Minimising Delays During Junction Improvements

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Portable or Temporary Traffic Light Signals

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Introduction

Everyday there are interventions taking place on the road network affecting its operational capacity. The vast majority of these works are planned, allowing the authority to review what is being proposed. The type of traffic management implemented in terms of signs or cones will not change dramatically as the impact of a lane closure is likely to be the same. However, is that the case when you are replacing or reconfiguring existing permanent traffic signal sites and could the delays to all road users be reduced depending on what type of system you deploy.

When it comes to the world of non-permanent traffic signals there are basically two options, Portable Traffic Light Signals (Portable System) or Temporary Traffic Light Signals (Temporary System), although there are differences between these systems its often not always clear why or which one is chosen.

There often is not enough time or resources to assess and model the difference between the options. Therefore, this paper has been produced to clearly show these differences, explain and show the capacity implications, via modelling, alongside other influencing factors which should be considered when choosing a suitable system.

Differences between Portable and Temporary Systems

There are a number of differences between Portable and Temporary Systems. These are based around two key factors:

- Functionality
- Deployment

Listed in Table 1 below are a number of these differences

Table 1 - Difference between Portable and Temporary Systems

Portable System	Temporary System
This is a system where the equipment is to TOPAS specification 2502B and uses traffic light signals to TSRGD diagram 3000.1.	This system uses a standard controller to Topas 2500 and uses traffic light signals to TSRGD diagram 3000.
The equipment can be deployed at short notice, in a number of hours, with limited planning and traffic management.	The equipment installation requires traffic management, electrical connection, planning and usually installed in 1-2 nights.
The majority of the equipment is powered by batteries.	The equipment is usually powered by an existing electrical supply.
The signals use wireless technology.	The signals are usually connected via a wired system.

The controller is pre-configured and safety and green timings are selected and implemented on street.	The controller is configured as per a permanent traffic signal controller where a TR2500 specification is produced tested and then uploaded to the system.
Can operate under VA, Fixed Time, Manual and Fixed Time UTC.	Can also operate under UTC SCOOT, CLF and MOVA.
The system method of control is simplified so you cannot select an approach to run in more than one stage per cycle and it provides an all red pedestrian stage.	The system method of control can mirror that of the permanent including, phase delays, filter/indicative arrows, walk with traffic and all red pedestrian stage.

Assessment

A primary factor to be considered when carrying out temporary works, is the impact to capacity on the network as if we get it wrong it will be visible to everyone. Working alongside RWA and focussing originally on junction capacity, SRL have assessed the difference between Portable and Temporary Systems with the aim to provide a guidance sheet which can be used to justify the choice of system. This was started by assessing the difference at a single site in VISSIM to provide visual and detailed results on the impact the two types of systems would have on journey times and the wider network.

VISSIM Modelling - Forest Road with Shernall Street

Red Wilson Associates have previously undertaken approved base VISSIM and LinSig modelling of the Forest Road corridor in Waltham Forest, London which comprises over 3km of road network and four signalised junctions. As this was a recent validated base model it was deemed an appropriate example of where to assess the impact of operating one of the junctions under a Portable System.

The junction of Shernall Street with Forest Road has been selected as it is a fairly complex site with pedestrian facilities and a separately signalled right turn movement. The method of control for a Temporary System will mimic the base layout (as shown in Figure 1) however the method of control for a Portable System will result in the east and west movements being split phased since the portables are unable to run the right turn movement at the same time as the ahead movement. In the temporary layout it is also possible to facilitate the pedestrian movements as walk with traffic however when a Portable System is used it is only possible to run the pedestrian phases in their own all round pedestrian stage. A comparison of the two method of controls is shown below.

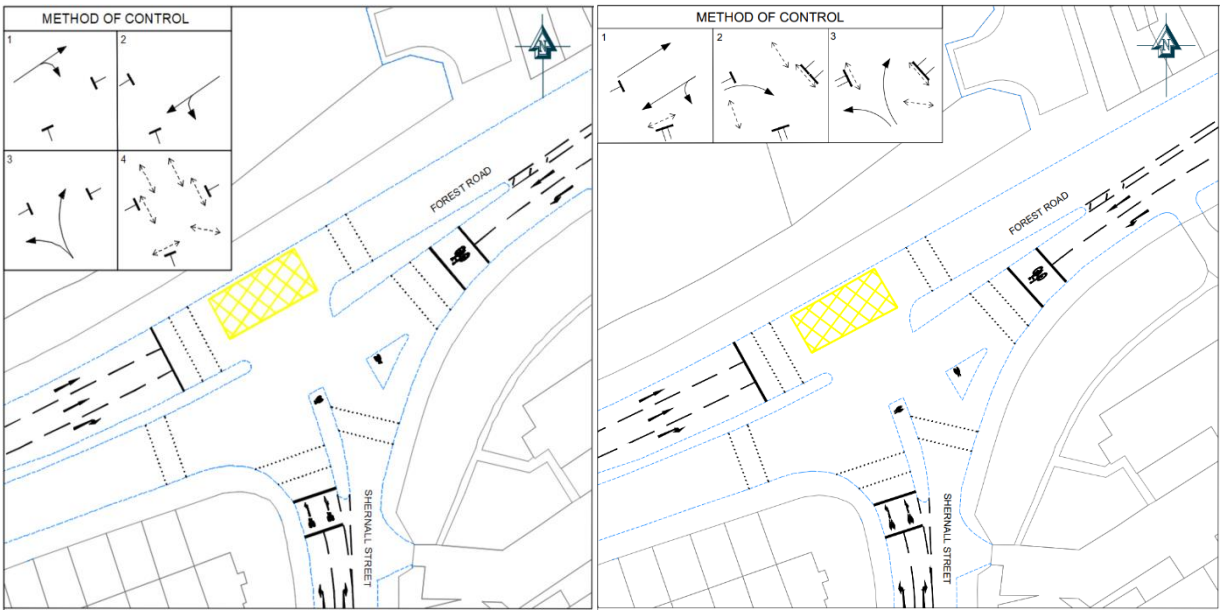

Figure 1- Method of Control for Portables (left) and Temporary (right) Layouts

Alterations were made to the LinSig model to mimic the portable signal layout. The signal timings were then optimised in an attempt to balance the degree of saturation on each approach. To optimise for delay, this resulted in increasing the cycle time in the AM peak to 120 seconds and keeping the PM peak at 104 seconds. The cycle time at the remaining junctions in the model remained unaltered due to their distance from Shernall Street.

This was then transposed into the VISSIM model and journey times, delay and queue lengths were extracted from the model to provide a comparison of the impact of operating the junction under Portable or Temporary Systems.

The journey time results shown below in Table 2 demonstrate that there is a significant increase in the journey time on the approach to the junction with Shernall Street if a Portable System were to be introduced. The journey time does then start to reduce in both the east and westbound directions past Shernall Street however this is attributed to the fact that less traffic can reach these points of the network as they are stationary in queues on the approach to the junction. The overall journey time along the corridor increases by at least 50% in both directions in both peak periods.

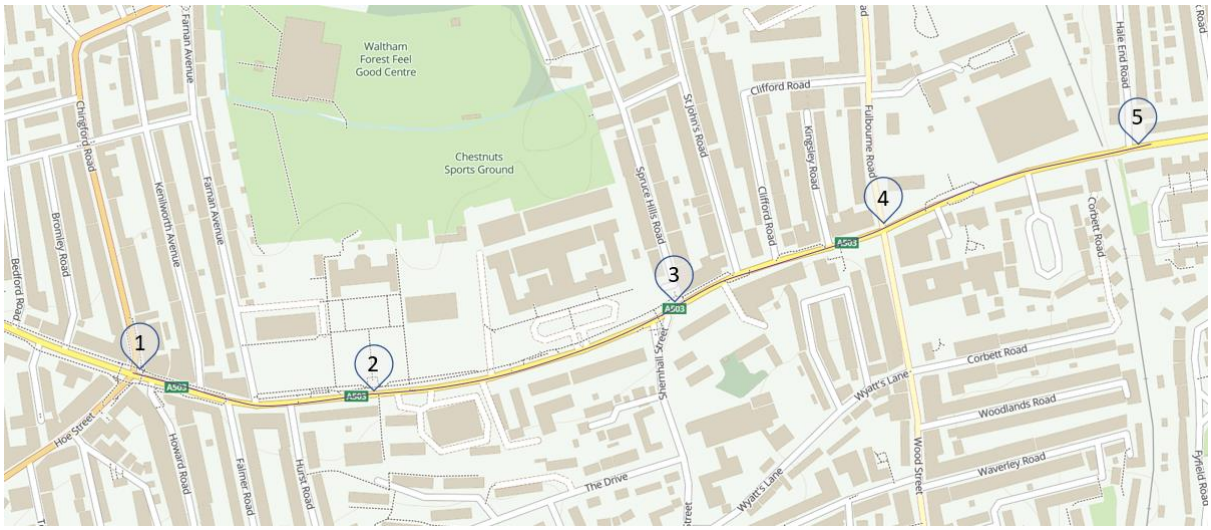

Figure 2 - Forest Road Corridor

Table 2 - Forest Road Journey Time Results

Forest Road - General Traffic Journey Time Results - AM PEAK (08:00 - 09:00)					
Direction	Description	Temporary Model JT (sec)	Portable Model JT (sec)	Diff (sec) Temporary vs. Portable	Diff (%) Temporary vs. Portable
Eastbound	Hoe Street to Town Hall (1 to 2)	53	78	25	46%
	Town Hall to Shernall St (2 to 3)	57	205	148	261%
	Shernall St to Wood St (3 to 4)	89	68	-22	-24%
	Wood St to Hale End Road (4 to 5)	57	55	-2	-4%
	Total	**257**	**406**	**149**	**58%**
Westbound	Hale End Road to Wood St (5 to 4)	99	269	170	172%
	Wood St to Shernall St (4 to 3)	74	140	67	91%
	Shernall St to Town Hall (3 to 2)	53	44	-9	-16%
	Town Hall to Hoe St (2 to 1)	131	92	-40	-30%
	Total	**357**	**545**	**188**	**53%**
Forest Road - General Traffic Journey Time Results - PM PEAK (16:45 – 17:45)					
Eastbound	Hoe Street to Town Hall	52	158	106	206%
	Town Hall to Shernall St	85	218	133	155%
	Shernall St to Wood St	106	89	-16	-16%

	Wood St to Hale End Road	45	44	-2	-3%
	Total	**288**	**509**	**221**	**77%**
Westbound	Hale End Road to Wood St	77	161	83	107%
	Wood St to Shernall St	65	170	105	161%
	Shernall St to Town Hall	43	44	1	2%
	Town Hall to Hoe St	115	96	-19	-17%
	Total	**300**	**470**	**170**	**56%**

These results demonstrate that at this location, a Temporary System has no impact on capacity when in situ however a Portable System will have a detrimental and significant impact on capacity as a result of the reduction in available green time to each traffic phase to accommodate an all-round pedestrian stage and the split phase of the east and westbound movements.

It has been possible to undertake this VISSIM assessment on this site since the model was readily available however it is understood that these exercises can have time and cost implications. Hence LinSig assessments have been undertaken on a variety of sites to ascertain how different sites will operate under a Portable or Temporary System dependent on their characteristics.

LinSig Assessments

High level LinSig assessments have been undertaken on 35 sites around the United Kingdom. Portable or Temporary Systems have all previously been deployed at these sites hence the timing data was readily available. A skeleton LinSig model has been produced for each of the sites showing the Portable or Temporary operation. These models have been used to assess how capacity can differ dependent on which system is used.

The sites have been split into four categories which are dependent on the site's key characteristics;

- Type 1- Walk with traffic pedestrian facilities with a separately signalled right turn/indicative arrow or filter arrow (10 sites);
- Type 2- Walk with traffic pedestrian facilities (10 sites);
- Type 3- All round pedestrian stage (10 sites); and
- Type 4- All round pedestrian stage with a separately signalled right turn/ indicative arrow or filter arrow (5 sites).

Walk with traffic crossings operate as an all-round pedestrian stage when considering Portable Systems and the approaches with right turn indicative arrows or separately signalled right turns have been modelled to operate in a split phase from the opposing movement.

A comparison between the available green time at each junction has been undertaken assuming that the cycle time stays the same in both arrangements. It has also been assumed that all stages and phases are demanded every cycle. The table (Table 3) below demonstrates the difference in available green time on average for each traffic phase;

Table 3 - LinSig Model Green Time Results Comparison

	Temporary Average Green Time to Traffic (secs)	Portable Average Green Time to Traffic (secs)	Difference (secs)	% Decrease Average Green Time to Traffic
Type 1	32	18	14	43%
Type 2	35	24	11	33%
Type 2a	19	8	11	59%
Type 3	26	25	2	5%
Type 4	25	16	8	34%

Both Type 2 and 4 result in a reduction in available capacity to traffic when considering the introduction of a Portable System as they both require the introduction of a new stage at the junction increasing the volume of lost time to traffic. Type 1 will also result in the introduction of additional stages; a minimum of two additional stages would be added to introduce and all-round pedestrian stage and also to split phase the traffic movements.

Junctions that operate a simple two stage arrangement (often referred to as a flip-flop junction) would typically fall under Type 2. A characteristic of these junctions is that they often operate under a lower cycle time. This therefore means that the impact of introducing Portables at this location is greater than at other Type 2 junctions so we have separated them into a separate category- Type 2a.

As previously mentioned, the results demonstrated that these sites with a lower cycle time (below 50 seconds) were experiencing a greater impact when operating under Portables than those running a higher cycle time. Therefore, we undertook an additional assessment to ascertain the impact the cycle time had on these sites and tested them operating at a higher cycle time of 72 seconds. The results showed that the percentage decrease in the average green time to traffic was only 33% at this higher cycle time.

The results demonstrate that the most significant difference in operation is the Type 1 junction. Type 3 junctions show the smallest difference in available green time as the method of control can operate the same way for traffic when on Portable or Temporary Systems. The only difference in the operation is the limitations to intergreens and pedestrian minimum phase lengths on Portables.

Other Influencing Factors

While capacity has a major impact on the road network there are other important factors which need to be considered, in order to create a holistic decision when deciding on the best system to utilise.

Duration and Cost

The budget of the specific scheme is an important factor to review. Therefore, the cost of the system to be used is fundamental so that the client is able to manage and forecast their budgets accordingly. When deciding on the solution there are the initial set-up costs but also the duration on street costs which are closely interlinked. Whilst the Temporary System is more expensive initially to deploy this cost balances out over a longer period compared to a Portable System.

There will also be a requirement for varying levels of traffic management to enable the installation and deployment of each solution which will need to be considered over and above the system itself.

Maintenance

Whilst both systems require routine maintenance to ensure they are working correctly. The most significant difference is that a Portable System requires regular battery changes, which requires a maintenance engineer to attend site, potentially weekly, to carry out the battery changes. There is also a risk of wireless communications being interfered with and causing an 'all out', especially in high density locations.

Whereas, a Temporary System is powered by mains and a connected via a communication line. Therefore, reducing the maintenance costs and risk of all outs.

Buildability

Buildability is fundamental when planning the works required at a location. The client and its contractors need to have a strong understanding of the overall scheme requirements. This should include the stages and phases of works, if any layout changes are proposed which would require multi re-configurations of the solution and also any risks.

A site visit is also recommended to review the size and footprint of the location, and to understand how the Portable or Temporary System can be installed on street.

This will influence the kind of system to be implemented and can help reduce any risks to cost, programme and impact to the network.

Functionality

Knowledge of the location from the client and Local Authority is paramount to understanding how the existing traffic signals and site functions. This should encompass pedestrian movements and demand, traffic behaviour, local school and business movements, alongside the functions which are already on street. For example, are cycling provisions required or specific linking to sites in the area.

This expert knowledge combined with existing conditions will assist with the solution decision and identify whether certain requirements are required when placing the location under a Portable or Temporary System.

Safety

Each site layout is different and will have a number of elements that could affect safety. These could be traffic signal operation factors for example banned traffic movements or specific timings decisions and/or installation factors like signal visibility and limited footway space. Consequently, when deciding on which method to take forward it is always paramount that safety of road users, pedestrians, cyclists and contractor installation teams are taken into account.

Summary and Conclusions

SRL and RWA have been working together to ascertain the differences between Portable and Temporary Systems by assessing their impact on available capacity at a junction. A VISSIM model has assisted in demonstrating how that can also impact a wider network and what the impact on journey times would be at a fairly complex junction.

Time and cost implications mean that it is often not possible to undertake modelled comparisons between the use of Portable and Temporary Systems at a junction. Therefore, a high-level assessment of the impact on capacity at a total of 35 junctions has been undertaken. This has included assessing how a site's operation might impact the suitability of Portable or Temporary Systems.

The results from the High-Level assessment give an indication of the impact to capacity on a junction based on the method of control. There are other contributing factors when establishing which type of system to use when making junction improvements. This includes;

- Duration and Cost
- Maintenance
- Buildability
- Functionality
- Safety

A Guidance Data Sheet has been created to assist in assessing the most suitable Traffic System to implement, based on the factors covered in this report. This includes the data captured from the 35 sites.

For further information or a copy of the Guidance Data Sheet please visit the SRL stand or email SRL at urban64@srl.co.uk.