TECHNICAL NOTE

QUICK-JUNCTION™
COMPARISION WITH TRADITIONAL SOFTWARE

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QUICK-JUNCTION COMPARISONS

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QUICK-JUNCTION™ - COMPARISON WITH TRADITIONAL SOFTWARE

1 Overview and Summary

Evaluation has identified that in general, **fast**-answers software Reference Flow to Capacity Ratio (RFC) and Degree of Saturation (DoS) estimates are marginally more conservative than *traditional* software equivalents.

The small difference in RFCs and DoS, output from **fast**-answers and output from *traditional* software packages, will not normally have any practical significance. The minor differences observed are dwarfed given the accuracy of:

- *traditional* software packages
  For example, Brown (1995) reports a 15% standard error for Arcady capacity estimates

- input data
  There are two main types of input data
  (a) Surveyed traffic flows which vary considerably from day to day.
  (b) Traffic flow data output from area wide traffic demand models. These are normally even less accurate than survey data.

- traffic forecasts
  Forecasts inevitably contain a degree of uncertainty. Forecasters often apply a range of predictions – usually encompassing a wide spread of possibilities.

For practical purposes most design decisions are usually clear cut. For example the number of approach lanes at signals may need to be one lane or may need to be two lanes. The situation of 1.5 lanes is not an option. In a few cases the designer may not be sure whether to implement one or two lanes: a sort of designer's *grey* area. Where design decisions are clear cut (not in the grey area) any debate over differences in estimates between methods will be irrelevant.

2 Introduction

This Technical Note compares the operational performance of junctions using the following approaches and software tools:

- **fast**-answers approach using **quick**-Junction
- *traditional* approach using Picady, Arcady, Oscady and Linsig.

Initial analysis is based on hypothetical data to ensure all aspects of comparison are similar. This is backed up with case studies undertaken at existing junctions.

3 Operational Assessment

Operational efficiency is assessed in terms of Reference Flow to Capacity Ratio (RFC), sometimes referred to as the ratio of flow to capacity, at priority junctions and roundabouts. Operational efficiency at signal controlled junctions is assessed in terms of Degree of Saturation (DoS).

Principal points to note when comparing the assessment of operational performance at junctions using **fast**-answers software with the assessment of operational performance at junctions using *traditional* software packages are:

- **Differences in RFCs and DoS** are generally less than 8% - being **typically 2 to 6%**.
- If required **fast**-answers designs can be verified by comparison with Linsig, Arcady or Picady prior to implementation or prior to use in a public inquiry
- Differences in RFCs between *traditional* software and **fast**-answers software output are less than
  - error in the method. For example Brown (1995) reports 15% standard error for Arcady capacity estimates
  - error and uncertainly in the input data which may arise from:
    - day to day variations in traffic flows (which can be significant) and from errors in measurement
    - errors in estimates of generated traffic (often used in Transport Assessments)
    - errors in assessment of traffic flows derived from traffic models. These estimates normally have a high level of uncertainty attached
    - errors associated with traffic growth forecasts, which are prone to high levels of uncertainty.

Thus, for practical purposes, the small difference in RFC and DoS estimates between fast-answers and *traditional* program output are normally of little significance.

In general **fast**-answers software RFC and DoS outputs are marginally more conservative than *traditional* software equivalents.

4 *Priority Junctions*

Table 4.1 compares **fast**-answers **quick**-PJ with the UK Transport Research Laboratory's (TRL) Picady using hypothetical data. The data shows good agreement for Arm B and for the right turn C to B. Arm B is overcapacity and the junction is in need of improvement.

Table 4.1 : Comparison of Fast-Answers Quick-PJ and TRL Picady Using Hypothetical Data

Movement (3 arm junction)	RFC output from quick-PJ	RFC output from Picady
Arm B	1.23	1.17
Right turn C to B	0.36	0.35

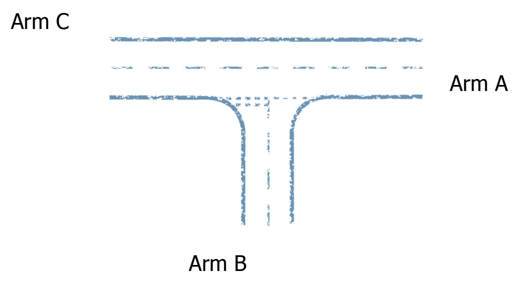
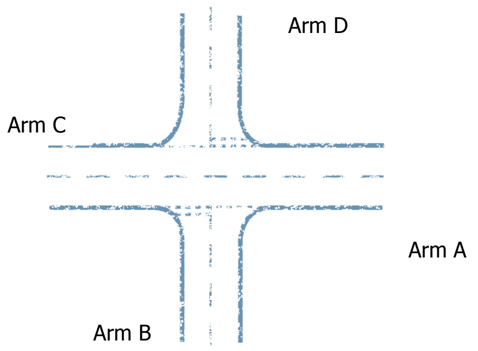


Table 4.2 shows case study results comparing **fast**-answers **quick**-PJ with TRL's Picady. The main carriageway has a width of 8m and observations on site have shown there is insufficient space for ahead traffic to pass right turners waiting to turn (drive on left system). These right turners subsequently block the road for ahead traffic.

Table 4.2 : Case Study Comparison of Fast-Answers Quick-PJ and TRL Picady

Movement (4 arm junction)	RFC output from quick-PJ (with blocking back on major road arms)	RFC output from Picady (with blocking back on major road arms)
Arm B	0.03	0.04
Right turn C to B	0.02	0.01
Arm D	0.31	0.30
Right turn A to D	0.07	0.05
Time to replicate Picady (starting from scratch)	4 minutes and 30 seconds	



5 Roundabouts

Table 5.1 compares RFC output from **quick**-RA and from Arcady using hypothetical data. There is good agreement between the results with variations ranging from 3% to 6%.

Table 5.1 : Comparison of Fast-Answers Quick-RA and TRL Arcady Using Hypothetical Data

Movement (3 arm junction)	RFC output from quick-RA	RFC output from Arcady
Arm A	0.88	0.85
Arm B	0.74	0.70
Arm C	0.70	0.67

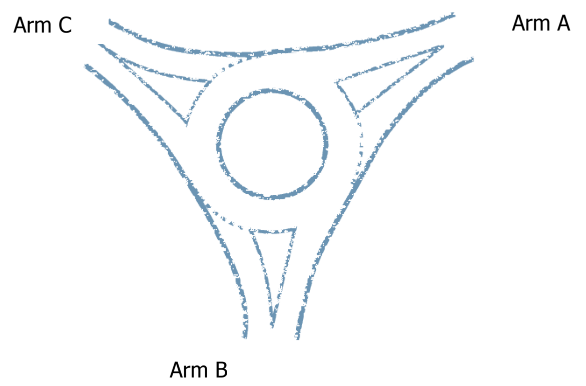
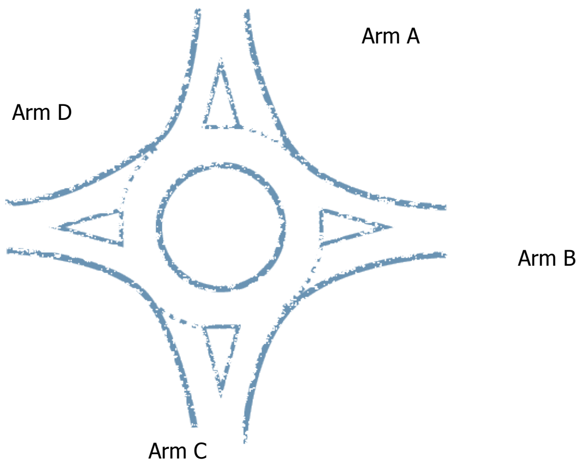


Table 5.2 shows the results of a case study and compares **quick**-RA and Arcady RFC results. Again there is good agreement between results with variations ranging from 0% to just less than 4%.

Table 5.2 : Comparison of Fast-Answers Quick-RA and TRL Arcady Using Hypothetical Data

Movement (4 arm junction)	RFC output from quick-RA	RFC output from Arcady
Arm A	0.76	0.77
Arm B	0.80	0.77
Arm C	0.05	0.05
Arm D	0.40	0.41
Time to replicate Arcady (starting from scratch)	5 minutes 32 seconds	



6 Signalised Junctions

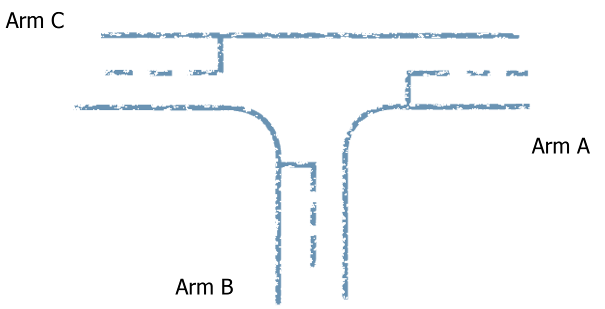
6.1 Oscady

Oscady Example 1

Table 6.1 compares DoS output from **quick**-Sig and from Oscady using hypothetical data. There is good agreement between the results with variations ranging from about 2% to 4% with the biggest difference being just less than 7%. Hence, the two programs will normally result in similar design decisions. Oscady usually predicts slightly higher saturation flows and this results in slightly lower DoS than **quick**-Sig. Since **quick**-Sig includes an option to use RR67 saturation flows (Kimber 1986), this option was used to help make a fair comparison. **quick**-Sig set the optimised cycle time at 48 seconds, so this was manually reset to 44 seconds to mimic the Oscady inputs as closely as possible.

Table 6.1 : Comparison of Fast-Answers Quick-Sig 223 and TRL Oscady Using Hypothetical Data

Movement (3 arm junction)	DoS output from quick-Sig (Wizard)	DoS output from Oscady
C to A	0.29	0.30
A to B and C	0.76	0.79
Right turn C to B	0.79	0.76
B to A	0.64	0.60
B to C	0.76	0.78
Cycle Time	44 seconds	43.5 seconds



6.2 Linsig

Linsig Example 1

Table 6.2 (Step 1) compares DoS data output from **quick**-Sig and from Linsig, using case study data.

Here, **quick**-Sig considerably underestimates relative to Linsig. Upon closer examination it was noted that **quick**-Sig Wizard estimated a much shorter pedestrian stage and a much shorter intergreen period than those implemented at the case study site.

The pedestrian stage and intergreens were subsequently checked and considered to be extremely conservative at the case study site. Thus **quick**-Sig served to quickly indicate that timings at the junction could be considerably improved.

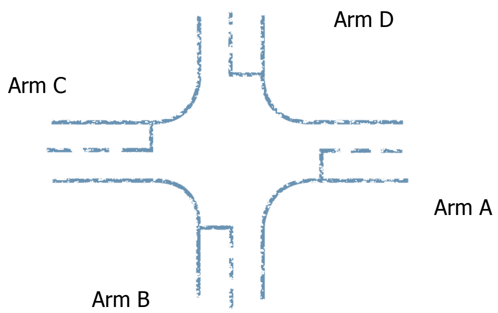
Table 6.2 : Case Study Comparison Between Fast-Answers Quick-Sig 223 and JCT's Linsig: Step 1 Indicating How Quick-Sig Wizard Can Rapidly Indicate Improvements

Movement (4 arm junction)	DoS output from quick-Sig (Wizard)	DoS output from Linsig
A	0.89	1.00
B	0.86	0.95
C	0.92	0.99
D	0.65	0.66
Cycle Time	88 seconds Fast-Answers rounds to nearest 4 seconds.	90 seconds
Time to replicate Linsig (starting from scratch)	5 mins 16 secs	
Pedestrian Stage:	**quick**-Sig Wizard estimates about 21 second traffic intergreen for pedestrian stage (peds).	Linsig data shows 27 seconds traffic intergreen for peds. **quick**-Sig analysis suggests a check on Linsig pedestrian timings is needed.

The purpose of the case study is to mimic Linsig and demonstrate compliance of **quick**-Junction with *traditional* industry software such as Linsig. Therefore the Linsig intergreen periods and pedestrian stage timings were input into **quick**-Sig in an attempt to improve the quality of the comparison. Table 6.3 (Step 2) shows the results and good agreement between the two software packages.

Table 6.3 : Case Study Comparison of Fast-Answers Quick-Sig and JCT Linsig
Step 2 Using Unimproved Linsig Data And Showing Good Agreement Between Output Results

Movement (4 arm junction)	**DoS output from quick-Sig (Wizard)**	**DoS output from Linsig**
A	1.00	1.00
B	0.90	0.95
C	1.00	0.99
D	0.66	0.66
Cycle Time	92 seconds Fast-Answers rounds to nearest 4 seconds.	90 seconds
Time to replicate Linsig	Step 1 + 8 secs	
Pedestrian Stage	27 second traffic intergreen	27 second traffic intergreen



Clearly **quick**-Sig is useful for quick checks of signal settings; and to indicate areas that may require attention and updating.

7 Comparison with Methods Used Globally

Comparison of **fast**-answers software with global junction design packages (other than UK based Oscady, Arcady, Picady and Linsig) would be expected to produce variable results due to the differences in methodology. Many junction design methodologies are based on gap acceptance (as opposed to TRL's empirical methods derived for UK conditions). Akcelik (1999) compares ARR31 roundabout capacity assessment with AustRoads, NAASRA, German Gap and TRL linear (Arcady) methods. Total entry flow estimates varied from a minimum range of 750 to 1020 pcu/h at a single lane roundabout (ICD = 40m) to a maximum range of 600 to 1700 pcu/h at a two lane roundabout (ICD = 60m). Except in the case of high circulating flows and low entry flow at small roundabouts the TRL linear method performs in the mid-range of the other methods. (For high circulating flows and low entry flow at small roundabouts the TRL method estimates set the upper bound of the range of estimates for all the methods.)

In conclusion, differences between capacity estimates for roundabout entries based on the various methods tested by Alcelik (ibid) are significant. However **quick**-RA can be expected to predict capacity within the midrange of the main methods used globally, since it is based on the same TRL research as Arcady and performs similarly. By extrapolation, and since **fast**-answers methodology is largely based on TRL research, it is tentatively asserted subject to further on-going investigations, that **quick**-PJ and **quick**-Sig could be expected to estimate junction capacity within the midrange of the main methods used throughout the world.

8 Independent Evaluation of Quick-Junction by Third Parties

8.1 As Part of Land Allocation Study

South Lakeland District Council in UK commissioned a traffic study in and around the Ulverston area. The work was required to support the authority's Land Allocation Study which had identified some 17 potential development sites in and around Ulverston for the provision of housing (about 1400 houses) and for office and light commercial uses (B2/B8 at three or four locations).

The study produced traffic forecasts for the proposed developments and subsequently assigned the resulting traffic flows on to the local highway network and identified the associated traffic impact. Assessing the impact involved evaluating the operational capability of 12 junctions for existing and future AM and PM peak hour conditions. Several of the junctions were on the A590 trunk road, and hence of interest to the UK Government Highways Agency. Junction capacity assessment was undertaken on all junctions using the **fast**-answers suite of programs.

The study report and associated analyses was subsequently reviewed by Cumbria County Council and the Highways Agency (assisted by their external consultants JMP). The result of the review was very positive, with no issues being raised regarding the analyses of the junctions, other than JMP's comment stating this as their first experience of **fast**-answers software.

The study report was subsequently lodged as a 'core' document at the associated planning inquiry and no challenge was made regarding the analyses of the highway network.

8.2 As Part of Defence of Planning Decision

In the early stages of the development of the **fast**-answers software suite, the methodology was deployed in the rapid analysis of development options at an out of town shopping centre in Edinburgh. The methodology was used to very quickly evaluate the operational capacity of junctions within the area of influence of the centre. On this basis a new development control policy was proposed and accepted and implemented by the planning authority. The policy was challenged by reputable national and international consultancies on behalf of the major developers involved at the site.

The development control policy was successfully defended; and indeed a public inquiry was averted. This was deemed by the **fast**-answers team to be equivalent to a successful peer review of the **fast**-answers methodology.

8.3 MSc Thesis at Edinburgh Napier University

Some work comparing **quick**-PJ with Picady and **quick**-RA with Arcady has been completed at the Transport Research Institute of Edinburgh Napier University (Djuric 2012). The MSc thesis also made comparisons with manually calculated RFCs using equations given in the UK Design Manual for Roads and Bridges (DMRB) (Highways Agency 1995).

Key results, based on case study junctions in Edinburgh and in Perth, are given in Tables 8.1 (priority junction) and 8.2 (roundabout) below. The results show good agreement but data was only available at low traffic volumes and hence low RFC values. It can be seen that both the **quick**-PJ and **quick**-RA results are slightly more conservative, when compared with Picady and Arcady results respectively. Djuric (ibid) notes that this effect arises as a consequence of the way cyclic flow profiles are simulated within the **fast**-answers software and the effect decreases as RFCs increase.

Table 8.1: Comparison of Fast-Answers Quick-PJ, DMRB Manual Methods and TRL Picady

Movement (3 arm junction)	RFC output from quick-PJ	RFC manually calculated DMRB[1]	RFC output from Picady
Arm B	0.26	0.240	0.229
Right turn C to B	0.26	0.259	0.237

Note 1: Design Manual for Roads and Bridges

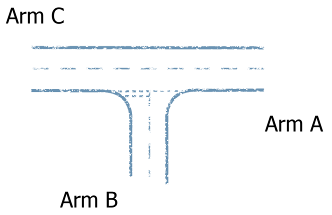
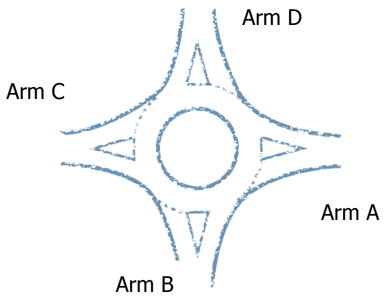


Table 8.2: Comparison of Fast-Answers Quick-RA, DMRB Manual Methods and TRL Arcady

Movement (4 arm junction)	RFC output from quick-RA	RFC manually calculated DMRB[1]	RFC output from Arcady
Arm A	0.17	0.173	0.131
Arm B	0.20	0.169	0.152
Arm C	0.34	0.286	0.269
Arm D	0.10	0.096	0.074

Note 1: Design Manual for Roads and Bridges



9 References

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