Material change for a better environment

Case Study: Material Logistics Planning

Central St Giles: Stanhope, Bovis Lend Lease and Wilson James

Reducing construction waste and carbon emissions through the use of a Construction Consolidation Centre, using an on site logistics specialist and reverse logistics for waste removal.

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Front cover photography: The distinctive terracotta wall panels at Central St Giles.

Executive summary

Developers Stanhope and their construction managers Bovis Lend Lease were two of the companies engaged with WRAP (Waste & Resources Action Programme) when the Material Logistics Plan guidance document and template were first drawn up. Central St Giles, in the centre of London, was a pilot project in this process and its use of a Construction Consolidation Centre (CCC) is of particular interest in this study. Work on the project started in the summer of 2007 and it is scheduled to be complete in March 2010.

This study focuses on the logistics operation during fit out, the study period being the first six months of 2009.

Key achievements

- 956 fewer delivery vehicle journeys into central London between January 2009 and July 2009 as a result of consolidation, leading to a 75% reduction in carbon emissions.
- A delivery accuracy averaging over 97% measured as vehicles arriving within ± 15 minutes of required time and with the correct load - thereby avoiding congestion and waiting time. Studies have shown that typically in the industry only 40% of deliveries arrive within ± 30 min of the scheduled slot.
- Plasterboard waste, using CCC, running at 6.4%. This compares extremely favourably with the industry average of 22.5% and exceeds by a wide margin the 15% target set in the Contractors and Developers Voluntary Agreement in 2008.[1]

Key elements of logistics strategy

- **Use of Construction Consolidation Centre.** The CCC makes possible operation without congestion at the extremely restricted site in central London. The use of the CCC has led to substantial vehicle traffic reductions and carbon reductions.
- **Just-in-time deliveries.** Materials are ordered and delivered from the CCC on a 48-hour cycle and material volumes kept on site are minimised.
- **Use of on site logistics specialists.** Wilson James (who operates the CCC) is also employed as on site logistics specialist. This results in smooth material flow all the way to the work face; trade contractors don't need to do any material handling. The same company is also responsible for waste bin handling, traffic management, security and other site services.
- **Off Site Manufacturing (OSM).** There are several examples of OSM such as wall units and toilet podwalls. Packaging waste for these items is close to zero and material damage is greatly reduced.
- **Reverse logistics.** The vehicles that deliver materials to site from the CCC remove segregated waste on their return leg, further reducing traffic and associated congestion and carbon emissions.

This comprehensive logistics strategy leads to the quantified achievements above. It also leads to further qualitative improvements such as creating:

- a clean uncluttered working environment;
- a safer working environment;
- an efficient working environment; and
- a construction site that is a good neighbour with minimum interruption to the life of the city.

[1] *The The Federation of Plastering and Drywall Contractors made an agreement; in 2008 to reduce plasterboard waste during installation (Contractors and Developers Agreement). The targets are to:*

- *Include waste management for plasterboard in SWMPs by 2010; and*
- reduce the plasterboard waste generated from new construction and refurbishment on residential and commercial projects to15% by 2010.

Contents

1.0 Bovis Lend Lease

1.1 In brief

Bovis Lend Lease, the main contractor, employs more than 8,000 people across the world, 1,800 of these in the UK. Bovis Lend Lease was a member of the Project Advisory Group that assisted in drawing up the Material Logistics Plan (MLP) guidance document and template.

1.2 Sustainability

Sustainability is an integral part of the culture and philosophy of Bovis Lend Lease and under the headline "Waste" in its published sustainability policy we read:

"We know that buildings use one-third of the world's resources and some 40 percent of waste to landfill comes from construction and deconstruction activities.

Recognising the contribution of our activities to the generation of waste, it is our long-term aspiration to be zero net waste in what we design, construct and develop, for the communities we build and influence, for assets we manage and for those we own."

1.3 The Logistics contractor

Wilson James (WJ) is the logistics contractor appointed by Bovis Lend Lease on the Central St Giles (CSG) project. WJ is a British company with activities in security, aviation logistics and construction logistics. In the CSG project the services provided by WJ include:

- operation of the London Construction Consolidation Centre (LCCC);
- transport between the LCCC and the CSG site; and
- site operations which include:
  - security;
  - traffic management;
  - welfare/cloakroom;
  - forklift driver;
  - slinger;
  - waste operators;
  - materials handling operators; and
  - site management.

WJ employs 42 people on site of which seven are waste operators and seven materials handling operators – including supervisors.

2.0 The Central St Giles project

Central St Giles is a new mixed use development that will provide 400,000ft^2 of office space, 56 apartments and 53 affordable homes, and a 26,000ft^2 selection of restaurants and retail units at ground level. Project value is approximately £175 million. It has a central London location just south of New Oxford Street.

Figure 1 Roadside access and traffic management.

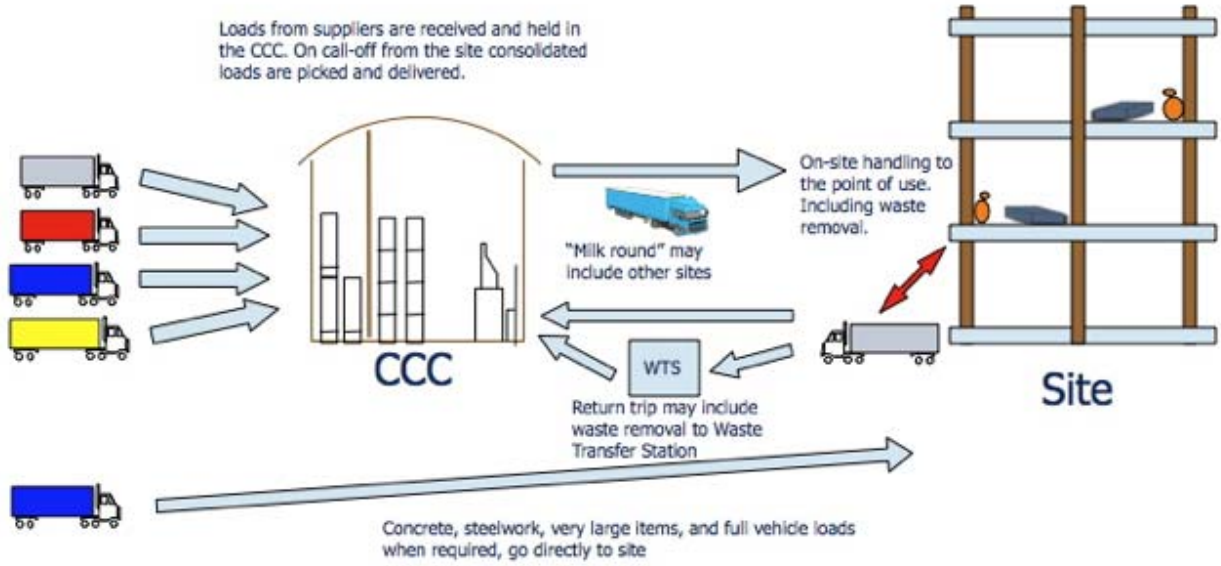
3.0 Logistics approach

3.1 Overview of the material flow

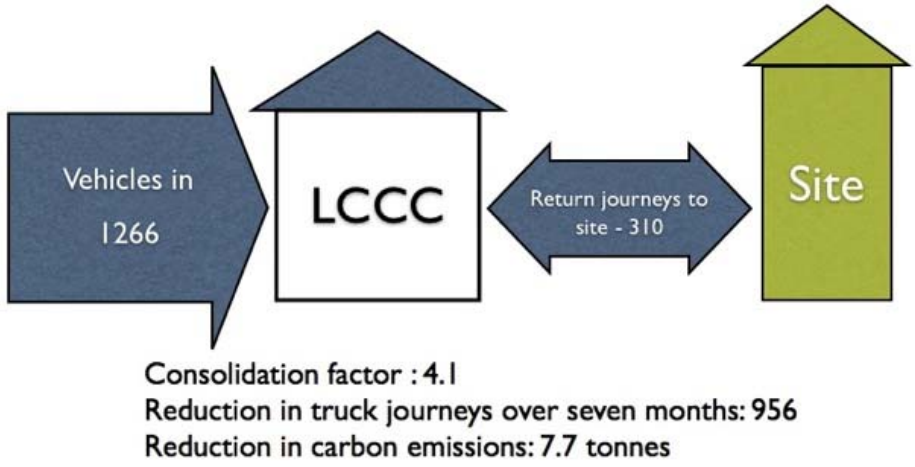
The LCCC is the key to the logistics operation at CSG. Contractors are required to instruct their suppliers to deliver to the LCCC. This mainly concerns materials in the fit-out stage; large loads such as steelwork and heavy plant are delivered directly. From arrival at the LCCC responsibility for the material supply to the workplace is taken over by the logistics contractor WJ.

The controller at the LCCC is in contact with the site and organises the assembly of consolidated loads. Delivering in consolidated loads means fewer vehicle arrivals to site are required than if suppliers deliver directly. The regular deliveries also mean that minimum quantities of material are held on the site thereby reducing risk of damage, obstructions, and H&S incidents caused by congestion. In addition, owing to the reduced waste and damage, less material is required to be delivered overall. The resulting reduction in CO_2 can be seen in the data analysis.

Figure 2 The principles of the material flow when using a Construction Consolidation Centre.



Consolidation cuts the number of vehicles entering the site, and consequently the delivery traffic into central London.



The effect of consolidating loads on traffic and CO_2 emissions is analysed in Section 5.

At the site WJ's operatives control traffic, receive and offload the vehicles, and deliver each load to holding areas earmarked for each trade contractor and adjacent to current activities.

3.2 The LCCC operation

3.2.1 The warehouse

The LCCC is located in Silvertown, close to City of London Airport. It is housed in a standard warehouse unit of 60,000ft^2 - about a quarter of which is laid out with pallet racking. The rest of the space is used for floor storage, with designated areas for assembling deliveries and loading. At the point of conducting this study the LCCC is supporting five major construction projects in London of which CSG is one.

Figure 3 Delivery vehicle being loaded in the LCCC and (right) pallets with plasterboard – low stacks for easy handling

3.2.2 Loads and pallets

The LCCC encourages suppliers to use pallets, cages, or stillages that allow mechanical handling so that manual lifting can be avoided. Good quality pallets also protect the goods and reduce damage and waste. Poor pallets and packaging often go in the skip and can contribute substantially to the waste generated on a building site, whereas good quality pallets or other load carriers can be returned to the supplier and reused many times, vastly reducing packaging waste.

In order to minimise handling damage on site plasterboard is stacked with relatively few boards per pallet. This means they are not too heavy and can easily be handled on site with a hand truck.

3.2.3 Receiving

Trade contractors advise the LCCC of intended deliveries. This should be done a minimum of 24 hours before delivery. The LCCC checks:

- which project the consignment is for;
- the trade contractor;
- whether there are space and resources available at the LCCC; and
- if they can receive the load at the requested time. If everything is satisfactory the trade contractor is notified that delivery can proceed.

3.2.4 Put away and storage

On arrival, deliveries to the LCCC are off-loaded and identified to the Warehouse Management System (WMS). A certain level of inspection is undertaken:

- what has been delivered;
- whether it agrees with what was notified;
- quantity (e.g. number of pallets); and
- a check of the load for any external damage.

Boxes and packages are not however opened for detailed inspection of the goods. A label (see WMS section 3.2.8) is produced and attached to each load, and the load is put away in the warehouse and its location recorded in the WMS. Loads are stored in pallet racking or stacked on the floor, depending on the physical characteristics of the load and the packaging.

3.2.5 Pick and deliver

For delivery to site, contractors are required to call off materials 48 hours before they are needed at the workface. Call off is by email from the site often complemented by telephone instructions. The LCCC picks the materials for a number of contractors and makes up consolidated vehicle loads for delivery to site. Whole pallets, crates, stillages etc are picked. The LCCC will also pick individual boxes from pallets to match precise quantity requirements; they will not however break open boxes to count out individual items.

3.2.6 Kitting

Sometimes the quantity in one box or container is too large for direct delivery to site, and often a mixture of components is needed at one workface. This means there is a need to make up a work package for a specific task; i.e. kitting. In these cases the trade contractors are welcome to come to the LCCC and make up kits in advance of delivery to site.

Kitting means that you only have the required materials at the workface and you avoid double handling on site. This reduces the risk of both damage to goods and congestion on site. Obviously there is also an important productivity benefit as no time is spent on site moving goods from one work area to another.

If the mixed load does not require individual boxes to be broken up the LCCC will prepare kits without the need for the trade contractor to visit the LCCC.

3.2.7 Pre-assembly at the LCCC

The LCCC can be used to perform tasks that are more conveniently done in a warehouse or workshop environment rather than on site prior to installation or in situ.

For example, the contractor responsible for lagging the air conditioning system is doing a large part of his job at the LCCC. It is a better, more undisturbed working environment than on site. Because there are no space constraints he can finish a large number of similar units at the same time, and he can set up a routine that is fast and which doesn't produce much waste. Loads are then prepared with the right number and types of units for each location/floor on site to minimise double handling.

Figure 4 The lagging contractor at work in the LCCC and (right) completed units palletised and labelled for particular zones on site.

3.2.8 Warehouse management system

On arrival at the LCCC each load is identified and entered on the Warehouse Management System (WMS).

The data entered:

- project;
- contractor/customer;
- supplier;
- goods;
- quantity; and
- date received.

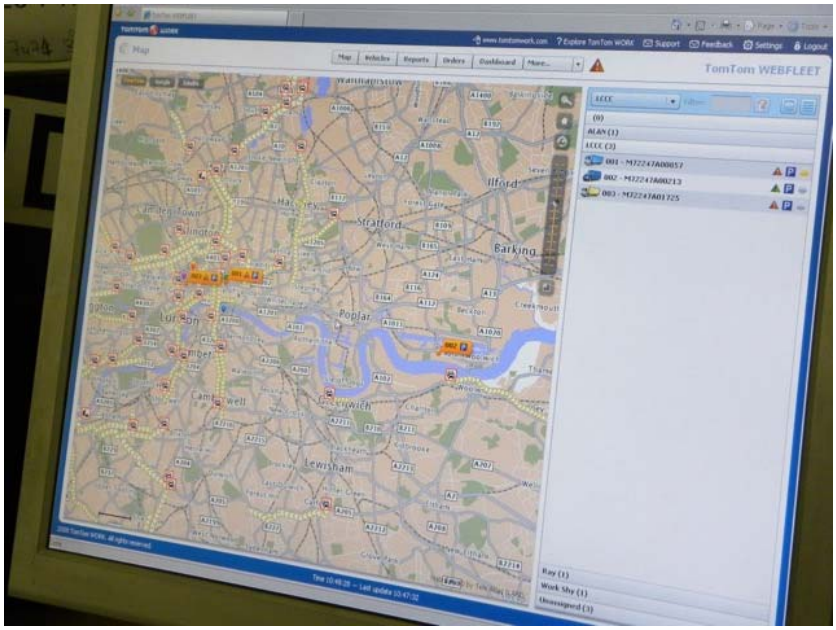
When the goods are registered the WMS allocates a Received Voucher (RV) number to the load; this is used for tracking until the entire load has been delivered to site.

3.2.9 Traffic management

The LCCC uses a GPS-based traffic management system. The system provides:

- GPS navigation support for the drivers;
- real-time information to the controller at the LCCC on the exact location of the vehicles at any time;
- forecast ETA;
- traffic information allowing drivers to avoid congested areas;
- communication, using messaging, between controller and drivers; and
- data logging of all aspects of the journeys: arrival/departure times, distance travelled, average speed, excessive speed etc.

Figure 5 Map screen indicating site, vehicle locations and live information on areas of traffic congestion.



3.3 On site handling

There is one small yard area at CSG, and one narrow street along which deliveries can be made. Careful traffic management is of the essence.

Receiving, off-loading and all internal handling is done by WJ – the same company that operates the LCCC. Materials are ordered to specific floors and temporary holding areas are provided for each contractor. Labels on the pallets ensure that operators put the right pallet directly in the right area, avoiding double handling on site. When work progresses onto a new floor WJ marks out limited space holding areas on the floor. Bins are clearly labelled for each trade contractor. The contractors rely on just-in-time supply from the LCCC.

Figure 6 Material holding area labelled for contractor

3.4 Off Site Manufacture (OSM)

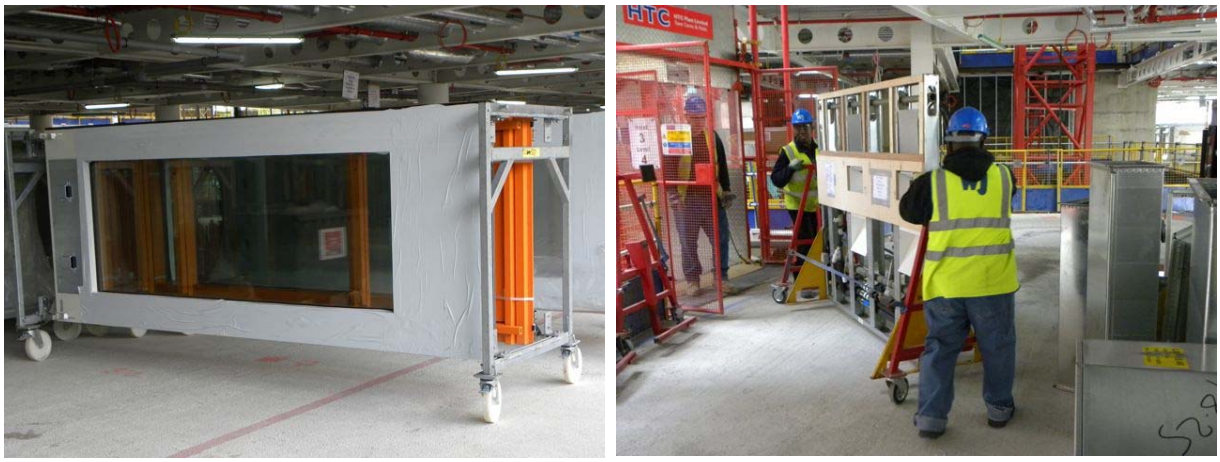
OSM is used for several different parts of the build such as:

- the terracotta wall elements are delivered complete from the factory in Italy. They sit in a rack which offers protection during transport and on site handling. On arrival to site wheels are attached and the rack can be easily pulled along by two operatives. To fit the wall element a special manipulator is used, avoiding manual handling;
- toilet podwalls are delivered on supports which have cutouts to allow fork entry. A small truck picks up at each end of the podwall and the unit can then be easily manhandled by two operatives. For more information on OSM visit WRAP's website and download the "Ropemaker" case study which can be found at: www.wrap.org.uk/construction/case_studies; and
- brackets for services are made up in advance to fit each particular location, which speeds up the installation process.

These examples of show how OSM helps to reduce site waste by:

- protecting the material in transit and during handling on site;
- using no or minimal packaging (packaging is one of the major waste streams during fit out); and
- using load carriers (stillages, frames, etc) which are returned to the supplier and reused, eliminating any pallet waste.

Figure 7 Two terracotta panels in each rack and (right) toilet podwall being wheeled to its point of use



4.0 Waste segregation, reuse and recycling

A strict waste segregation policy was enforced. Bins are provided and are handled by the logistics contractor; the trade contractors are responsible for using the correct bins.

Waste was segregated in the following categories:

- cardboard only;
- polythene/shrink wrap only;
- MDF/Chipboard only;
- hazardous waste;
- plasterboard/gypsum;
- mixed metal;
- timber only;
- waste only; and
- cable off-cuts.

Due to a lack of space on site for skips, bins were originally emptied directly into mobile compactors. As from early 2009 waste is taken to transfer station by WJ delivery vehicles on their return leg. The different waste streams were transported using different methods.

- Timber, MDF and metal are strapped and palletised.

- Cardboard and polythene are baled.
- Plaster is carried in one-tonne bags.

Pallets and cable drums are also returned to the LCCC for reuse.

Figure 8 The waste segregation policy is well publicised on site with posters and material for toolbox talks.

5.0 Data

5.1 Total waste

Table 1 Waste analysis – study period during fit out only.

Five months (Mar 09 – Jul 09)	Tonnes	%
Total	484	100
Recycled	323	67
Recovered	84	17
Hazardous	0	0
Waste	77	16
Divert from landfill	**407**	**84**

The 84% figure for diversion from landfill is good, though not spectacular. It should be borne in mind however that this refers to the fit-out phase only. The demolition and construction phases tend to generate high tonnage materials with high recovery rates whereas the fit-out waste often contains a more complex mix of materials such as packaging waste.

5.2 Plasterboard waste analysis

Plasterboard waste was monitored and analysed separately.

Table 2 Plasterboard waste.

	Tonnes	%
Plasterboard delivered to site Jan 09 – Jun 09	282	100
Plasterboard waste generated	18	6.4

The plasterboard waste running at 6.4% during the six-month study period compares extremely favourably with the industry norms. Under the Contractors and Developers Voluntary Agreement, 2008, a target was set of reaching a 15% level of plasterboard waste to be compared with a current industry average estimated to be 22.5%.

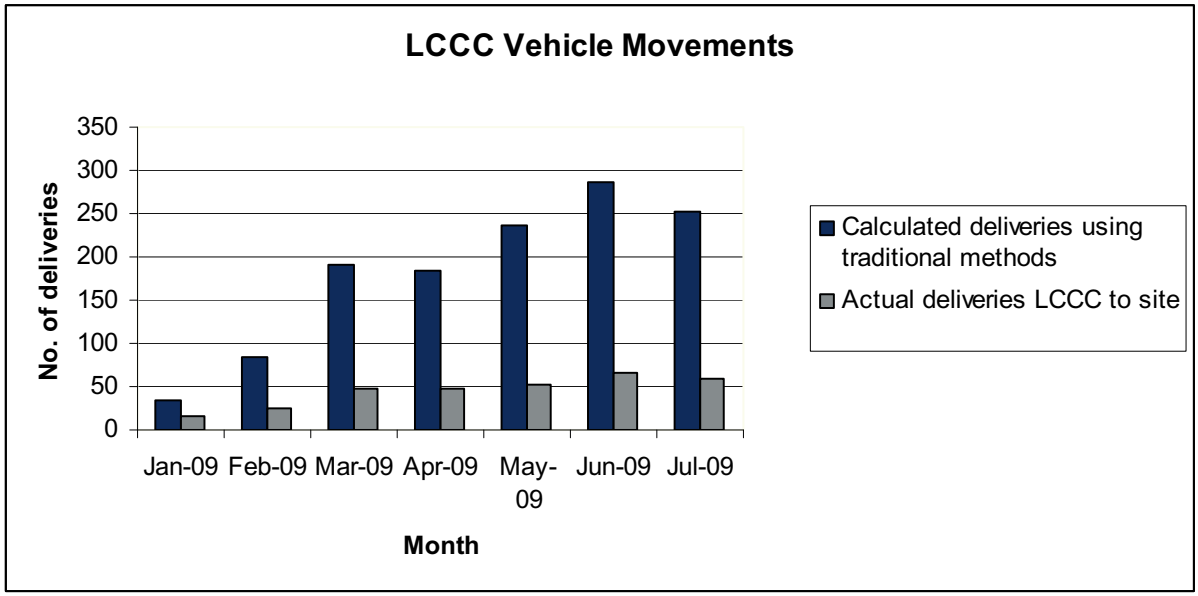
The waste here is likely to be almost entirely made up of off-cuts with close to zero waste generated in the storage and handling of plasterboard.

Figure 9 Well-organised handling of both materials and waste.

5.3 Transport related CO_2 analysis

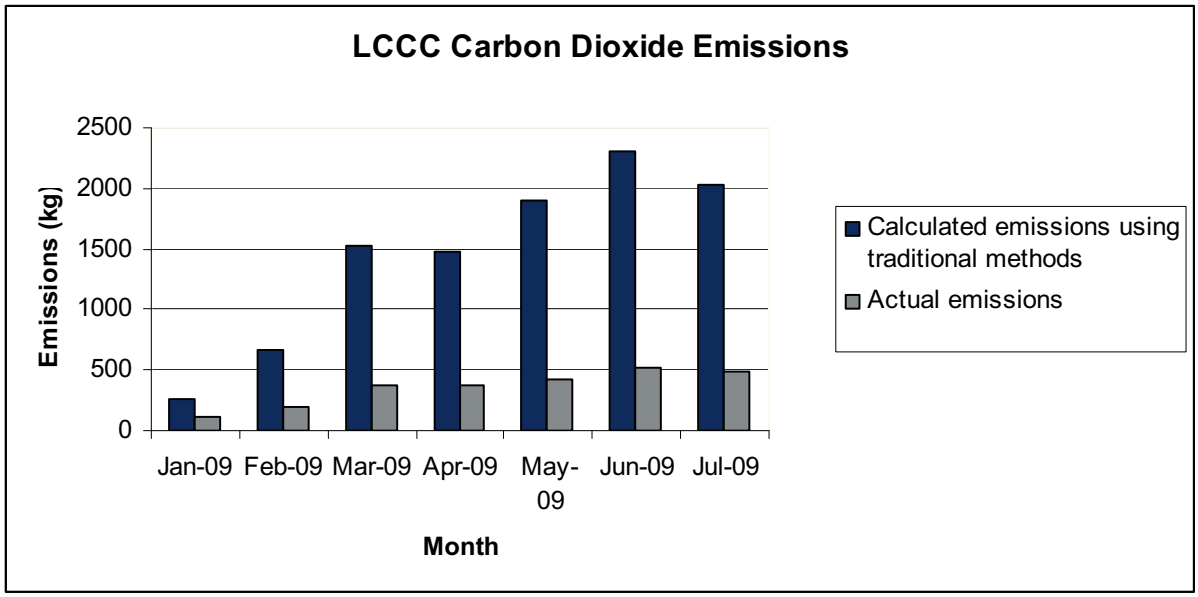
The use of consolidation of incoming loads at the LCCC means that fewer vehicles arrive on site than would otherwise be the case. 310 deliveries from the LCCC to site took place between January and July 2009 against 1266 which would have been made had the LCCC not been used; a reduction of 956 journeys.

Graph 1 CSG actual deliveries to site compared to traffic had consolidation not been used.



The reduced vehicle movements lead to correspondingly reduced CO_2 emissions - 2.5 tonnes emitted against an estimated 10.2 tonnes without consolidation. This is a reduction of 7.7 tonnes or 75% over seven months. Note that the reduction relates to the last leg of the journey only, from the Consolidation Centre to the site, i.e. the 75% reduction does not relate to the total journey from supplier to site.

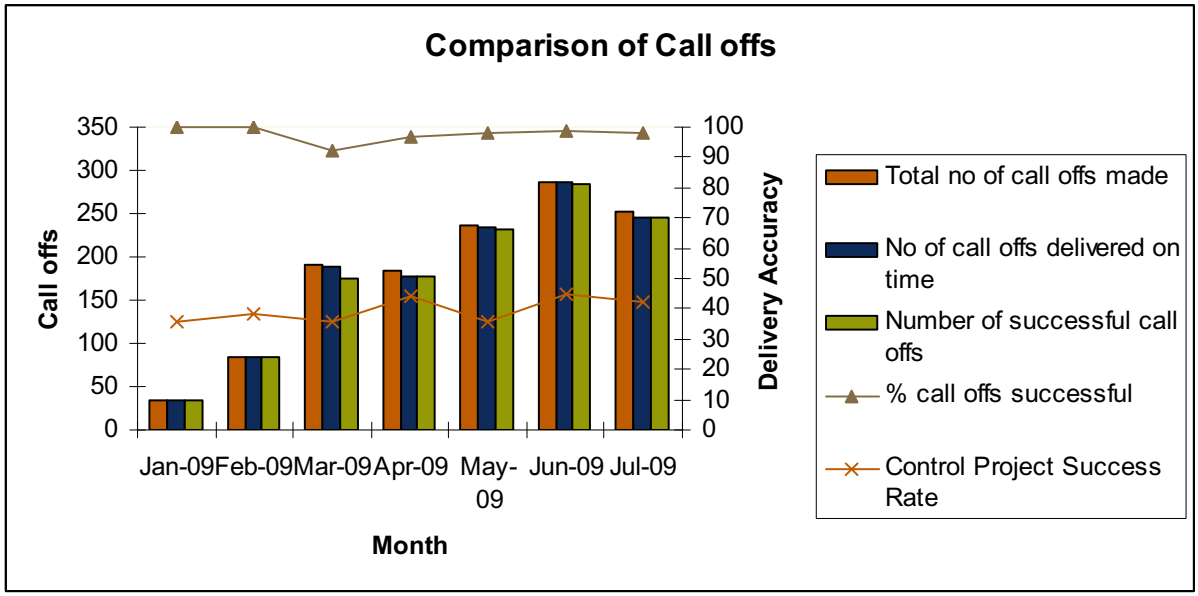
Graph 2 CSG actual CO_2 emissions to site compared to estimate had consolidation not been used.



5.4 Delivery accuracy and the effect of using CCC

Delivery accuracy is critical for a successful just-in-time operation. A successful delivery is one that delivers the right materials, undamaged, in the correct quantity, and on time. "On time" is defined as delivering within ±15 minutes of the requested delivery time.

Graph 3 Central St Giles delivery accuracy.



6.0 Conclusions

By using a CCC and an on site logistics specialist operator, materials are delivered undamaged, in accurate quantities and reliably on time to the point of use on site. Through planning and timekeeping congestion at gates and on site is avoided. This is a successful implementation of a just-in-time material flow. Through this strategy the CSG project achieves low levels of construction waste and substantial reductions in traffic to site. The carbon emissions for the inbound transport are reduced by 75% compared to consolidation not being used.

The consolidation strategy also improves productivity as trade contractors spend no time looking for and bringing material to their work place. An innovative use of the LCCC is to undertake tasks there that would normally be done on site as illustrated by the lagging contractor. This is highly productive, controls waste and saves time on site. High quality handling is illustrated by the 6.4% waste of plasterboard – against the industry target of 15%.

Extensive use of off site manufacture and reusable stillages and frames to hold materials safely, greatly reduce packaging waste and damage to materials; and packaging waste is a major waste stream during fit out.

Waste is strictly segregated on site and the segregated waste is taken to a transfer station close to the LCCC by the same vehicles that deliver materials to site, further reducing site traffic. This reverse logistics operation is the final link in a tightly controlled and resource efficient construction logistics operation.

Waste & Resources Action Programme

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