TRICS

Construction Traffic

Research Report

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JMP Consultants Limited
The Crescent Centre
Temple Back
Bristol
BS1 6EZ

T 0117 376 3300
F 0117 376 3301
E bristol@jmp.co.uk

www.jmp.co.uk

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1 Introduction

Background

1.1 This report has been complied by JMP Consultants Ltd to address the possible need for a construction traffic option within the TRICS® database. Whilst the TRICS® database contains site and traffic data for sites in the UK, to date it has not been concerned with collating trip rates for construction traffic. The focus of this study is to understand how the issues relevant to construction traffic and construction sites may be represented within the TRICS® database.

1.2 The construction phase of a proposed development can lead to significant impacts on existing road users depending upon the scale of the development. Although only a temporary phase in the lifespan of a site, Local Planning Authorities are increasingly requiring that transport issues relating to construction is considered as part of the planning submission and that all potential traffic impacts be identified and measures implemented to manage their effects wherever possible. The need to make an accurate estimation of construction traffic is therefore of growing importance to developers.

1.3 Until recently the impact of construction traffic has not been covered within the Transport Assessment process unless consideration of construction traffic has been specifically requested by the planning or highway authority. Typically, however, some estimates of construction traffic data are generated according to the design and work plan for site management planning. This may be considered in the development of the Construction Environmental Management Manual (CEMM) or the contractor's Environmental Management Plan (EMP). The CEMM sets out the approach of the environmental management during the construction phase of the development; the EMP actions for minimising construction-related traffic.

1.4 For the purpose of the EMP, assumptions are often made to derive the number of construction vehicle movements. In estimating the number of construction-related vehicle movements, consideration must be given to the following vehicle trips:

- Workforce movements to/from the site;
- Deliveries made to the site;
- Removal of material from the site; and
- Trips made by associated trades.

1.5 The first principles approach identified above is perhaps most commonly used; the main benefit being the site specific nature of the data generated. However, at outline application stage, the degree of certainty required for such calculations is frequently not available as the construction methods and programme may not be finalised and contractors not appointed. The calculations are so site-specific, that their use in predicting trip generation of other sites raises issues of comparability. Should suitable data be available from a large number of sites, it may be possible to provide 'generalised' trip generation figures relating to land use, construction method and ground floor area. These construction site trips could then be categorised and built into the TRICS® database for comparison by users.

Policy Context

1.6 The Department for Transport Guidance on Transport Assessment (2007) introduces construction traffic to the transport assessment process for the first time. It advises inclusion of a detailed

description of the proposed use or uses of the site to be provided and as a minimum this should include the traffic impacts of the site construction works:

'the traffic impacts of site construction works, including the requirements of abnormal loads in the construction, use and decommissioning of the present development.'

Paragraph 4.26, Guidance on Transport Assessment.

1.7 The guidance also states that for large developments, the impact of construction traffic will require separate consideration as part of the development trip generation assessment. In paragraph 4.66 it advises that the assessment should identify the time period(s) during which construction activities will take place, the numbers of trips likely to be generated, the vehicle type and, where appropriate, a diversion route or a traffic management plan to minimise local impacts.

1.8 Where impacts from construction traffic are large, especially where mitigation measures may be required, paragraph 4.89 recommends the use of Conditions or obligations which may require that any necessary mitigation measures be completed before work on the development site commences, or before first occupation of units on the site, especially where construction is phased.

2 Construction Traffic Issues

Who does construction traffic impact upon?

2.9 The extent of traffic generated by construction can be considerable, with congestion, noise, environmental and safety issues. Any assessment should therefore address these impacts upon all users, including pedestrians, cyclists, public transport and vehicular users, and include consideration of the access and servicing requirements of affected residential and commercial premises.

2.10 These impacts, although temporary, may be significant, affecting both the site and its immediate environs, and more widely on the road network. The site boundary may expand or contract as required by the construction works, removing or releasing land for footways and roads. There may be delays, closures and diversions for road users, footways, public transport services and interchanges, parking and loading. Additionally, there may be changes in road safety, and changes in noise levels and air quality as a result of increased vehicular traffic.

2.11 The use of temporary traffic and site management measures can have a wide range of repercussions for different users, which are illustrated below:

- Pedestrian footways narrowed, temporary closures, diversions and temporary footways of varying quality;
- Cycles routes closed, narrowed, diverted, reallocation of parking;
- Bus services diverted, suspended and relocation of bus stops and stands;
- Rail passengers impacted by alterations to station entrances and exits, public transport and taxis access and circulation within stations;
- Taxis rank relocation;
- Traffic:
  - Lane closures and/or shuttle working with signal control;
  - Introduction of one-way streets, reversed flows and removal or introduction of banned turns;
  - Road closures with signed diversions;
  - Changes to traffic signal timings; and
  - Temporary speed limits.
- Parking suspension and/or reallocation;
- Bridleway narrowing, closure or diversion.

2.12 All of the above can have significant impacts upon the needs of mobility impaired persons; these must be addressed in any traffic management plan.

2.13 Disruption arising from the construction site is generally more localised in its effects, typically noise, vibration, dust and dirt, and a loss of amenity due to the presence of heavy construction traffic (DMRB). . The TRRL Supplementary Report SR 562 states that:

- Of the people living within less than 50 metres of either side of construction sites, less than half were ‘seriously bothered’ by construction activity; and
- Beyond 100 metres, less than 20 percent of the people were ‘seriously bothered’.

2.14 Nonetheless, the number of properties within 100 metres of a proposed site should be established, especially sensitive buildings such as schools and hospitals. This information needs to be collected as part of the Noise Assessment and the presence of schools and hospitals will be particularly relevant to the impact and management of construction traffic due to the high number of

trips already generated by these land uses. Various vehicle transport routes should therefore be considered to ensure disruption is kept to a minimum

Cost and efficiency

2.15 Transport accounts for between 10 and 20 percent of construction costs, with construction traffic alone accounting for 13 percent of UK total fuel use (The Construction Industry Mass Balance, Viridis, 2002). The construction industry has in recent years moved more toward competitive tendering procurement that favours low price, fixed fee contracts, which in turn has created pressure to optimise the supply chain; this, against a trend of increased fuel costs. The industry has been effective in creating efficiencies to reduce site transport wherever possible, which in turn can cut assist in reducing costs.

2.16 In order to achieve these efficiencies, a number of techniques and working practices have evolved, which include:

- Supply chain optimisation;
- Load optimisation;
- Consolidation centres;
- Just in Time deliveries;
- 4th party logistics (outsourcing); and
- Delivery booking (deliveries by pre-arranged time slots).

2.17 Whilst many of these techniques have been instigated for cost reasons, they have clear implications for the manner in which a construction site is accessed and managed, not least the ability to provide and manage mitigation against potentially adverse construction traffic.

Typical activities during construction

2.18 A 'typical' construction site will involve certain activities taking place and structures being installed as part of the construction period, which, depending upon the site and access constraints may influence vehicles used. Full construction logistics are usually calculated by the main contractor as part of the detailed programming for the operation of the site. This will usually encompass all activities including site security, staff, transport management, materials handling, transportation, plant, stores, deliveries etc. Of all these activities, the delivery of construction materials is usually the biggest aspect both in cost and time, although on some sites this can be closely followed by the cost of removal of demolition and other spoil. Activities to consider may include:

- Implementation of secure site fencing
- Disconnection of services
- 'Soft Strip' demolition
- Asbestos removal
- Demolition of structures
- Break out foundations and ground slabs
- Archaeological/Ecological surveys and investigation
- Reduced level dig and cart away
- Piling
- Pile caps and ground slabs
- Structure erection
- Roof and wall cladding
- Internal mechanical and electrical services
- Fit out and facilities
- External works

- Test and commission
- Handover
- Defect period

2.19 Additional activities may include temporary site facilities, including delivery, installation and removal of specialist plant and site offices/portacabins, toilets, water bowsers, electrical supply etc.

Vehicle types

2.20 The varieties of activities that may take place during construction require the use of a wide range of vehicle types. These may be identified and grouped according to their size:

- Car/pick up/3.5 ton van
- 7.5 ton box van/panel van
- Low loader and articulated Heavy Goods Vehicle (HGV)
- Ready mix concrete truck
- Mobile crane
- Skip lorry
- 32 ton tipper truck

2.21 The trips generated by each vehicle type are highly dependent upon the nature of the job. For example, the Highbury Redevelopment (May 2006) required a large amount of material to be transported to and from the site and as a result, 45.1% of vehicle trips (see T1.1) to the site were made by 32 ton tipper trucks (15m^3 capacity).

2.22 It is worth noting here that vehicles with a weight in excess of 7.5 tonnes require approval to use trunk roads and motorways if trips to or from a site exceed 24 movements on any day.

2.23 Developments are often completed in phases, with earlier stages often requiring greater use of HGVs for site clearance and bulk delivery of construction materials. Where the site location is favourable, large, bulky and heavy materials may be transported by rail or barge.

T1.1 The percentage of vehicle trips made by each vehicle type during the Highbury Redevelopment, based on a total of 29,788 trips.

Vehicles	Car/pickup /3.5 Ton van	7.5 Ton Box van/panel van	Low loader & artic	Ready mix concrete truck	Mobile crane	Skip lorry	32 Ton Tipper truck
% of trips made by vehicle type	10.45	18.07	2.38	22.77	0.05	1.29	45.07

3 Construction Impacts on Traffic

Initial considerations

Peak Hours

3.24 Peak hours for a construction site are generally outside regular 'office' hours, frequently starting at 07:00 and finishing as late as 19:00. Specific site activities may spread trips across the site's operating period.

Traffic Management

3.25 The local road network may require certain limitations, such as width and weight restrictions, which may limit the available routes suitable for HGVs. However, in general, construction traffic will have minimal impact on traffic, except where temporary road closures or re-routing is required. Construction traffic normally generates less vehicle movements than the agreed use of a new development.

3.26 To facilitate site access or construction activities, a range of traffic management measures may be required to maintain access and servicing where reasonably possible within the constraints of the works and the need to ensure the safety of the public. These may include provision of temporary roads/footpaths/access points, or closure of same, temporary parking restrictions, creation of special signing and/or temporary residents parking schemes. Some traffic management proposals may require Traffic Regulation Orders under the Road Traffic Regulation Act 1988, for which a minimum of 28 days notice is usually required by the relevant local authorities.

3.27 For larger developments, and/or developments, especially those with already limited parking, it may take up to six months to implement such schemes.

Calculating the Trip Rate

Types of movement

3.28 In estimating the number of construction-related vehicle movements, consideration must be given to the following vehicle trips:

- Workforce movements to/from the site;
- Deliveries made to the site;
- Removal of material from the site; and
- Trips made by associated trades.

Construction programme

3.29 Construction programme managers will be able to calculate vehicle movements based upon the site construction programme, once this is known. Movement calculations require simple, but fundamental data which will have implications for the quantity and type of vehicle movements:

- materials (quantity and bulk);
- construction programme (construction process, timescale, phases and occupations); and
- site logistics (access, on-site storage capacity, load consolidation etc.).

3.30 From these, the nature and number of vehicles required can be calculated. Trips calculated will relate to optimised vehicle loadings; in reality consideration should be given to calculating trips based on an average 80 percent vehicle loading to reflect part loads, missed orders/deliveries and

other assorted ‘real world’ complications, which will result in an increase in trips. Ensuring optimisation of vehicle loading is an obvious opportunity to both reduce trips and construction costs.

3.31 For the early phases of development, typified by the use of HGVs, identifying whether a site is ‘greenfield’ or ‘brownfield’ will have a significant impact on the nature of vehicles required on site (such as for demolition) and the amount of material to be removed from a site (topsoil, rubble, hazardous waste) and any remedial works (land reclamation), and therefore the number of HGV trips generated.

3.32 Also of significance will be the nature of the development; certain commonalities in construction type and materials used are typified by land use, such as residential, industrial, office and so forth, and the degree of prefabrication. It may be worth separating the type of development into ‘sub-sections’ or phases to get a more accurate calculation of traffic generation relative to site.

3.33 Access to building materials, especially for larger developments, bulk or specialised materials, where supplies may not be found locally, may also have an impact on traffic. As a result, consideration of where supplies will be sourced from and their route and method of delivery is important when assessing the impact of construction traffic. These may include the use of bulk quarried materials, or access to site by specialised machines (such as cranes) or large prefabricated sections.

3.34 All such considerations should help to inform the need for routing and delivery scheduling under the traffic management plan.

Ready Reckoner for Trip Generation

3.35 The first principles approach identified above is commonly used within the construction industry. With respect of enabling such data to be accurately represented within TRICS®, the main variables of materials (quantity and bulk), speed and type of construction, and site logistics (storage), results in very site specific data that is of limited use in predicting trip generation of other sites. However, at outline application stage, the degree of certainty required for such calculations is frequently not available as the construction methods and programme may not be finalised and contractors not appointed.

3.36 Obtaining historic data from a large number of completed sites may enable ‘generalised’ construction vehicle trip rates relating to land use, construction method and ground floor area to be discerned and represented within the TRICS® database. However, during the research for this report it became apparent that such data is not widely maintained or recorded within the construction industry.

3.37 However, a simple ‘Ready Reckoner’ was devised by the Building Research Establishment (BRE) in the 2003 report ‘Construction Site Transport, The Next Big Thing’. This provided a summary of indicators for construction site transport, using the M4I environmental performance indicator (www.m4i.org.uk) on transport as a starting point to construct two calculations, both of which relate to project value.

3.38 The first calculation relates the number of road vehicle movements to a site, per £100,000 project value. Factors considered include workforce movements, delivery of materials and plant to site and movement of waste off-site. The full methodology is displayed in Appendix A.

3.39 The second calculation relates the distance (km) vehicles travel to site, per £100,000 of project value, using the same factors as above. The full methodology is displayed in Appendix B.

3.40 Constructing Excellence recorded 'Commercial Vehicle Movement KPI' as part of the 2007 UK Construction Industry Key Performance Indicators. This uses a measure of the total number of commercial vehicle one-way movements onto a site (collected from security or other gate records, contractor notes and waste transfer notes) against the total project value. For inclusion, sites used in the assessment should be entirely non-operational, i.e. being constructed without any elements of the site being occupied which may skew the data.

3.41 Based on data collected in 2006, the total recorded movements onto a site per £100,000 of project value is 29.4 one-way trips (www.kpizone.com). For deliveries of materials, the indicator simply considers the final delivery journey to site, therefore not accounting for off-site storage, consolidation of loads or other factors.

The Construction Traffic Management Plan

Managing construction traffic

3.42 An output of the assessment should include a Construction Traffic Management Plan, which should be prepared in consultation with highway and traffic authorities and provide the strategy for managing and mitigating the identified impacts. It should address:

- site boundaries and main access/egress locations;
- traffic management strategy;
- temporary and permanent closures and diversions of highways and public rights of way;
- HGV routing (both locally and if necessary strategically), including signing, holding areas/consolidation centres, abnormal loads, prohibited routes and means of monitoring HGV use.

Practical Solutions

3.43 A range of measures may be employed via a Construction Traffic Management Plan, as indicated below:

Measure	Considerations
Supply Chain Optimisation	The logistics industry has developed a range of techniques to maximise efficiencies within the supply chain. Perhaps most well known is the concept of 'Just In Time' delivery, although general supply chain optimisation addresses ranging, procurement, storage, distribution and back loading activities to maximise load optimisation.
Delivery logistics	Delivery booking (deliveries by pre-arranged time slots), which can be used to enable delivery of materials either as part of a 'Just in Time ' operation so that materials only arrive on site when needed (scheduled), or as part of a 'smoothing' operation to enable the peaks and troughs in demand to be evened out over a period of time, or to avoid certain time periods such as morning and evening peaks, or school start and finish times.
Load consolidation	Off-site consolidation of materials (where suitable off-site can be identified and procured), providing 'Just In Time' deliveries and reducing access congestion and on-site material storage. This is particularly useful if the development site is constrained for suitable storage space, or faces access constraints.
Route mapping	Routing and scheduling arrivals may make it possible to reduce trips to a site, by providing a more organised, logistical style method of operation.

	Routes should be surveyed and swept path analysis undertaken.
Operating Hours	Restricted site operating hours, especially on sites adjacent to sensitive sites such as schools, hospitals and residential areas.
Construction Travel Plan	Employees to use walking, cycling and/or using public transport can reduce the number of trips to a site. A minibus may be used to transport workers in bulk to the site. This has the advantage of restricting traffic generation to the daily arrival and departure of staff employed on site, as well as removing the need for car parking facilities on site.
Programme Compression	The severity of any adverse impacts could be balanced by compressing the programme of phases, thereby causing greater disruption over a shorter time period, or overlapping certain activities.
Noise	Restrict operating hours, compress activities to minimise disruption.
Vibration	Restrict operating hours, compress activities to minimise disruption.
Dirt	Wheel washing Load covering
Construction methods	Consider alternative construction methods, such as prefabrication, onsite concrete mixing etc to minimise external site trips.

4 Conclusions

4.44 Given the complex interrelation between construction programme, materials and site logistics, a first principles approach is recommended as the primary means of understanding and reporting the impacts of transport generated by construction at a site. In seeking to determine and calculate trips, consideration should be given to the nature and type of activities likely to be undertaken on site; a summary of which is provided in Section 2.

4.45 In instances where insufficient data exists to undertake a detailed assessment of construction traffic, a 'Ready Reckoner' approach is provided in 3.12, which enables calculation of both construction trip numbers and distances travelled to site, based on the value of the project. At this time, this appears to provide the most robust methodology.

4.46 Included in Section 3.19 is a summary of construction traffic management plan measures that may be considered to minimise disruption and other impacts associated with construction; these build upon the evidence provided in Section 2 relating to traffic management and logistics techniques.

Implications for TRICS®

4.47 A mechanism for representing detailed construction trip generation within the TRICS® database is considered unfeasible at this time, due to the relative lack of suitable data, and the incompatibility of the ways in which data is used and manipulated by TRICS® users and the construction industry.

4.48 To provide users with guidance on construction traffic trip generation calculation and other relevant issues, this report should be made available to users of the TRICS® website and additional functionality created within the TRICS® database. This could include the provision of an additional main Land Use categorisation entitled 'Construction' below the existing item 16 'Mixed', which if selected would provide a 'Pop-Up Advice Note' dialogue box with a brief summary of, and hyperlink to the research report. Similar additional prompts relating to construction movements could be applied to 'OGV' commercial vehicles in vehicle type definitions and 'OGV' button mouse-over notes.

Appendix A

Vehicle Movements by Project Value

Number of vehicle movements per £100,000 of project value.

Table One

Definition Number of road vehicle movements to site, per £100,000 project value. Consider:

- Workforce movements
- Delivery of materials and plant to site
- Movement of waste off site

Methods

Workforce Either during construction, or on completion, using induction questions, actual numbers of vehicles in on site car parks, or security records, ascertain the total number of workforce vehicle movements onto site and the value of the project completed.

Commercial Either during construction, or on completion, using security or other gate records, contractor notes and waste transfer notes, ascertain the total number of commercial vehicle movements onto site and the value of the project completed.

Total Performance score (workforce and commercial vehicle movements per £100,000) =

$$\frac{\text{Total number of workforce and commercial vehicle movements}}{\text{Value of the project completed}} \times £100{,}000$$

Example Without on-site parking, the induction question yielded the following data: 70% drive in their own car, 10% share a van with one other, 10% drive on a motorbike, 10% come by public transport. On average 100 people come to site every working day.

Therefore there are on average 85 vehicle movements daily (70 singly occupied cars, 5 shared vans, 10 motorbikes, ignore public transport.). From records kept at the gate, it is known that during the project, there were 1000 deliveries to site and 250 waste vehicles arrived. With 100 working days on site and a project value of £1M, the workforce and commercial vehicle movements per £100,000 project value is:

$$\frac{(85 \times 100) + 1250}{1{,}000{,}000} \times 100{,}000 = 875$$

Source: 'Construction Site Transport, The Next Big Thing', Building Research Establishment (BRE), 2003.

Appendix B

Vehicle Distance by Project Value

The distance (km) vehicles travel to site, per £100,000 of project value

Table Two

Definition The distance (km) vehicles travel to site, per £100,000 of project value. Consider:

- Workforce movements
- Delivery of materials and plant to site
- Movement of waste off site

Methods

Workforce Either during construction, or on completion, using induction questions, and travel diaries, ascertain the total workforce distance travelled onto site and the value of the project completed.

Commercial Either during construction, or on completion, using security or other gate records, contractor notes and waste transfer notes, ascertain the total distance travelled by commercial vehicles and the value of the project completed.

Total Performance score (workforce and commercial vehicle distance per £100,000) =

$$\frac{\text{Total number of workforce and commercial kilometres}}{\text{Value of the project completed}} \times £100{,}000$$

Example The induction question was used to calculate the average round-trip distance travelled for each transport mode: the car drivers come 30 km on average, van drivers 40 km, the motorcyclists 50 km, ignore public transport. (Remembering that 70% drive in their own car, 10% share a van with one other, 10% drive on a motorbike, 10% come by public transport.)

On average 100 people come to site every working day, there were 100 working days on site, with a project value of £1M.

The suppliers kept records of mileage attributable to the site (ie when a vehicle was loaded 50% or more with a load for or from the site). The 1000 deliveries resulted in 10,000 km. The 250 waste deliveries were all by the same vehicle type, all to the same waste management site 25 km away, resulting in 12500 km.

So the workforce and commercial distance travelled per £100,000 project value is:

$$\frac{\text{Workforce} + \text{Commercial}}{(((30 \times 70) + (40 \times 5) + (50 \times 10)) \times 100) + (10{,}000 + 12{,}500)} \times 100{,}000$$

$$= \frac{1{,}000{,}000}{}$$

= 30250 km per £100,000

Source: 'Construction Site Transport, The Next Big Thing', Building Research Establishment (BRE), 2003.