Bridges carbon calculator

The BCSA and Tata Steel have commissioned Atkins to create an easy to use spreadsheet tool for calculating the carbon footprint of typical steel composite bridges.

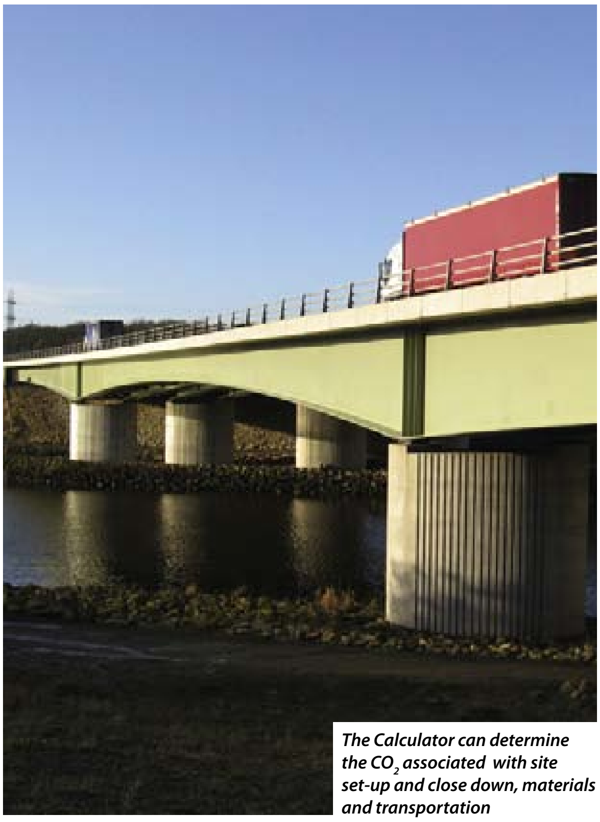
Sustainability or how best to achieve it, is now an important aspect for the entire construction industry. This is borne out by how much importance developers and contractors place on gaining a top BREEAM rating for their structures and buildings. A rating which not only judges a project on how it performs and functions after completion, but also on how it was built.

Running in conjunction with the overall issue of sustainability is the desire to limit carbon footprints, not just for entire companies but also for projects, large and small. This applies to the construction of bridges, but until recently there has not been a definitive way of calculating the carbon footprint of these structures.

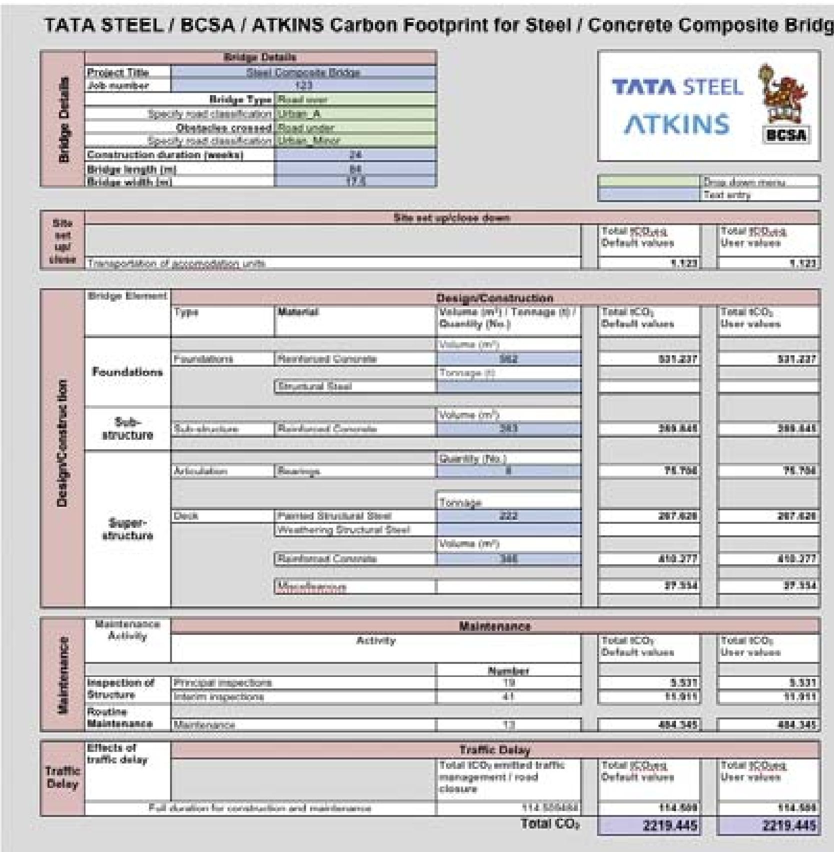
Although many papers have been written on the subject, they have tended to use a variety of data sources and assumptions to quantify the carbon footprint of a bridge. This lack of a consistent approach is one of the main reasons why Tata Steel and the BCSA initially commissioned Atkins to create a spreadsheet tool for estimating the carbon footprint of typical steel composite bridges. The other main reason was to ensure that the correct parameters and assumptions were used for structural steelwork.

What was wanted was an easy to use tool that gave a good approximation of the CO_2 for the construction and maintenance of such bridges with the minimum of effort using preliminary design quantities.

"However, what we got was something far more in-depth," explains Chris Dolling, BCSA Manager, Technical Development. "The Carbon Calculator is simple to use, yet at the same time it



The Calculator can determine the CO_2 associated with site set-up and close down, materials and transportation



TATA STEEL / BCSA / ATKINS Carbon Footprint for Steel / Concrete Composite Bridges

Bridge Details	
Project Title	Steel Composite Bridge
Job number	123
Bridge Type	Road over
Specify road classification	Urban_A
Obstacles crossed	Road under
Specify road classification	Urban_Minor
Construction duration (weeks)	24
Bridge length (m)	84
Bridge width (m)	17.5

(green)	Drop down menu
(blue)	Text entry

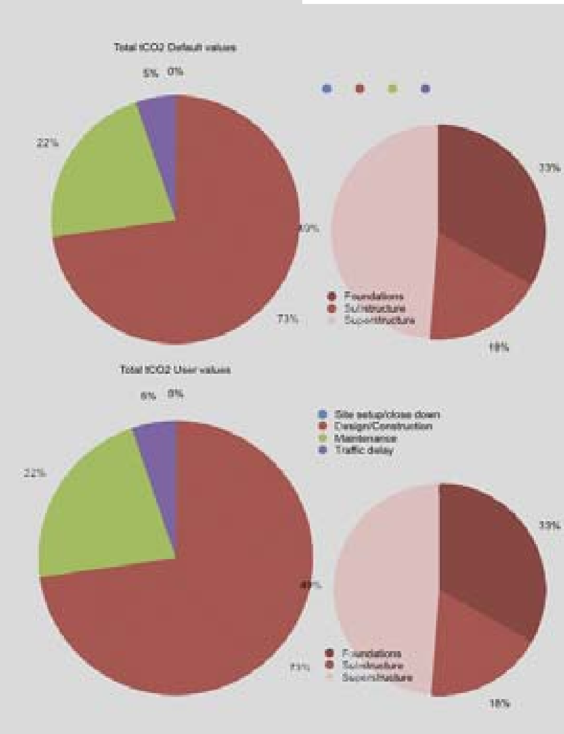
Site set up/close down	Total tCO_2eq Default values	Total tCO_2eq User values
Transportation of accommodation units	1.123	1.123

Bridge Element	Type	Material	Volume (m^3) / Tonnage (t) / Quantity (No.)	Total tCO_2 Default values	Total tCO_2 User values
Foundations	Foundations	Reinforced Concrete	Volume (m^3): 562	531.237	531.237
		Structural Steel	Tonnage (t):		
Sub-structure	Sub-structure	Reinforced Concrete	Volume (m^3): 383	389.645	389.645
Super-structure	Articulation	Bearings	Quantity (No.): 8	75.706	75.706
	Deck	Painted Structural Steel	Tonnage: 222	267.628	267.628
		Weathering Structural Steel			
		Reinforced Concrete	Volume (m^3): 386	410.277	410.277
		Miscellaneous		37.554	37.554

Maintenance Activity	Activity	Number	Total tCO_2 Default values	Total tCO_2 User values
Inspection of Structure	Principal inspections	19	5.331	5.331
	Interim inspections	41	11.911	11.911
Routine Maintenance	Maintenance	13	484.345	484.345

Traffic Delay: Effects of traffic delay	Total tCO_2 emitted traffic management / road closure	Total tCO_2eq Default values	Total tCO_2eq User values
Full duration for construction and maintenance	114.508484	114.509	114.508
Total CO_2		2219.445	2219.445

The easy to use spreadsheet showing information inputted on a composite bridge with helpful charts displaying CO_2 values



The spreadsheet allows users to definitively calculate the carbon footprint of a typical steel composite bridge

is a comprehensive, complex spreadsheet tool which users can spend as little or as much time using as they wish."

Once the tool has been opened, the user is immediately shown a helpful User Guide which explains exactly what the tool is, and includes a flow chart that shows how to use the Calculator.

From here the user is directed to the Summary page where a worksheet allows you to quickly determine the CO_2 emissions for a bridge project.

At this simplest level, all you need to do is select what your bridge is carrying, what it is crossing, enter the length and width of the deck, estimate the construction duration, and then enter half a dozen basic quantities from a preliminary design. Having done that, the spreadsheet automatically calculates the carbon footprint of your bridge with a graphical breakdown showing the relative proportions due to construction, maintenance, and traffic delays. The construction element is further sub-divided to show the proportions for the deck, substructures and foundations

"This allows a bridge designer to see where the major CO_2 burdens are, allowing the focus of design development to be on the big issues in terms of reducing emissions," explains Mr Dolling.

Behind this simple 'Summary' is a huge amount of data and considered assumptions. If the user wishes, they can delve into all of the data and assumptions, amending them to suit any better information that they may have, or testing the effect of different design details. For example, is a ladder deck better than a multi-girder deck, or is a pair of column piers better than a leaf pier?

As a bridge design develops, the amount of available project specific information increases, so the carbon footprint calculation can be updated, becoming more and more accurate. The spreadsheet even allows the user to calculate an 'as built' estimation at the end of the project.

The Carbon Calculator is free to download from the BCSA website: *www.steelconstruction.org/bridgescarboncalculator*

Study shows steel has smaller footprint

Using the Carbon Calculator, Atkins has recently completed a comparison study for a three-span, 84m long bridge which has shown the steel composite option to have a smaller carbon footprint than the concrete alternative. Atkins based the concrete option on a real recently-constructed pre-tensioned, precast concrete beam bridge with spans of 24m, 36m and 24m carrying a road over another highway. The steel alternative was developed using software for the preliminary design of steel composite bridges to the Eurocodes. This software produced by Atkins for BCSA and Tata Steel last year is also free to download from the BCSA website. Preliminary quantities for the two alternative designs were run through the Carbon Calculator to provide two sets of answers. The results of this like-for-like comparison for the three span bridge showed that the steel composite bridge had a 25% smaller carbon footprint than the precast beam alternative. Whilst this cannot be quoted as a general conclusion, it shows both the potential for steel to be the optimal carbon solution in this span range and also the effectiveness of the preliminary design tool for optimising the design in terms of quantities.