Traffic simulation – **Rio Olympics**

A detailed traffic study using Aimsun software has led to a clever solution to avoid congestion at the 2016 Olympics

One of the major challenges for any country hosting the Olympic Games, and the following Paralympic Games, is the additional transport loads as spectators pour into the venue cities. On top of that, officials and competitors have to be guaranteed a free flow of traffic to make sure the Games begin on time, and that competitors reach the events each day during the fortnight duration that each Games lasts.

For Rio de Janeiro, the main location for the 2016 Games, this is a doubly complex task. To begin with, the city has a difficult layout along strips of the Atlantic coast and the main entrance to the famously scenic harbour bay; the well-known Copacabana tourist area and Ipanema beach are on the ocean coast here, and some 20km further west is the Barra, and Jacarepaguá, a coastal area with a long tongue of beaches with lagoons behind and two large lakes just inland from those. The central city and business district is northwards, inland along the bay coast, opposite a large island where the Galeão airport is situated.

"In between there are mountains, which together with the lakes mean much of the southern development is limited to the coastal strips," said André Libânio, a traffic analyst and director at consultant Modelle Logistics & Engineering, which has been studying the city's traffic. The firm is part of the larger Tectran engineering company.

The main effect is that the city stretches out linearly, with only limited corridors for many commuter and other routes. Highways are often congested at peak hours, even though in places there can be as many as six lanes each way. "The problem is they narrow down, sometimes to just two each way, for tunnels for example," said Libânio. There are two major tunnels along the Atlantic coast between Copacabana and Barra.

On top of that the city has been growing fast, just like the Brazilian economy in the last decade, which is one of the booming BRIC group of fast developing countries. That has brought a round of investment in new public transport which will help carry more people and ease the increasing road traffic, but ironically some of it adds to the problems.

Two subway lines are also being built but most of the new system is a bus rapid transit (BRT). "That compounds the difficulties on narrow sections of roads especially, because it requires a dedicated lane in the highway," explained Libânio, "That removes one road lane from general vehicle use."

"When the Olympics is on we lose not one but two lanes therefore," said Rodrigo Coelho, also a director at Modelle. As in London and other Games, a network of dedicated lanes was part of the Games bid, and these form a network which partly overlaps with the BRT lane routes; in places two lanes of road are taken out.

The Games network is fairly large because it must connect the Barra area where the Olympic village is being built, to a variety of events stadiums, courses and other venues which are scattered across the city. Some of these are 20 or 30km away. The main airport and a smaller one to the south are also key points.

The impact of the Olympic network spreads further too because the Olympic traffic is prioritised at junctions; signalling is altered and traffic flows in capillary roads too.

The city's main traffic company, CET-Rio wanted to assess the impact on traffic that the Games would have, both by the spectator movements on the roads and through the reduction in lane capacity caused by the

BELOW: **Traffic problems can be serious in Brazil with extensive queues and delays**

BOTTOM: **Modelling traffic flows has revealed areas of concern for potential congestion points**

Brazil's Olympic Routes may well utilise the BRT routes

priority lanes. It commissioned the Modelle study which began in December 2011 using traffic demand data and a network base from previous studies. Both the city network and matrices from that were brought into Aimsun's modelling software, using its built-in import tool.

Initially the model was calibrated against traffic survey data for vehicles' volumes and modal classification says Coelho. Some 50 or so different road network points were used, looking at morning and evening peaks.

After calibrating the entire area, sub-areas requiring more detailed information were extracted. This can be done with Aimsun using its "traversal matrix generation" tool which uses the same macro network as a base to ensure consistency.

A variety of mesoscopic, microscopic and hybrid simulations were then run to analyse the Public Transport exclusive lanes, special priority lanes for the Olympic Family and the impact on general vehicles.

First results, put simply, were catastrophic; the city would not be able to contain the traffic loads. Even taking into account some changes in vacations and staggered travel patterns for commuters, studies showed that the city would suffer major traffic problems.

But the analyses threw up some interesting observations about the BRT lanes, namely that they are not fully utilised. Flow capacities in the dedicated bus lanes can be nearly 1100 vehicles/hour it was concluded, depending on how junction signalling is set. But the bus frequency is much less, perhaps 200/hour.

The reason is to do with bus stopping times at the "station" areas and the time needed for passenger boarding, door operation, bus acceleration and deceleration and other factors.

The intriguing possibility was thrown up of spare capacity which might be usable for as much as 800 more movements. That would not make much difference for the general traffic. But it happens that the BRT routes more or less overlap onto the routing of the Olympic network. It is not a perfect match but Modelle had the audacious notion of using the bus lanes for the Olympic routes. It could just be a possibility at least where there was a match between the two networks.

It would make sense, the analysts reasoned, because the special Olympic lane movement is quite low, around 100 cars and 100 larger vehicles in an hour. That would fit easily into the spare 800 "slots".

So using the mesoscopic and microscopic simulation models particularly, the consultants took a close look at whether this could be part of the solution for the Games. Looking in detail, it seemed to work, with the flow of buses and Olympic travel merging into the one lane without causing difficulties.

"That is something we like about the Aimsun programme, its capacity to let you do studies at various levels using the same model network" says Coelho.

It seemed that the traffic impact could be reduced substantially if the lane operation was merged, allowing the special Olympic lanes to be removed in some places. The installation of the reserved lanes has as much as a 30% impact on capacity on roads where they are used and so taking them out again is a significant advantage.

By combining this solution with the use of school and some administrative services holidays to synchronise with the Games periods, and by staggered office opening hours to spread the commuter load, it offers a solution for the city to cope with the extra demand.

CET-Rio traffic engineering, the city's main traffic engineering company and client for the studies, is considering this as the city proposal. ■

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New Aimsun solution

The latest version of Aimsun's traffic modelling and analysis software suite, Aimsun 8 includes full support for traffic demand modelling, the company says. This means modellers can now start a transportation modelling project from scratch, entering raw geographical and socio-economic data, and then follow the process all the way through to simulation in the same package. It claims to be the only one offering all steps of an analysis from traffic demand to dynamic traffic assignment in either mesoscopic or microscopic levels as well as hybrid form.