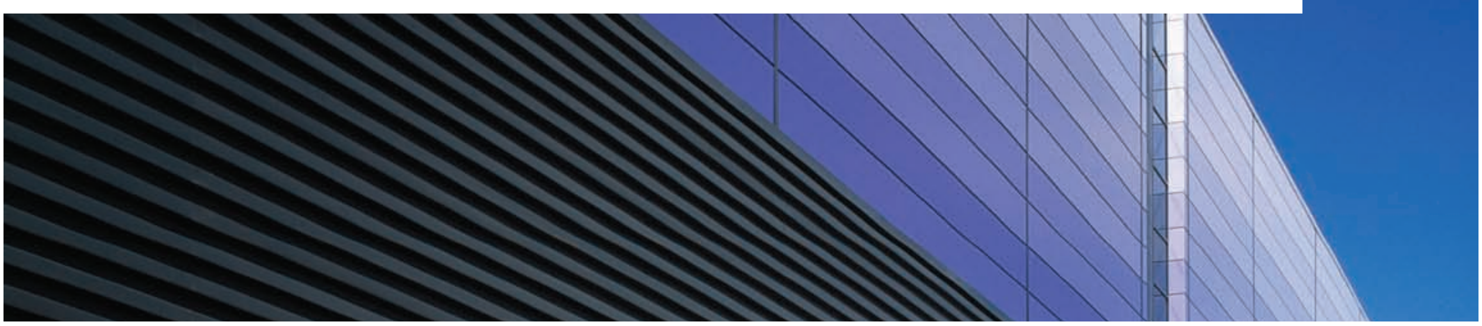
STEEL INSIGHT #12

COST UPDATE AND CASE STUDIES



STEEL INSIGHT

The latest article in the series provides an update from Gardiner & Theobald on construction costs, while overleaf we have two case studies of how steel has been used in industrial buildings

01
MATERIAL PRICES UPDATE

The January 2015 Business Innovation and Skills (BIS) Construction Cost indices (Figure 1) show diverging trends in frame component material price movements across 2014.

While cement, concrete and precast concrete material prices were largely stable across Q3 and Q4 2014, the sharp increases earlier in 2014 resulted in overall material price increases. In December 2014, cement prices were 5.1% higher than in December 2013 while concrete was 2.8% and precast concrete 3% higher.

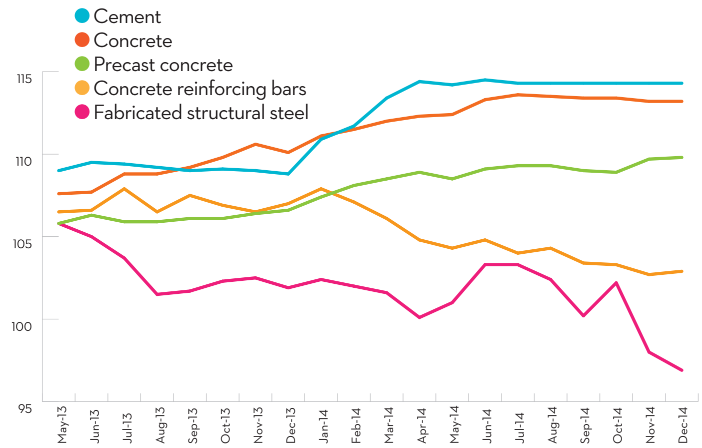
Concrete reinforcing bar and fabricated structural steel material prices fell across 2014; with reinforcing bar 3.8% lower and structural steel prices 4.9% less in December 2014 than a year earlier. This was driven by significant falls in global iron ore and oil prices. Iron ore prices fell to a five year low following increased production at a time of reduced demand from China while oil prices fell below the symbolic threshold of $50 a barrel for the first time since April 2009.

However, raw steel only constitutes 30%-40% of the structural frame cost, so while structural steel maintains its competitive cost position, other cost pressures have meant that tender prices for structural steel have firmed as shown in the next section.

02
TENDER PRICES UPDATE

While the BIS "All Work" year-on-year change for the Construction Material Price Index has remained between 0% and 1.1% since June 2013, wage rises and construction demand during 2014 has allowed an improvement on unsustainable tender pricing levels.

Figure 1: Department for Business, Innovation and Skills Construction Cost indices (January 2015)



Alongside continued growth in construction in London and the South, increased workload also spread across the UK towards the end of 2014. This stronger market enabled some overhead recovery and increases in wages, with the Construction Industry Joint Council (CIJC) agreeing a 3% pay rise in 2014.

The upwards pressures on tender prices generally, the continued strength of demand for residential construction and the largely stable material prices for concrete elements resulted in further increases to concrete tender prices in Q4 2014, with increases of 6% for concrete and 2% for reinforcement recorded.

Similarly, increased demand and overhead recovery offset some of the fall in material prices for structural steel, with tender prices falling 2% in Q4 2014. In response to improving demand at a time of falling material prices and depressed margins, both Tata Steel and ArcelorMittal have increased sections prices by £20 per tonne within the last month and further manufacturer price rises are expected in 2015 as demand continues to improve. Construction Markets forecasts that UK consumption of structural steelwork will increase by 9% in 2015, a further rise from the 6% increase in 2014.

For 2015, increased demand for construction combined with supply constraints for certain trades and increased wage expectations, are all likely to drive tender price rises.

The CIJC has agreed a further 3% pay rise from June 2015 and similar increases have been agreed by other trade bodies suggesting that wage growth is set to continue into 2015.

While private residential construction demand is expected to slow in London and the South during 2015, growing residential demand in the regions and for commercial and private infrastructure sector projects generally is forecast to increase overall construction demand; predicted at 5.3% for 2015 by the Construction Products Association.

This has been reflected in Gardiner & Theobald's Q1 2015 Tender Price Annual Percentage Change forecast, where average tender rates across the UK are anticipated to increase by 4% across 2015 and by 3.5% year on year from 2016 to 2019.

While London and the South-east are still leading the increased construction demand, where a 5% tender price increase is expected in 2015, further recovery is anticipated across the UK with tender price increases of 2.5% in 2015 and 3% rises in 2016 and 2017 for the regions.

03
COST MODEL UPDATE

Steel Insight 3 "Cost Comparison study" (April 2012) analysed two typical commercial buildings to provide cost and programme guidance when considering available options during the design and selection of a structural frame. Building 1 is a typical out-of-town speculative three-storey business park office with a gross internal floor area of 3,200m^2 and rectangular open plan floor space. Cost models were produced for four frame types developed by Peter Brett Associates to reflect the typical available framing options; steel composite, steel and precast concrete slab, reinforced concrete flat slab and post-tensioned concrete flat slab.

Building 2 is an L-shaped eight-storey speculative city centre office building with a gross internal floor area of 16,500m^2 and a 7.5m x 15m grid. Cost models were developed for a steel cellular composite frame and post-tensioned concrete band beam and slab, being two frame and upper floor types that could economically achieve the required span and building form.

In updating this cost model, all general cost items have increased by 2.8% to reflect the final quarter of G&T's 2014 forecast 6% average tender price inflation for London and the Q1 2015 forecast 5% increase. Specific increases have also been applied to the relevant frame rates for reinforcing bars, concrete and structural steel to reflect recorded and expected tender price changes in Q1 2015 for these materials. Similarly, main contractor direct costs have been reviewed to reflect tendering conditions, increased demand, more selective contractor tendering and the prevalence of two stage tendering and hardened attitudes to risk transfer.

The updated cost model tables are set out to the right. As Figure 2 shows, the steel composite beam and slab option remains the most competitive for Building 1, with the lowest frame and upper floors cost and total building cost.

For Building 2 (Figure 3), the cellular steel composite option has both a lower frame and floor cost and lower total building cost than the post-tensioned concrete band beam option, with lower substructure costs, lower roof costs and a lower floor-to-floor height resulting in lower external envelope costs.

The tender price increases seen across Q4 2014 and expected in Q1 2015 have also been reflected in the structural steel frame cost table (Figure 4).

It should be noted that typical costs are based upon the particular project being attractive to the market and the selection of an appropriate procurement route.

In overheated areas of the market it is important that a careful and proactive procurement strategy is developed as where the procurement strategy doesn't respond to market conditions, the cost impact on individual tender returns can be dramatic.

The move away from the previously favoured single stage fixed price procurement routes experienced in London and the South-east in mid-2014 is also starting to be seen in the regions, where hybrid routes are now being considered to overcome a shortage of mid-range contractors.

Figure 2: Building 1 Cost Model (key costs per m² GIFA, City of London location)

	Steel composite	Steel and precast concrete slabs	Reinforced concrete flat slab	Post-tensioned concrete flat slab
Substructure	£59	£62	£76	£70
Frame and upper floors	£153	£168	£159	£168
Total building	**£1,683**	**£1,713**	**£1,770**	**£1,752**

Figure 3: Building 2 Cost Model (key costs per m² GIFA, City of London location)

	Steel cellular composite	Post-tensioned concrete band beam and slab
Substructure	£62	£66
Frame and upper floors	£210	£237
Total building	**£2,095**	**£2,186**

Figure 4: Indicative cost ranges based on GIFA (Q1 2015)

TYPE	GIFA Rate (£) BCIS Index 100	GIFA Rate (£) City of London
Frame 1 - low rise, short spans, repetitive grid / sections, easy access (Building 1)	90 - 122/m²	100 - 135/m²
Frame 2 - high rise, long spans, easy access, repetitive grid (Building 2)	140 - 168/m²	155 - 185/m²
Frame 3 - high rise, long spans, complex access, irregular grid, complex elements	168 - 190/m²	185 - 210/m²
Floor - metal decking and lightweight concrete topping	50 - 68/m²	55 - 75/m²
Floor – precast concrete composite floor and topping	55 - 73/m²	60 - 80/m²
Fire protection (60 min resistance)	14 – 23/m²	15 - 25/m²
Portal frames – low eaves (6-8m)	55 - 73/m²	60 - 80/m²
Portal frames – high eaves (10-13m)	68 - 90/m²	75 - 100/m²

Figure 5: BCIS Location Factors, as 6 February 2015

Location	BCIS Index	Location	BCIS Index
City of London	110	Leeds	92
Nottingham	96	Newcastle	98
Birmingham	91	Glasgow	100
Manchester	99	Belfast	60
Liverpool	94	Cardiff	100

Continued pressure on estimating resource coupled with increased demand has hardened attitudes to risk transfer, complexity and the number of bidders, and reduced the number of returns being procured for many projects.

The BCIS location factors demonstrate that the gap between City of London, the majority of regional cities and the UK mean of 100 has narrowed as the economic recovery picks up pace across the UK (see Figure 5).

Looking forward across 2015 and beyond, the forecast increase in demand for construction across the UK coupled with increased wage expectations and rising material prices mean that consideration should be given to the inclusion of substantial inflation allowances for estimates for projects that are expected to be tendered in 2015 and beyond.

To use the table a) identify which frame type most closely relates to the proposed project b) select and add the preferred floor type c) add fire protection if required.

Before using such standard ranges it is important to confirm the anticipated frame weight and variables such as the floor-to-floor heights to determine whether they are above or below the average and to adjust the rate used accordingly.

Similarly, all of the other key cost drivers of complexity, site conditions, location, function, logistics, programme and procurement strategy should be considered in turn. »

This and the previous Steel Insight articles produced by Rachel Oldham (partner) and Alastair Wolstenholme (partner) of Gardiner & Theobald are at www.steelconstruction.info

LOGISTICS CENTRE

Travis Perkins is putting the finishing touches to its new £35m regional logistics centre at Omega Warrington. A steel, portal frame is the most efficient solution for the huge multi-spanned structure

Something big is taking off at the former RAF Burtonwood airfield on the outskirts of Warrington. The planes can no longer be heard soaring above what was Europe's largest air base during the Second World War, but the sounds of construction are breathing new life into the vast site.

The last remnants of Burtonwood survived until around five years ago, now demolished to make way for Omega Warrington, a joint venture between Miller Developments and KUC Properties, which is currently the largest mixed-use development site in the North-west. Strategically located on both sides of the M62 at Junction 8, about two miles north of Warrington town centre, the £1bn, 233ha Omega development, to be delivered over the next 25 years, is proving attractive to a number of major players looking for regional logistics centres. Brakes, Hermes and Travis Perkins have taken plots north of the M62 and Asda is confirmed as the first to take space south of Junction 8.

Construction has just completed at Travis Perkins' regional distribution centre, the biggest development so far at Omega. The construction equipment supplier's £35m home will accommodate over 65,000m² of space to supply the company's wholesale and retail outlets across the region, supporting around 450 jobs on site.

"Travis Perkins is a well-informed client and had very clear ideas about what they wanted," explains Keith Lewis, regional director at Chetwoods, architect on the project. Travis Perkins wanted an improvement on the standard box often encountered in buildings of this type, and the result is a steel, portal-framed structure, faceted to create its signature curved roof design. "Travis Perkins wanted an improved image and rooflights at 90° to the centre's internal racking," says Lewis.

The latter is achieved with CA Group's cladding solution. The building envelope specialist worked closely with main contractor Sir Robert McAlpine and Chetwoods to deliver the curved roof. Stuart Brown, project development manager for CA Group, says: "The curved roof delivers a look and feel which is far removed from the conventional box-style building, creating instead a modern, aesthetically-pleasing finish

PORTAL TO SUCCESS

To form the building's multi-arched roof, each portal has purlins set on a radius along 533mm × 210mm segmented rafters. The rafters are connected to 16m high 356mm × 368mm internal columns, with 610mm × 228mm columns used on the building's perimeters. Additional stability is obtained from bracing located around the perimeter elevations – avoiding windows and loading doors – and more triangular bracing in the roof. Due to the phased handover sequence required by the client, a considerable amount of temporary bracing was needed to allow cladding to commence before the frame was completed. Steelwork contractor Caunton Engineering put up 2,100t of steel during an eight-week programme.

which really sets it apart. The reduced height of the apex lowers the amount of internal "dead space" and consequently the energy required to heat – and cool – a warehouse of this size. It also enables in-plane rooflights to be installed, virtually from eaves to eaves, enhancing light distribution into the building and minimising shadows, further reducing energy costs and CO_2 emissions associated with the lighting load."

The curve eliminates the need for hips and parapets, reducing the complexity of steel required in the build and minimising the associated costs. It also improves thermal detailing and delivers enhanced thermal performance overall.

"This was always going to be a steel-framed building," points out Jon Moister, director at structural engineer Curtins. "For warehouses and industrial buildings, the steel, portal-framed solution is just so efficient that you wouldn't entertain anything else. You couldn't manufacture things to the necessary size and scale to the same level of efficiency. The options that you go through are more in terms of the stability – which direction should your portals run, do you have portals every frame, every other frame – what is the cleverest way we can get this built?"

The result is a building that measures 350m × 160m and the steel structure consists of 10 portal frames each with a 35m span at 8m centres. "There's a balance to be struck in terms of the spans," explains Andrew Isherwood, associate at Curtins. "You could have frames at 9m centres but then you have to think about the cladding and purlins and it becomes a balancing act between the cost of the purlins offsetting the extra cost of increased tonnage of steel."

Everything about a building of this nature is about efficiency. With the best part of 200 columns, design is crucial. "Travis Perkins' internal racking layout semi-defined the column positions, although there is some flexibility so that they can adapt it in the future," says Isherwood.

The project team worked very closely together. "What's very apparent on a project like this is the importance of early involvement of the supply chain," argues Moister. "How you go about putting the structure up is probably as influential as how the building behaves in the permanent condition, so the steelwork contractors were brought to the table very early to look at the best way to erect the building."

Steelwork contractor Caunton Engineering opted to erect the steelwork such that some of the columns are built to take temporary bracing to withstand wind loadings during the construction (see "Portal to success", above). "We had to understand that early on because it affects the foundations," points out Isherwood. "The foundation design was dictated to some extent by the temporary conditions rather than the permanent conditions, giving the contractor the flexibility to build in the sequence that it wanted."

This was not helped by particularly challenging ground conditions. The site was steeply sloping and excavation took place during one of the wettest winters on record. "A lot of thought went into the foundation design to drive efficiency and, given the huge area, a small saving on the slab equates to a lot of money overall," points out Moister.

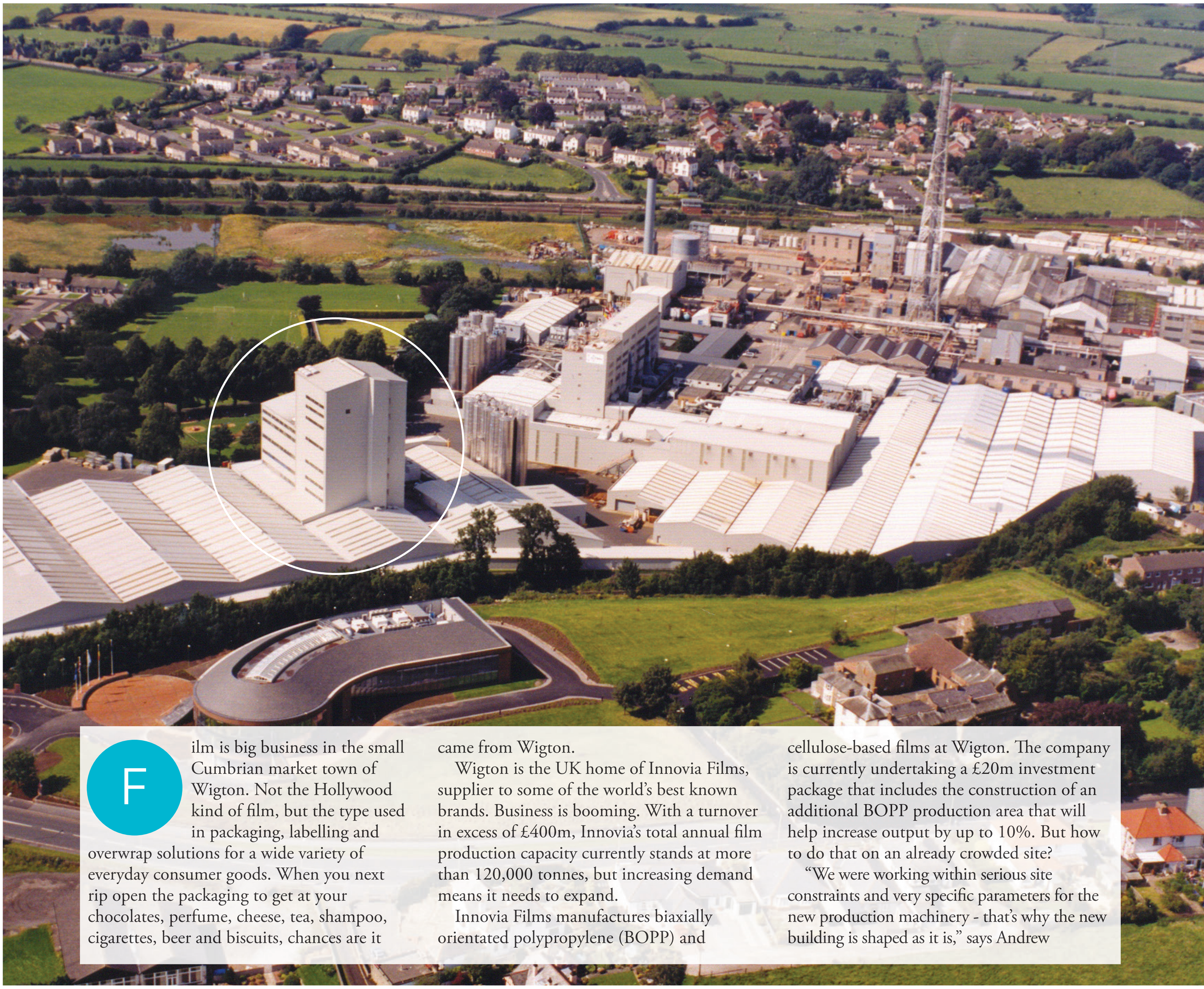
Fit-out is progressing and the logistics centre is scheduled to be operational later this year. The planes may be long gone from RAF Burtonwood, but the trucks will soon be taking their place. »

PROJECT TEAM

CLIENT Travis Perkins Group
MAIN CONTRACTOR Sir Robert McAlpine
ARCHITECT Chetwoods
STEELWORK CONTRACTOR Caunton Engineering
STRUCTURAL ENGINEER Curtins Consulting

MANUFACTURING FACILITY

Global packaging supplier Innovia Films needed to expand its manufacturing facility without disrupting existing on-site production. A steel-framed extension gave the team the flexibility needed



Film is big business in the small Cumbrian market town of Wigton. Not the Hollywood kind of film, but the type used in packaging, labelling and overwrap solutions for a wide variety of everyday consumer goods. When you next rip open the packaging to get at your chocolates, perfume, cheese, tea, shampoo, cigarettes, beer and biscuits, chances are it came from Wigton.

Wigton is the UK home of Innovia Films, supplier to some of the world's best known brands. Business is booming. With a turnover in excess of £400m, Innovia's total annual film production capacity currently stands at more than 120,000 tonnes, but increasing demand means it needs to expand.

Innovia Films manufactures biaxially orientated polypropylene (BOPP) and cellulose-based films at Wigton. The company is currently undertaking a £20m investment package that includes the construction of an additional BOPP production area that will help increase output by up to 10%. But how to do that on an already crowded site?

"We were working within serious site constraints and very specific parameters for the new production machinery - that's why the new building is shaped as it is," says Andrew

THE FINISHED BUILDING MIGHT LOOK QUITE STRAIGHTFORWARD, BUT TYING IT IN TO THE EXISTING BUILDING AND DOING THAT WHILE KEEPING EVERYTHING WIND AND WATERTIGHT WAS THE REAL DIFFICULTY

ANDREW JOHNSTON, JOHNSTON AND WRIGHT ARCHITECTS

Johnston, director at Johnston and Wright Architects. The extension has a skew along its main elevation due to the site constraints, so it is not a perfectly rectangular building. "Architecturally, the challenge was how to fit the machinery into a very confined space, with the restrictions of existing underground services and having to fit ancillary rooms within the space, rather than adjacent to it," says Johnston.

That wasn't the only challenge. The site is also adjacent to a public park and it was imperative that existing production processes carry on as usual during the extension, despite that the fact that the new machinery is no more than 5m away from the existing plant.

The new facility is a steel-framed extension added to the existing BOPP production building. "At 37m high, this was always going to be a steel frame," says Johnston. "This is a lot more than a box around a machine. The frame is interlinked to the machinery and supports it [see "Steely endeavour", right]. The machinery dictated the steel frame and steel positions and then we just had to put a skin around it and provide fire escapes and so on."

The new steel frame has been added on to one end of the existing building. To make sure that there was no disruption to production during the build, steelwork contractor Border Steelwork Structures had to cut openings in the existing building's cladding to allow for connections to be made from each steel beam between the new and existing frames. "The finished building might look quite straightforward, but tying it in to the existing building and doing that while keeping everything wind and watertight was the real difficulty," says Johnston. Once a connection was made, the team would make sure the hole was watertight before moving onto the next steel connection.

"We had to demolish part of an existing office block to make room for the new facility," says Johnston. "One half remains, extending over another section of the factory. We have basically torn down half of it and put up an internal wall separating the two sections."

The steel-framed extension essentially follows a 6.7m × 5.1m grid pattern, and measures 22m long × 11m wide and 37m high. The new facility mirrors the existing structure, with column centres and the floors matching up to level five. However, it is 3.5m higher than the existing building, with the extra space accommodating a series of mezzanine levels and one extra floor.

"It was great fun this project, because of the challenges," says Johnston. Next time you tuck into a box of chocs, spare a thought for the team that made the box that makes the film that covers your Thorntons.

Main image (opposite): The new facility has been added to an existing structure (circled)
This page: The structure with cladding
Inset: Steelwork being constructed

STEELY ENDEAVOUR

The new production facility includes a steel-braced frame. This gets its longitudinal stability from the existing frame, with additional stability provided by circular hollow section diagonal struts positioned along the main elevation at every floor level. The steel design also needed to cater for the heavy loadings that the processing equipment will impart on the steel frame.

To this end, many of the steel sections are larger than they would have been if it was not a factory extension, however this over-sizing of the steelwork does give the benefit of added fire protection, with attendant cost savings.

Border Steelwork Structures completed the steelwork and cladding in a 34-week programme, using one mobile crane and, because of the building's height, two 42m-reach MEWPs.

PROJECT TEAM

CLIENT Innovia Films
MAIN CONTRACTOR Story Contracting Land Securities, Canary Wharf Group
ARCHITECT Johnston and Wright Architects
STEELWORK CONTRACTOR Border Steelwork Structures
STRUCTURAL ENGINEER A L Daines and Partners