STOP/GO'S ON OUR ROADS: WHAT DOES THIS COST OUR ECONOMY?

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ABSTRACT

Stop/Go systems on our roads due to construction works is a cause of great frustration to many motorists, but also comes with a price tag. The purpose of this paper is to determine the macro-economic cost of Stop/Go systems to our economy. This paper further investigates alternative traffic accommodation options to Stop/Go systems as well as the point where these alternatives become financially viable on a macro-economic scale.

Alternative traffic accommodation options with regards to reseal as well as the reconstruction of roads are looked at and the advantages and disadvantages of these options are weighed up against one another. The requirements for the successful implementation of these alternatives are also presented.

1. BACKGROUND: CURRENT SITUATION ON CONSTRUCTION SITES

Stop/Go systems are a regular encounter on South African roads. They have almost become standard practice during road upgrade/reconstruction and reseal projects. E.g. during November 2013, a road user could have encountered up to 7 Stop/Go's en route between Cape Town and Johannesburg.

A big contributing factor to this is the fact that this arrangement is the most favourable to the Contractor, and sometimes more economical to Clients, but it does not consider the macro-economic cost to the South African economy as a result of time lost by the road user.

2. REQUIREMENTS FOR ACCOMMODATION OF TRAFFIC OPTIONS

According to requirements for Health and Safety legislation, everyone is entitled to a safe environment. In terms of this, the Accommodation of Traffic (AoT) practice norms are considered by the authors to be the following:

- The environment has to be safe for the travelling public
- The environment has to be safe for the construction workers

Other points which the authors consider to be requirements during AoT designs are the following:

- The AoT arrangement should aim at minimal disruption to the travelling public
- The lane widths available during construction should conform to a minimum width (considering the type of traffic making use of the road section). Lane width can also be used as a measure of traffic calming)
- The AoT arrangement should take into account the final product e.g. the final longitudinal joint position of the road surface
- The cost of the specific AoT proposal

3. ACCOMMODATION OF TRAFFIC ALTERNATIVES

There are a few AoT alternatives that can be implemented during upgrading/reconstruction projects as well as for reseal projects. They are as follows:

3.1 Re-construction/ Upgrading projects

3.1.1 Half width construction (one-way traffic using stop-go)

During this AoT arrangement, half of the road is closed for construction and traffic needs to stop to allow one direction of traffic to pass, whilst the other direction waits their turn. Refer to Figure 1 below.

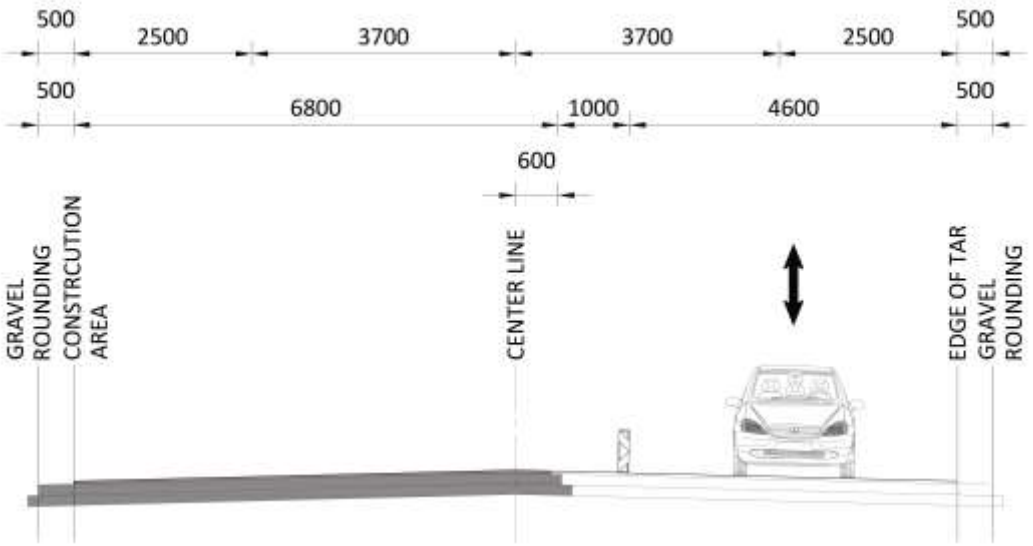

Figure 1: Typical arrangement for half width construction (one-way traffic using Stop/Go

3.1.2 Half width construction (two-way traffic)

During this AoT arrangement, the roadway is widened temporarily. This allows for two way traffic to be able to pass through the construction area without having to stop whilst the contractor carries on with construction on the remaining section. Refer to Figure 2.

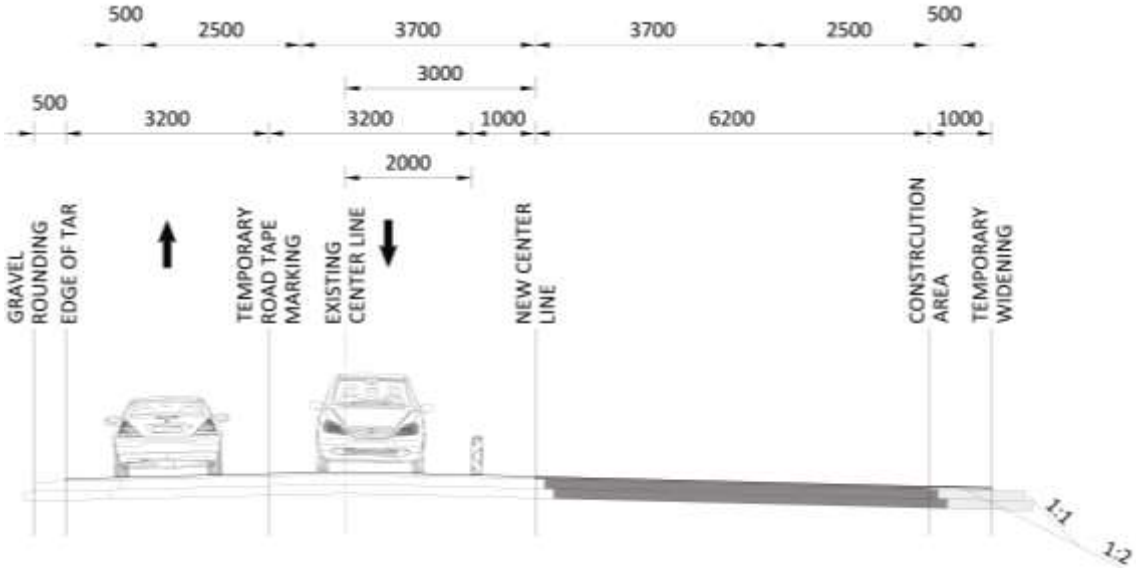

Figure 2: Typical arrangement for half width construction (two-way traffic)

3.1.3 Full width construction using bypass

This AoT arrangement can be implemented if an economically viable and suitable alternative route is available (not considered in this paper).

3.2 **Reseal projects**

3.2.1 Half width construction (one-way traffic using stop-go)

This is similar to half width construction (one-way traffic using stop-go) as per par 3.1.1 above. Refer to Figure 1.

3.2.2 Half width construction (two-way traffic)

This is similar to half width construction (two way traffic) as per par 3.1.2 above. Refer to Figure 2.

3.2.3 Partial width construction (two way traffic)

For this AoT arrangement, the road is resealed in three stages. This allows for two way traffic to be able to pass through the construction area without having to stop whilst the contractor carries on with construction on the remaining section. Refer to Figure 3.

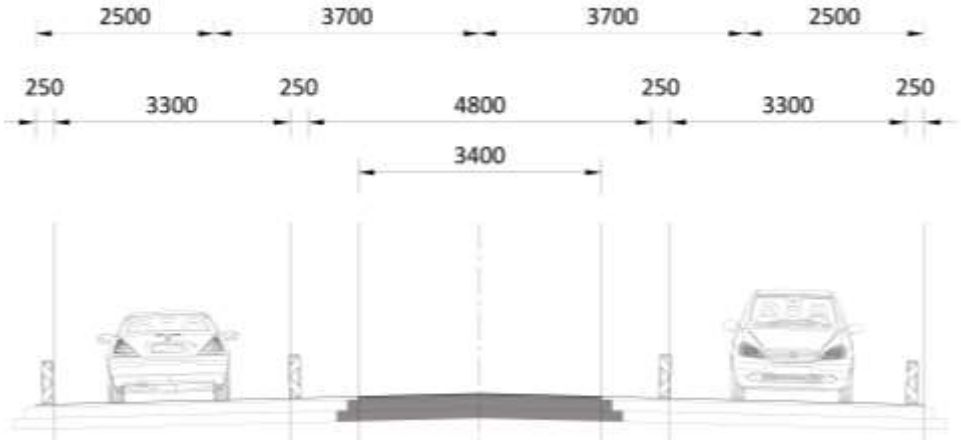

Figure 3: Typical arrangement for partial width construction (two-way traffic)

3.2.4 Full width construction using bypass

This is similar to par 3.1.3 above.

4. ASSUMPTIONS FOR MACRO ECONOMIC EVALUATION

A macro-economic evaluation was done for the above AoT alternatives (with the exception of the full width construction using a bypass alternative) with the following variables:

- Traffic volumes (Average Annual Daily Traffic (AADT))
- Average time delays at Stop/Go's

4.1 Assumptions made for both Reconstruction/upgrading and Reseal projects:

- A length of 3 km was assumed for a Stop/Go section
- A rate/hour for time delays was based on the following values used by the Western Cape Government in their macro-economic evaluations:

	Value of a working hour	Value per recreational hour for all persons	Value per recreational hour for workers
Income Group	**R**	**R**	**R**
Low	9.46	0.53	2.16
Middle	30.20	1.85	6.89
High	90.59	7.52	20.86
TOTAL Population	41.52	2.50	9.47

  It was assumed that for the hours of 07h00-19h00, 80% of the time is spent on work and 20% on recreation. For the hours of 19h00-07h00, 50% is spent on work and 50% on recreation. This results in a value of R32.29/hour (single person). A value of 2 persons/vehicle was assumed and this results in a cost of 64.58/hour per vehicle.
- A rate of R350/m² for temporary layer works
- A cost of traffic signals for the Stop/Go's of R 85 000 for the initial installation, R 5 000 for relocation of signals and R 3 000/day for operational costs.

4.2 Additional assumptions made for Reconstruction/Upgrading projects:

- Existing road cross-section (1 x 3.4 m wide lane width per direction with gravel shoulders)
- New road cross section (1 x 3.7 m wide lane width per direction with 2 x 2.5 m wide surfaced shoulders – typical SANRAL class 1 cross-section)
- The new centreline can be offset by 3 m from the existing centreline
- The existing vertical alignment is reasonably close to the new vertical alignment
- Width of temporary widening required is 2 m
- From the authors' experience, the duration of construction is a function of the value of the works, as well as the type of construction and the length of road under consideration. It was therefore considered that the macro-economic values are a function of the length of construction. The assumptions below were based on a 20 km case study and using the authors' experience on other projects, the values were extrapolated to construction lengths of between 12 km and 32 km (but can be extrapolated even further):

Length of construction area (km)	12	16	20	24	28	32
Duration of construction (months)	16	21	27	32	37	43
Number of Stop/Go's simultaneously in operation	2	2	3	3	3	3
Cost of temporary widening (million)	R 8.4	R 11.2	R 14	R 16.8	R 19.6	R 22.4

4.3 Additional assumptions made for Reseal projects:

- Width of temporary widening required for half width construction (two-way traffic) is 2 m.
- As indicated above, the duration of construction is a function of the value of the works, as well as the type of construction and the length of road under consideration. The assumptions below were based on a 46 km case study and using the authors' experience on other projects, the values were extrapolated to construction lengths of between 12 km and 32 km (but can be extrapolated even further):

Length of construction area (km)	12	16	20	24	28	32
Duration of construction (months)	4	6	7	8	10	11
Number of Stop/Go's simultaneously in operation	2	2	3	3	3	3
Cost of temporary widening (million)	R 8.4	R 11.2	R 14	R 16.8	R 19.6	R 22.4

5. MACRO-ECONOMIC EVALUATION OF ALTERNATIVES

A number of assumptions have been made above and the dependency of the assumptions and the sensitivity of the different variables have been taken into account as far as possible. It is considered by the authors as typical and reasonable for larger national and provincial roads in South Africa and is therefore used in the calculations below.

5.1 Re-construction/ Upgrading projects

5.1.1 Half width construction (one-way traffic using stop-go)

The cost associated with time delays as a result of Stop/Go's was calculated using average time delays of 10 and 20 minutes. For each average time delay, the calculation was made for AADT's of between 2000 and 4000.

5.1.2 Half width construction (two-way traffic)

The cost of the required temporary widening was calculated for the different lengths of construction.

5.1.3 Calculations

The cost associated with the additional works (temporary widening) was subtracted from the cost as a result of the Stop/Go time delays plus the cost of the temporary traffic signals to determine the difference between the two. A negative value indicates that temporary widening (two way traffic) will be more expensive than the saving in time delays (one-way traffic using Stop/Go). A positive value indicates that it is viable on a macro-economic scale to do the temporary widening. The results were plotted on individual graphs for the average time delays. Each graph indicates the results for the different AADT's.

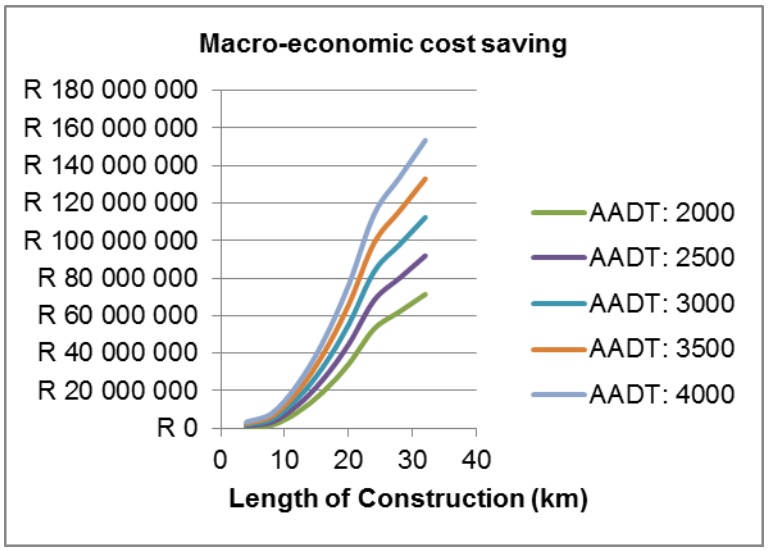

Figure 4: Macro-economic cost saving - reconstruction/upgrading projects: average time delay of 10 minutes

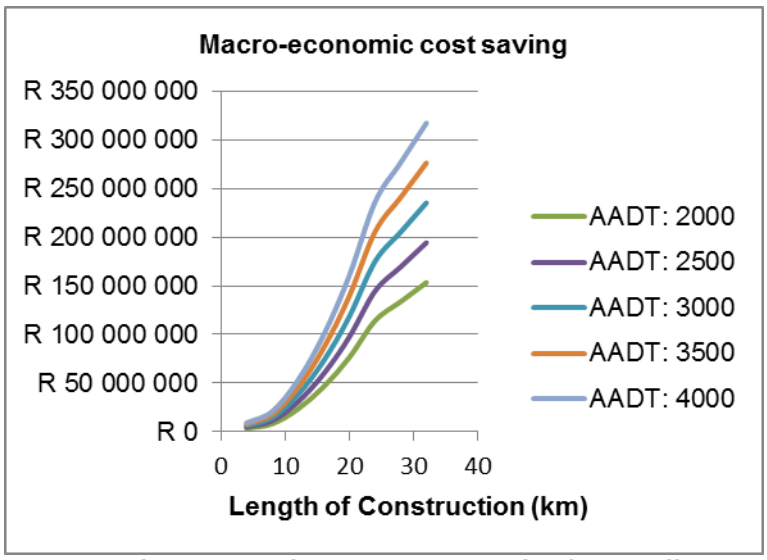

Figure 5: Macro-economic cost saving - reconstruction/upgrading projects: average time delay of 20 minutes

From the graphs it is clear that (based on the parameters above) from a macro-economic point of view, it is always viable, irrespective of the AADT values considered, to widen temporarily when compared with a Stop/Go alternative.

5.2 Reseal projects

5.2.1 Half width construction (one-way traffic using stop-go)

The cost associated with time delays as a result of Stop/Go's was calculated using average time delays of 10 and 20 minutes. For each average time delay, the calculation was made for AADT's between 2000 and 4000.

5.2.2 Half width construction (two-way traffic)

The cost of the required temporary widening was calculated for the different lengths of construction.

5.2.3 Partial width construction (two way traffic)

For this alternative there are no additional costs.

5.2.4 Calculations

Similarly to the calculations done as stated in par 5.1.3 above, the results of the economic evaluation were plotted on individual graphs for the average time delays.

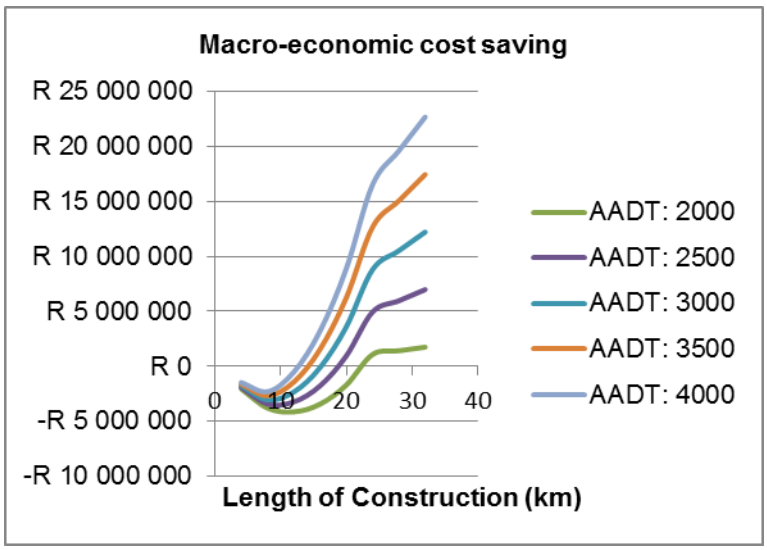

Figure 6: Macro-economic cost saving - reseal projects: average time delay of 10 minutes

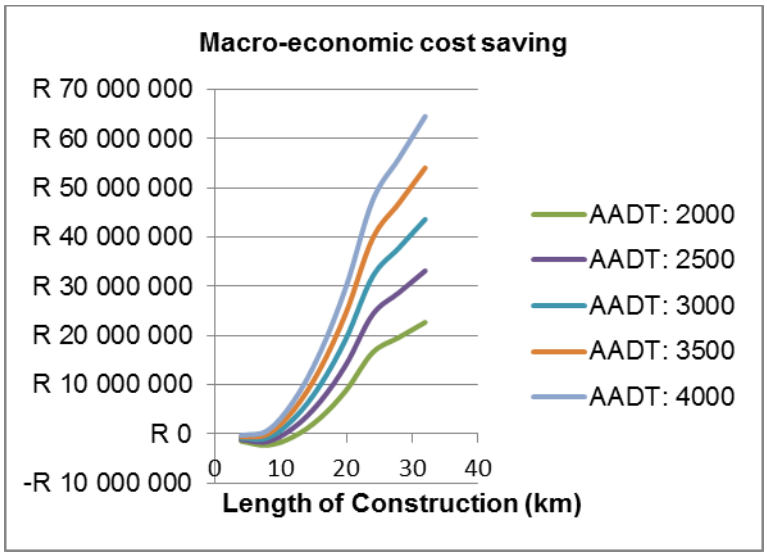

Figure 7: Macro-economic cost saving - reseal projects: average time delay of 20 minutes

From the graphs it is clear that it is not as economically viable to widen the road temporarily for reseal projects as it is for upgrading/reconstruction projects (mainly due to the fact that the duration of the construction period is shorter and the resultant saving in time delays is less), but there still remains a point where it does become viable from a macro-economic point of view.

As there are no additional costs when considering the partial width construction (two way traffic), it is an alternative that is always economically viable. An example (assuming an average time delay of 15 minutes) of the macro-economic cost saving is indicated in the graph below.

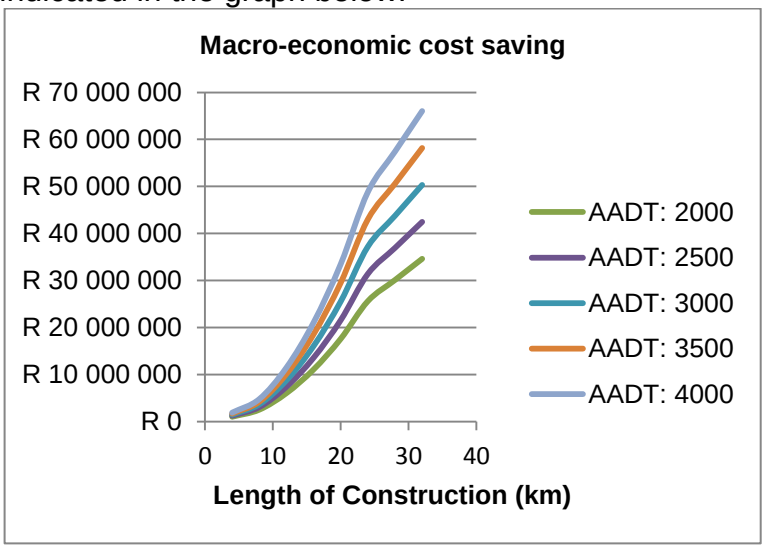

Figure 8: Macro-economic cost saving for reseal projects, partial width construction (two way traffic): Average time delay of 15 minutes

6. ADVANTAGES AND DISADVANTAGES OF AOT ALTERNATIVES

Besides the macro-economic calculations for different construction alternatives, other factors also need to be considered in the decision making process. These are summarized in the tables below for both reconstruction/upgrading alternatives and reseal alternatives.

Table 1: Advantages and disadvantages of reconstruction/upgrading alternatives

Half-width (two-way) – Temporary widening		Half-width (one-way) – Stop/Go	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Minimal disruption to normal traffic	Limited working space - additional measures required in working area	Slightly lower construction costs	Traffic signal operation required
No permanent traffic signal system required	Slightly higher construction cost		Higher speeds through construction area due to lane width availability – limited by heavy vehicles
Narrower lane widths - resulting in lower speeds			User frustration
Wider road width can be used during future reseal projects			Time delays

Table 2: Advantages and disadvantages of reseal alternatives

Partial-width (two-way)		Half-width (one-way) – Stop/Go	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Minimal disruption to normal traffic	Limited working space - additional measures required in working area	More working space at work areas	Traffic signal operation required
No permanent traffic signal system required			Higher speeds through construction area due to lane width availability – limited by heavy vehicles
Narrower lane widths - resulting in lower speeds			User frustration
			Time delays

It should be noted that no additional construction period will be necessary to construct the temporary widening.

7. REQUIREMENTS FOR SUCCESSFUL IMPLEMENTATION

To successfully implement the half-width (two-way) alternative for reconstruction/upgrading projects as well as the partial width (two-way) alternative for reseal projects, there are certain requirements:

- The Client needs to support the alternative as some of the macro-economic advantages will not be directly reflected on the Client's budget.
- The Engineer needs to support the alternative. Care needs to be taken with the AoT design as well as supervision during the construction stage to mitigate the disadvantages.
- The Contractor needs to support the alternative, but the chosen alternative will be dictated by the Client and the Engineer – a positive mind-set however, will be beneficial.
- The AoT design needs to be looked at very carefully to ensure that temporary signage/flagmen and any other required measures are put in place to ensure the safety of the travelling public as well as the safety of the construction workers.

8. WHAT DOES THIS COST OUR COUNTRY

An order of magnitude calculation was made to determine what the current Stop/Go systems are costing our country.
The current number of Stop/Go systems in place during April 2014 was 53 for SANRAL roads and 20 for roads in the Western Cape. Information on Stop/Go systems for the other provinces was not obtained, but an assumption of 5 per province was made. This resulted in a conservative total of 113 Stop/Go systems in place on South Africa's roads during April 2014.

Assuming an AADT of 2500, an average time delay of 10 minutes/vehicle, and a rate/hour of R64.58, this results in a value of R 92 740 000 per month and a value of R 1 112 875 000 per year lost to our economy as a result of time delays at Stop/Go systems.

9. CONCLUSION AND RECOMMENDATIONS

Considering the above, it is clear that for reconstruction/upgrading projects (based on the assumptions made above), with the average time delay at Stop/Go's and the AADT boundaries considered, the half width (two-way) AoT alternative is always viable from a macro-economic point of view, when compared with a Stop/Go alternative. Considering the current AADT's on most of our major routes this alternative should be considered.

For reseal projects, it is clear that it is not as economically viable to widen the road temporarily as it is for upgrading/reconstruction projects (mainly due to the shorter duration of the construction periods and the subsequent less time delay). However for the partial width (two-way) AoT alternative, there is no additional cost involved and therefore, this alternative is always viable from a macro-economic point of view.

There are a large number of variables that determine the viability of the different alternatives and they should all be taken into consideration when doing such evaluations. It is therefore recommended that Clients and Engineers carefully consider each construction project and determine if an AoT alternative other than Stop/Go systems can be implemented. This can potentially result in major cost savings for our country's economy.