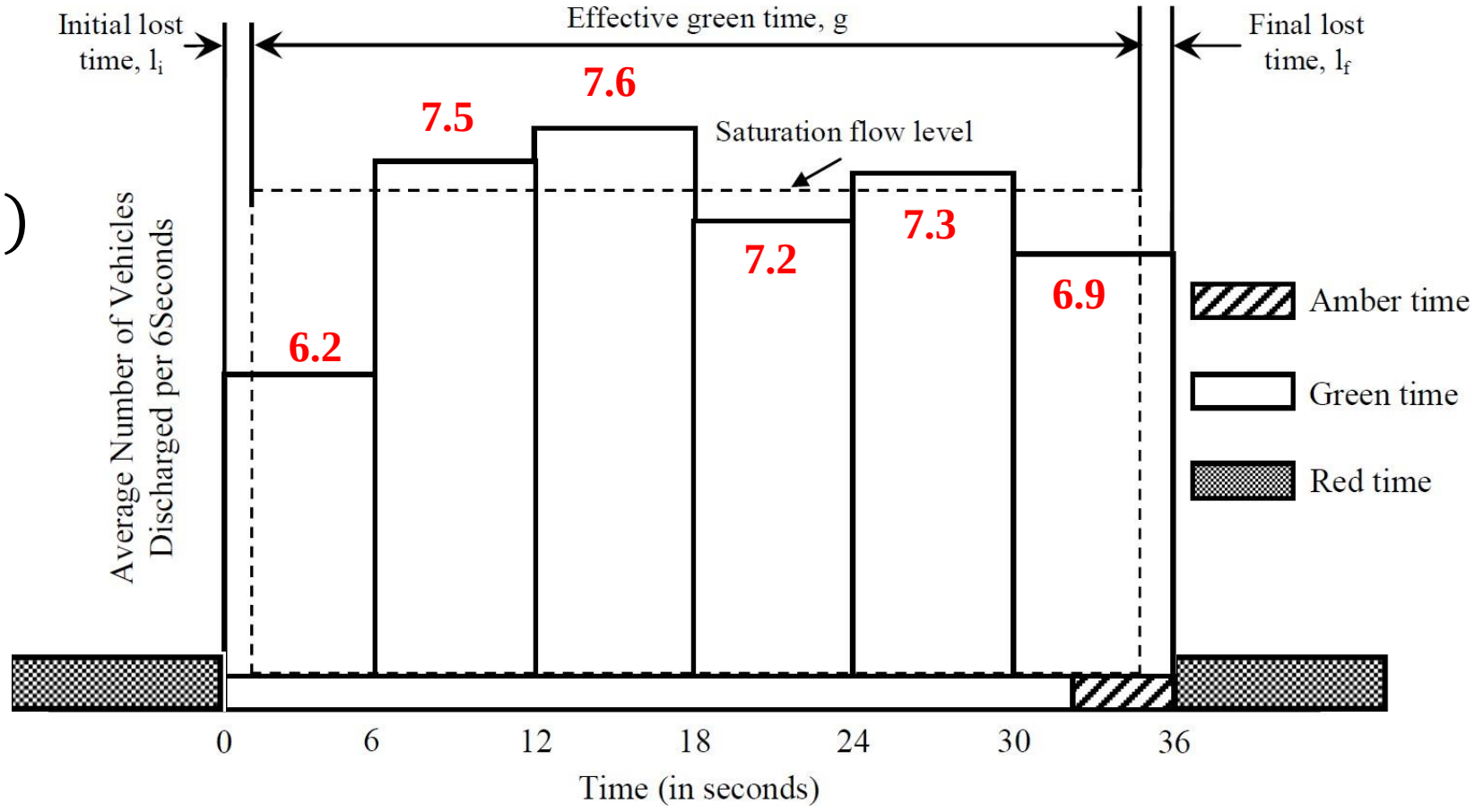


Sample Calculation: Effective Green Time

$$g = G + A - (l_i + l_f)$$

$$= 36\,\text{sec} - (0.97 + 0.405)$$

$$= 34.62\,\text{sec}$$



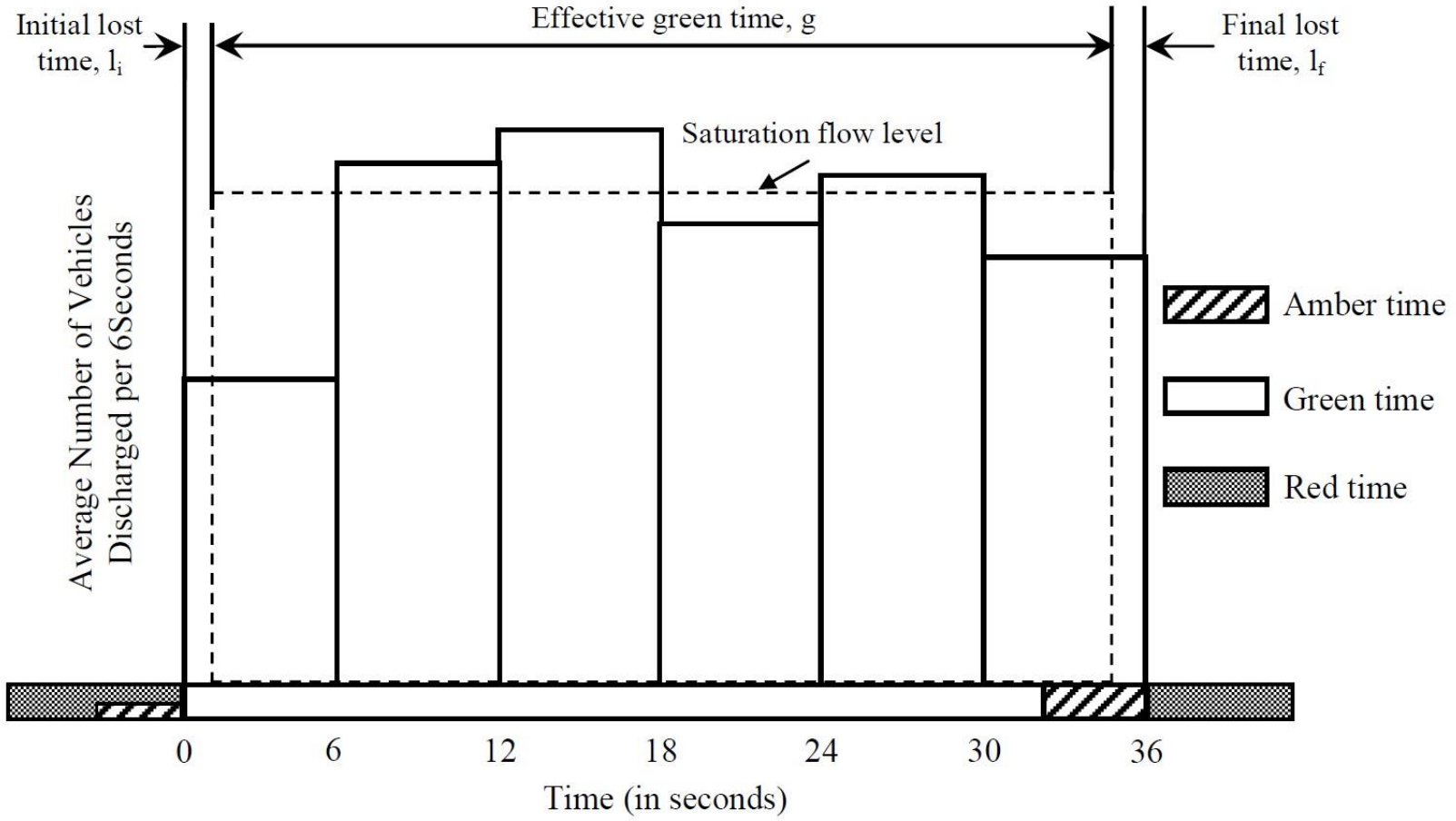
Sample Calculation: Approach Capacity

$$approach\ capacity = \frac{g}{C}\ x\ S\ [\mathrm{C = G+A+R}]$$

$$= \frac{34.62\ sec}{60\ sec}\ x$$

$$4440\ PCU/hr$$

$$= 2562\ PCU/hr$$



[Assuming Cycle length = 60 sec]

Calculation (2)

- Calculate initial and final lost times
  - Formulae: $l = t - \frac{n}{s}$
  - **Remember the unit of s i.e., the saturation flow should be in PCU per sec**
- Calculate effective green time
  - Formulae: $g = G + A - (l_i + l_f)$
  - i.e., **effective green = Green (s) + Amber (s) – (initial loss time(s) + final loss time(s))**
- Calculate approach capacity