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Case No: HT2015.00104

IN THE HIGH COURT OF JUSTICE
QUEEN'S BENCH DIVISION
TECHNOLOGY AND CONSTRUCTION COURT

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 14/07/2017

Before :

MR JUSTICE STUART-SMITH

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Between :

125 OBS(Nominees1) & anr	**Claimants**
- and -	
Lend Lease Construction (Europe) Limited & anr	**Defendants**

- -
- -

Anneliese Day QC & Calum Lamont (instructed by **Reynolds Porter Chamberlain LLP**) for the **Claimants**
Adam Constable QC & Sarah Williams (instructed by **Charles Russell Speechlys LLP**) for the **Defendants**

Hearing dates: 23-31 March, 6 April 2017

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Approved Judgment

I direct that pursuant to CPR PD 39A para 6.1 no official shorthand note shall be taken of this Judgment and that copies of this version as handed down may be treated as authentic.

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THE HONOURABLE MR JUSTICE STUART-SMITH

Mr Justice Stuart-Smith:

Introduction

1. 125 Old Broad Street ("125 OBS") once housed the London Stock Exchange. It stands on a prime site of 0.6 hectares in the heart of the City of London, flanked by Throgmorton Street to the north, Bartholomew Lane to the west and Threadneedle Street and Old Broad Street to the south. Between about 2006 and 2008 the First Defendant carried out an extensive redevelopment of the building under a design and build contract for the Claimants. The end result was intended to be a highly prestigious building with a 26 storey tower and a lower-level podium building that together would provide approximately 320,000ft^2 of Category A office space and 6,400ft^2 of retail space. Category A is reserved for the most prestigious buildings competing for premier office users with rents above average for the area. An integral part of the renovation was that the podium and tower were to be clad with a curtain walling system of storey-height framed glass panes.

2. Between 2008 and 2012 there were 17 spontaneous failures of glass panes on the building. The failures occurred without prior warning and, although on some occasions the shattered glass was retained in its frame until it could be removed, on others the glass was ejected away from the building and down towards street level. Early in the sequence of failures, and with the involvement and agreement of the District Surveyor, scaffolding was erected around the building to protect people from falling glass. In places it extended right across the road, pavement or walkway around the building and abutted (or almost abutted) other prestigious buildings such as Drapers Hall. Fortunately, no one was seriously injured by falling glass; but the disastrous nature of the failures is well illustrated by the obvious need for the protective but disfiguring scaffolding and the fact that the problems made waves in the national press.

3. In due course, the decision was taken to replace the outer skin of the glass curtain walling. That was done between 2012 and 2013. Half of the removed glass was placed in storage, where a further 4 failures occurred.

4. By this action the Claimants claim damages from the Defendants, including the cost of re-cladding the building. The parties have identified a number of Disputed Issues, to which I will refer in the course of this judgment. In briefest summary, the Defendants' case is that the only effective obligation under the design and build contract was to install glass that had been heat soaked in accordance with the relevant European Standard (but with a holding period of four hours); that they complied with that obligation; and that the risk of the failures that happened had been accepted under the contract by the Claimants.

5. The primary facts and the relevant provisions of the contract are largely not in dispute. The major disputes on liability at trial have been about contractual responsibility and the expert evidence that has been led on the science and properties of properly heat-soaked toughened non-laminated glass. Quantum is in dispute though there has been extensive agreement on figures.

6. For the reasons set out in this judgment, I find that the Claimants succeed on liability and are entitled to recover £14,753,195.16 in damages as a result. Interest remains to be calculated.

The Witness Evidence

7. The Claimants' lay witnesses all contributed useful evidence. Each of them came to assist the Court and each was impressive in his own way. The Defendants called no live witnesses. The evidence of Mr Kirchner was admitted without him being called by the Defendants.

8. There was a marked contrast between the liability experts called for the Claimants and the Defendants respectively. Mr Colvin was called on behalf of the Claimants. He is one of the leading experts in the world on the manufacture of glass, and is qualified both intellectually and by experience to give expert evidence on the issues that arose in the case. He is a mathematician and as such has great clarity of vision, conviction and expression. Sometimes this clarity of thought puts him outside the general consensus of his profession; but his views always commanded respect by being based on the application of rigorous logic allied to his expertise.

9. Mr Josey, who was called by the Defendants, suffers by contrast with Mr Colvin in almost every respect. He does not have Mr Colvin's accumulated practical and first-hand experience; nor, in my assessment, does he have the intellectual expertise and rigour that Mr Colvin brings to his opinions. None of this would matter particularly, though it would contribute to my conclusion that, in general, I preferred Mr Colvin's evidence and normally agreed with Mr Colvin's conclusions when they differed from those of Mr Josey. What matters much more from the perspective of the court is the failure by Mr Josey to follow the implications of what he knew. It is sufficient for the purposes of this judgment to say that I do not understand how the Defendants could maintain to trial the assertion that the documentation from the supply chain proved that the glass with which the action is concerned had been heat-soaked when they should have appreciated that it showed no such thing. That does not necessarily implicate Mr Josey, but by the end of the trial it also remained quite unclear how he could, consistently with his duties to the Court, have failed to make plain his clear understanding that some of the documentation was fabricated and that, whatever else it showed, the documentation as a whole (on which he commented extensively) did not support his clients' case.

10. Both Quantum experts provided some useful material. Each succumbed to the temptation on occasions to express opinions about matters outside their expertise. The tendency was more prevalent in the evidence of Mr Morley, who was called for the Defendants, than in the evidence of Mr King, who was called for the Claimants; but both were attempting to assist the court and both gave some useful evidence.

Toughened Glass

11. Glass as initially manufactured in bulk from its constituent materials is known as annealed glass. Annealed glass is the weakest form of glass and breaks into large, pointed, sharp-edged shards. It is glass without internal stresses caused by heat treatment. Toughened glass is a type of safety glass created from annealed glass that has been heated to approximately 600^{o}C before being rapidly cooled, which results in

a permanent surface compressive stress. Toughened glass is usually five times as strong as annealed glass and will break into small fragments known as "dice" or "nuggets", which can knit together to form clumps.

12. Toughened glass is susceptible to spontaneous failure caused by Nickel Sulphide ("NiS") inclusions within the glass. The experts are agreed that NiS inclusions are formed when tiny particles of steel wear from the machinery that is used to grind the raw materials and find their way into the materials (known as frit) that are melted to form glass. NiS is immiscible with glass and so remains as small "droplets" in the molten glass, solidifying as small balls when the glass is formed and known as inclusions.

13. NiS is a complex material which experiences phase change (or "transformation") when heated. At ambient temperatures, NiS inclusions are described as being β phase, which is stable below about 380ºC. When heated, the NiS transforms to the α phase, which is stable at higher temperature and has a smaller volume than when NiS is in the β phase. The heating of glass to toughen it therefore causes the transformation of NiS inclusions from the β phase to the smaller α phase. The process of transformation is reversible. Accordingly, when the toughened glass is cooled the process of re-transformation to the β phase begins, with potential increase in the volume of the inclusion of c. 2-4%. But the cooling process is too rapid to enable the re-transformation to be completed. As a result, the initiated re-transformation continues in the cooled toughened glass. The NiS inclusion will be critical and spontaneous breakage of the glass may occur if (a) the inclusion is more than 40-50 microns in diameter, (b) the inclusion occurs in the central tensile stress zone of the toughened glass, and (c) the chemical composition of the inclusion is within a certain range (of which more later). At this point it is only necessary to mention that inclusions that may be described as being highly sulphur rich are not critical because their transformation back to the β phase at ambient temperatures is so slow that it will not cause the glass to break within any realistic design life.

14. The experts agree that the risk of NiS inclusion induced breakage changes with time. In the first 6-12 months breakages are rare. Thereafter, depending on temperature, the failure rate tends to peak after 4-5 years from the date of production. The failure rate then tails off but breakages can occur up to 20 years after the date of production. Represented graphically, the typical rate of breakage follows an S-curve, with a shallow (slow) start, steeper (faster) middle, and progressively flatter (tailing off) end period. I accept Figures 22 and 23 of Mr Colvin's first report as reasonable representations of a general cumulative NiS breakage curve and of the cumulative breakages for 125 OBS respectively.

15. The experts agree that the presence of NiS in glass occurs randomly; and that with Western European standards of glass manufacture critical NiS inclusions occur at an average rate of 1 per every 4-5 tonnes of toughened glass. Because the presence of NiS in glass occurs randomly, the experts also agree that its distribution will not be constant throughout a given quantity of glass.

16. In order to prevent or minimise the incidence of NiS breakages in toughened glass, a process known as heat soaking (or heat soak testing) has been developed. In brief outline, the toughened glass is placed in an oven and heated to a pre-determined temperature ("the heating phase"). It is then held at a notionally constant temperature

for a period that is intended to facilitate the transformation of any critical NiS inclusions from the α phase to the β phase. The intention and effect is that critical NiS inclusions will cause the glass to break during the heat soaking so that glass which does not break then can be used with confidence that it will not break subsequently. I accept the evidence of Mr Colvin that, in theory, heat soaking should be able to eliminate all critical NiS inclusions. There has, however, always been a recognition that there may be a residual risk of breakage even after heat soaking. The reasons why such a residual risk may exist is only of interest for the outcome of this case to the extent that it aids an understanding of what the residual risk may be and how it might affect the distribution of glass, which still has critical NiS inclusions that may yet cause breakage in service, to a given building or project.

17. References to "batches" of glass, though frequently encountered, may be misleading. The original process by which raw materials are melted, held at high temperature in very large tanks and then floated so as to produce annealed glass is essentially a continuous process, which may admit of minor variations of composition (including numbers of NiS inclusions) over time; but the continuous replenishing of raw materials into the float tanks means that any variation is likely to be both marginal and (when it occurs) progressive in its effect and the subsequent elimination of that effect. It does not sit easily with the common conception of a "good" batch and then a separate "bad" batch produced by a discrete and separate process or production run. Annealed glass will then be selected from the product of the continuous run for toughening and heat soaking. Here the common conception of batches is more relevant because, for example, the settings on the ovens could vary from load to load. However, by the time of toughening and heat soaking, any defects attributable to the raw materials are already in the glass. I therefore conclude that the concept of "bad" or "good" batches of annealed glass arising from the original production process is unlikely in theory to give rise to "bad batches" of heat soak tested toughened glass on a particular building, though variations may exist. This theoretical conclusion is supported by the absence of any reliable empirical evidence of "bad batches" manifesting themselves on particular projects or buildings where it is known that the toughening and heat soaking processes have been carried out properly.

18. It is common ground that there is a range of chemical compositions of NiS inclusions that may be critical and that inclusions with a chemical composition outside that range are not a cause of concern. At the start of the trial, Mr Josey's evidence, based upon the work of Kaspar, was that critical inclusions would be within the range Ni_7S_6 to $Ni_1S_{1.046}$. The chemical composition of an NiS inclusion affects the time that it takes to transform, both when heated and at ambient temperatures. Mr Colvin's evidence, extrapolating from the findings of Kaspar, was that an inclusion beyond the sulphur-rich end of the identified critical range would transform so slowly that it would not be critical, at least within any realistic design life for the use of the glass. In cross-examination Mr Josey accepted that Kaspar's work in 1997 and 1999 showed that inclusions at the extremities of the critical range (i.e. Ni_7S_6 and $Ni_1S_{1.046}$) would not be of concern during the design life of a building because their transformation to the β phase would be so slow. In re-examination he was taken to later papers by Kaspar (2003 and 2010) in which Kaspar had proposed lowering the heat to be applied during the holding phase. Those papers (and others questioning the most efficacious temperature for heat soaking) are relied upon by the Defendants to found a submission that inclusions at or beyond the range agreed by Mr Josey to be critical

may explain breakages of glass that has been correctly heat soaked in accordance with the regime that is relevant to this action.

19. A fair reading of those papers would bring to mind that Kaspar in the 2010 paper described the heat soaking regime in place since 2005 (of which more below) as very effective and possibly "over-safe", with no more breaks of tested glass known to the author since it was introduced; and that he described the sulphur-rich conditions that he was considering as being infrequent and extreme. Neither Kaspar's later work nor the other papers relied upon by the Defendants support the notion that there would be unacceptable rates of breakage with glass heat soak tested in accordance with the 2005 Standard. Kaspar's 2010 paper, on which the Defendants relied extensively, was to the opposite effect, as summarised above. It is apparent on a fair reading of the paper that the proposed reduction of the temperature in the holding phase was motivated as much by economic considerations as the possibility of eliminating any residual risk of breakage. Mr Josey did not give evidence to the contrary from his own experience and accepted that there is no published literature identifying the quantity of the sulphur-rich inclusions relative to other compositions: he accepted that it is said in the literature to be "small".

20. Subject to the limited gloss provided by Kaspar's 2010 paper, I prefer the evidence of Mr Colvin, based as it is on the earlier experimental work of Kaspar which Mr Josey accepted, that inclusions at the sulphur-rich end of the critical range should be eliminated by the regime of heat soak testing that should have been applied to the glass for 125 OBS. Kaspar concluded in his 1999 paper that empirical evidence showed that a holding time of 2 to 3 hours is enough to guarantee a reliability of the test of 98.5% with 95% reliability. The Defendants point to the fact that GTS (a reputable testing house described as the "go to" experts in their field) analysed inclusions implicated in failures of glass on 125 OBS. Of the five inclusions where GTS were able to report on the make-up of the inclusion, one (TAP26686A) was very unusual in that it fell outside and beyond the sulphur-rich end of the range assessed as critical by Kaspar and agreed to be critical by the experts in this litigation. Mr Colvin had never come across such a result in his experience and I accept his suggestion that there must be a question mark over whether or not the stated composition is correct. There is otherwise no empirical or theoretical evidence to subvert or preclude the conclusion that the heat-soaking regime from 2005 was very effective in practice or the evidence of Mr Colvin on this point.

21. It is agreed that the minimum size for a critical inclusion is 40-50 microns. I accept the evidence of Mr Colvin that the only material difference for present purposes is that an increase in volume of up to 2-4% of a larger inclusion will be greater in absolute terms than a proportionately similar increase in volume of a smaller inclusion. All other things being equal, therefore, transformation of a larger NiS inclusion is more likely to be critical than transformation of a smaller one or, if both are critical, may cause spontaneous breakage sooner.

22. Mr Colvin's evidence was that an increase in the number of NiS inclusions before heat soaking should not lead to an increase in the number that remain after heat soaking because the heat soaking process should cause the transformation of each inclusion separately and discretely provided that the parameters of the heat soaking are appropriately set and maintained. I accept that there is no rational basis for any theory of "overloading" and that Mr Colvin's evidence should in theory be correct.

But there is a significant body of evidence that suggests that there may be a relationship between the number of NiS inclusions present before and remaining after heat soaking, though the relationship itself and the reasons for any such relationship are not clear. That said, even those who propose a relationship between the numbers of NiS inclusions before and after heat soaking recognise that the success rate of heat soaking is typically expressed as having a confidence level of 95 (and sometimes as high as 98.5)%: see, for example, Jacob & Calderone (2003) and Calderone (2013). It is not necessary for the purposes of this judgment to decide the theoretical basis for the survival of some residual NiS inclusions after heat soaking because the issue does not affect the overall weight of the evidence about what levels of failure caused by NiS inclusions should be anticipated in heat soaked toughened glass made to normal Western European standards of manufacture. The agreed evidence of the experts, which I accept, is that critical NiS inclusions occur randomly at an average rate of one per every 4-5 tonnes of Western European toughened glass before heat soaking. I consider the evidence about the residual rate after heat soaking further below.

The 2005 Standard

23. After a period of research, which is summarised by Mr Colvin in his first report, the European Committee for Standardisation approved and introduced European Standard, EN 14179 on 19 May 2005 ("the 2005 Standard"). The introduction of the 2005 Standard was preceded by a period (the precise duration of which is not in evidence) during which the precursor to the 2005 Standard was in existence and published: it was known as PrEN 14179 and was in materially similar or identical terms as the 2005 Standard.

24. Section 5.3 of the 2005 Standard set out the norms for the heat soak process cycle. In summary, it provided for:

    i) A heating phase, which commenced with the toughened glass at ambient temperature and concluded when the surface temperature of the last glass reached 280ºC;

    ii) A holding phase, which commenced when the surface temperature of all of the glasses had reached a temperature of 280ºC, and concluded 2 hours later. During the 2 hour holding phase, the glass surface temperature was required to be maintained in the range of 290ºC +/- 10ºC, i.e. between 280ºC and 300ºC; and

    iii) A cooling phase, which commenced when the last glass to reach 280ºC had completed its holding phase, i.e. having been held for 2 hours at 290ºC +/- 10ºC. During the cooling phase, the glass temperature was brought down to ambient temperature.

25. At Annex A the 2005 Standard included a normative heat soak process system calibration test. The heat soak system had to be calibrated in accordance with Annex A and was required to be capable of meeting the requirements of the time/temperature regime at both 100% and 10% load. The Standard also made detailed provision covering aspects of the heat soaking process such as glass support and separation during the process.

26. The risk of NiS induced breakages was addressed in the introduction to the 2005 Standard, as follows:

> *"Heat soaked thermally toughened soda lime silicate safety glass has a safer breakage behaviour when compared with annealed glass. It also has a known level of residual risk of spontaneous breakage arising from the possible presence of critical nickel sulphide (NiS) inclusions in the thermally toughened soda lime silicate glass.*
>
> *Note 1 This case deals with extremely large quantities of glass. These quantities are dealt with on a statistical basis. Therefore it is impossible to select a quantity of heat soaked thermally toughened soda lime silicate safety glass, for a building, and claim that "no break" by NiS inclusion can occur. The breakage of heat soaked thermally toughened soda lime silicate safety glass caused by other influences is excluded."*

The 2005 Standard addressed the level of residual risk after heat soaking directly at [3.2] in the following terms:

> *"risk of spontaneous breakage of heat soaked thermally toughened soda lime silicate safety glass, on a statistical basis, due to the presence of critical nickel sulphide inclusions, is no more than one breakage per 400 tonnes of heat soaked thermally toughened soda lime silicate safety glass."*

27. As will appear when I set out relevant contractual terms later, it is common ground that Lend Lease was required by the contract to heat soak the outer panes of the curtain walling system in accordance with the 2005 Standard, subject to an agreed extension of the holding phase from 2 hours to 4 hours. It is also accepted that applying a rate of 1 breakage per 400 tonnes mechanistically to a quantity of 300 tonnes would indicate that there would be either no breakages or one breakage on the building.

28. The residual risk of one breakage per 400 tonnes is expressed in the 2005 Standard on a statistical basis for extremely large quantities of glass. "Extremely large quantities" is not further defined, but the working assumption of the experts at trial was that it would be much larger quantities than 400 tonnes. This needs to be borne in mind when considering what rate of breakage should be anticipated on a given building project. I accept the evidence of Mr Colvin that the figure of 1/400 tonnes first emerged as a result of German research in the early 1980s. When the 2005 Standard was revised in 2016, various aspects of the procedure and heat regime were changed: but [3.2] from the 2005 Standard was retained unchanged. Mr Josey and the Defendants argued that this showed that [3.2] of the 2005 Standard was unreliable. I disagree. Retention of [3.2] unchanged is equally consistent with it having been a reliable assessment both before and after the introduction of the 2016 Standard. There is evidence from the literature and the experts, which I accept, that a significant driver for the changes introduced in 2016 was economic: in other words, the 2016 Standard attempted to achieve as good a result as the 2005 Standard but at a lesser cost to manufacturers. There is no substantial body of evidence in the literature between

2005 and 2016 (or thereafter) that casts doubt on the efficacy of the 2005 Standard heat soaking processes to achieve compliance with the stated residual risk of 1 breakage per 400 tonnes. To the contrary, the weight of the evidence in the literature is to the effect that the heat soaking regime instituted by the 2005 Standard was very effective and, if anything, oversafe. When Ms Day QC took Mr Josey to a number of papers, each of which supported the conclusion that the 2005 Standard was reliable and safe, he accepted that he knew of no papers questioning the reliability of the Standard. In this state of the expert evidence and literature, I accept the evidence of Mr Colvin that the figure of no more than 1 breakage per 400 tonnes was shown both by research and by experience of the industry in general (and Mr Colvin in particular) to be realistic and reliable for very large quantities of glass after heat soaking in accordance with the 2005 Standard. Adopting Mr Colvin's words (as set out in the Experts' Joint Statement) I find that a failure rate of 1 in 400 tonnes was "a reasonable worst case scenario" for glass manufactured to proper European standards.

29. Faced with at least 21 breakages in the 125 OBS supply of c. 300 tonnes of glass, Mr Josey was by the time of trial able to advance only two possible explanations, namely that:

    i) The glass had been heat soaked in accordance with the 2005 Standard but that the rate of temperature increase in the heat soaking ovens was excessive; and

    ii) There was a surfeit of sulphur rich NiS inclusions that the heat soaking process did not eliminate but which proved to be critical when installed on the building.

30. The 2005 Standard did not prescribe the rate of temperature increase in the oven during the heating phase. Basing himself on a 2001 paper by Kaspar, Mr Josey postulated that the rate applied to the 125 OBS glass was excessive and would have prevented transformation even though it was not in breach of the 2005 Standard because of the absence of any relevant provision in its terms. I reject the argument. It is correct that, at the end of the paper, Kaspar proposed that "[f]ollowing our new results, heating rates … shall not be higher than 2 K/min." However, the relevant finding in the body of the paper was that "the energy turnover depends strongly on the heating rate. Below 2 to about 5 K/min (depending basically on the sample's composition) it remains constant at about 50-60 J/g. Above this limit it decreases dramatically." Mr Josey accepted that this provided a range of between 2 and 5 K/min before the efficacy of the heat soaking process fell away; and he accepted that the ovens used by AGC for the 125 OBS glass heated at a rate of 2.6 K/min, which was within the range of 2-5 K/min: this was consistent with Mr Colvin's evidence that he had never come across an oven that would heat at a rate of more than 5 K/min. Mr Josey had done no tests himself and provided no sustainable explanation why the heating rate of the AGC ovens should have led to such a disastrous failure of the glass used for 125 OBS. The Defendants seek support from two papers. Lam & Lim (c.2003) refer to rates of heating and state that "the only document that cited the rate of heating is included in the German Building Regulation that as issued in March 2002. A "*continuous temperature gradient of at the most 2^{o} C/min*" has been specified." Jacobs and Calderone (2003) repeat Kaspar's conclusion, as set out above. Neither paper gives reasoned support to the proposal that a heating rate of 2.6 K/min could have caused failure of the heat soaking process on the scale implied by

the failures on 125 OBS. I reject this proposed explanation for the rate of failure of the 125 OBS glass.

31. I have referred to the significance of sulphur rich inclusions, and Mr Josey's evidence of the critical range of compositions at [17] to [20] above. The Defendants have referred to various papers where the potential significance of different compositions of NiS inclusions have been raised. However, accepting as I do that the range of critical inclusions is from Ni_7S_6 and $Ni_1S_{1.046}$ and that inclusions that are more sulphur rich than the top of the critical range would not be of concern during the design life of the building, there is simply no evidence to support a finding that there was a super-abundance of NiS inclusions at the sulphur rich end of the critical range that could provide an explanation for the failure rate that occurred. To the contrary, the findings of GTS (even taking into account the suspect finding to which I have referred) suggest that this theory is fanciful[1]. I reject it.

32. I have rejected the concept of "bad batches" at [17] above. Substantially for the reasons given by Mr Colvin in his first report at [9.14.1], which highlights the randomisation of any NiS inclusions either before or (if they persist) after heat soaking, I do not accept that "clustering" will occur to a material degree. That said, the finding that the presence of NiS inclusions in very large quantities of heat soaked toughened glass (a) will be essentially random and (b) should give rise to a residual risk of no more than 1 breakage per 400 tonnes means that (c) there could be marginal variations between different selections from the very large quantities of heat soaked toughened glass but (d) the distribution of any NiS inclusions within each selection is itself likely to be essentially random. In other words, if one takes a random selection of 300 tonnes from a very large quantity of, say 64,000 tonnes, the fact that the distribution of NiS inclusions within the 64,000 tonnes was random means that the incidence of inclusions within a given selection could be higher (or lower) than the overall incidence of inclusions within the 64,000 tonnes. To that extent, I accept that a very large quantity which, viewed overall, would be subject to a residual risk of 1 breakage per 400 tonnes could give rise to a higher risk within a selection from it. However, there is no evidence to justify a finding that the risk within the selection would be orders of magnitude higher than the 1 per 400 tonnes risk for the whole.

33. Allied to the fact that the residual risk in relatively smaller quantities of heat soaked glass may vary somewhat from the residual risk when applied to the whole of a much larger quantity from which the selection is drawn, the fact of random distribution means that there will be variations in the incidence of breakages. This has been widely recognised, both by the experts who gave evidence and by others who did not. For example:

    i) In 2002 the Centre for Window and Cladding Technology wrote that:

> *"By specifying a requirement for failure rates for the process for large volumes of heat-soaked toughened glass, an onus is put on the heat-soaker to know the performance of the oven and to have the equipment duly calibrated. Thus a specifier may*

[1] I note in passing the evidence of Mr Josey that the questioned finding was well outside the critical range and was not of concern; and that the next most sulphur-rich inclusion identified by GTS should have converted in a heat soak oven at 290° in between 20 and 25 minutes: Day6:84.16-86.25

indicate a requirement for the heat-soaking regime to be designed with an objective of achieving a residual risk of 1 failure per 100 tonnes or 400 tonnes of glass as a statistical average over large volumes of hear-soaking. However, higher or lower rates of failure may still occur on smaller batches associated with individual projects.";

ii) In 2010, in a draft of a report to advise the Claimants on the breakages they were experiencing, Dr Wolmuth wrote:

"In practice, in my experience, most projects that use toughened glass have no nickel sulphide breakages reported despite the project's glass volumes suggesting that some might be expected. However, a few projects have more failures proven than might be expected. I attribute this experience to the small amount of contamination required to create a large number of Inclusions. This results in average projects being rare. I consider the statistic of 1 in 400 tonnes as being similar to the typical family being quoted as having 2.4 children. The varying incident of nickel sulphide Inclusion breakages on different projects may be explained to some extent by statistical analysis if a Poisson distribution is assumed to predict the probability of a given number of failures.";

And, later in the same report:

"When using toughened glass, the risk of nickel sulphide inclusion related failure can not be eliminated despite diligent heat soaking. The risk can also not be quantified on project specific glass volumes - far higher or lower rates of NIS induced failure are likely to occur than large glass volume production statistics suggest.";

iii) To similar effect, in December 2010 when advising the Claimants on remedial works, Wintech Ltd wrote:

"All toughened glass is susceptible to spontaneous breakage due to nickel sulphide inclusions. <u>All</u> toughened glass is to be heat soaked to reduce the risk of such breakage. The heat soaking regime is to comply with the specified requirements and the associated equipment calibrated and procedures vetted technically prior to the glass for the project being processed. The objective of heat soaking is to limit the residual <u>statistical</u> risk <u>on large glass volumes</u> to 1 in 400 tonnes. However, the residual risk of such breakages on individual projects may be much higher or lower. Thus, a small but real risk remains of a number of breakages after installation despite diligent heat soaking. The incidences of any such breakage are likely to peak in the first five years or so but breakages may occur many years later."

34. The lack of numerical quantification when referring to the risk of a higher rate of breakage than would be predicted by mechanistic application of a residual risk of 1 breakage per 400 tonnes is notable in all of these extracts. Although there is a background noise of anecdotal evidence about buildings where a greater than expected number of breakages of toughened glass has occurred, there is no adequate or reliable evidence in the literature that glass which has been properly heat soaked in accordance with the 2005 Standard has suffered rates of breakage in situ that are inconsistent with the worst case rate of 1 per 400 tonnes for very large quantities. Mr Josey was unable to identify from his experience any building or evidence to support a finding that such inconsistent rates of breakage either could have happened or had happened after proper heat soaking on particular projects.

35. In answers to the Court, Mr Josey accepted that, if the 2005 Standard's heat soaking regime was deficient as he suggested, there should be an endemic problem of which the experience at 125 OBS was typical. On the evidence before the Court there is no such endemic problem. Confronted by this difficulty, Mr Josey said:

> *"No, but this is something that happens a lot. It doesn't happen to the same extent that it has happened here, perhaps, or in quite the same upfront buildings, but there are quite a lot of buildings where it takes place."*

Mr Colvin's evidence was:

> *"If you are talking about glass which has been heat soaked, there aren't that many that are really bad, to be quite honest. There are some that go over the top a little, but not many, in the UK."*

36. A number of points arise on this evidence. First, there is no evidence to justify a finding that toughened glass manufactured to generally accepted Western European standards and heat soaked in accordance with the 2005 Standard could or would suffer rates of breakage as bad as or even approaching the rates sustained with the 125 OBS glass. Second, I prefer the evidence of Mr Colvin as set out above to that of Mr Josey based on my assessment of Mr Colvin's greater experience and expertise in the field. Third, the passages cited above do not attempt to provide any numerical or quantitative explanation of what is meant by phrases such as "far higher" or "much higher". I merely note that if the mechanistic application of a rate of 1 breakage per 400 tonnes would lead to the conclusion that there would probably be either no breakages or one breakage on a particular building, it would be a reasonable use of descriptive language to describe 5-7 breakages as "far higher" or "much higher" than anticipated.

37. Mr Colvin provided evidence of anticipated incidence of NiS-induced breakages within the c. 300 tonnes of glass on 125 OBS by applying the Poisson distribution at a rate of 1 breakage per 400 tonnes. For the reasons just given, I would accept in theory that the application of that rate could underestimate the properly anticipated incidence of NiS breakages on a given building, including 125 OBS. However, in cross-examination on whether contamination with NiS inclusions would occur in particular

areas of the glass, Mr Colvin responded[2] that "if you'd had all 300 tonnes of glass come off [the floating of annealed glass] on 31 July, as the date you picked, the you might have a vague argument, but you haven't. There are 64,000 tonnes of glass been produced out of which that 300 has been randomly picked." I accept that evidence. It means that the theoretical possibility of different random selections from the whole exhibiting varying rates of breakage (and rates that differ from the rate applicable to the whole) will be attenuated. Elsewhere, in answer to the Court, he said that he had not "come across any situation where the use of Poisson statistics doesn't accord with the number of breakages you get on a particular building." It was implicit in his answer that he meant using Poisson statistics applying a rate of breakage of 1 per 400 tonnes. I accept that evidence also.

38. When estimating the number of panes that should have broken during the heat soaking process, Mr Colvin acknowledged the effect of random distribution of NiS inclusions by saying that there would be "some variation around" the values that would be produced by a mechanistic application of a given rate of breakage. I accept that evidence and that approach as reasonable when applying a statistical rate of breakage in very large quantities to smaller quantities such as the c. 300 tonnes that was placed on 125 OBS.

39. Bearing in mind that 1 breakage per 400 tonnes is a reasonable worst case for very large quantities of toughened glass heat soaked in accordance with the 2005 Standard, and the qualification that is required when dealing with a selection rather than the whole as discussed above, I would not adopt 1 breakage per 400 tonnes as a hard and fast or absolute worst case figure for a selection of 300 tonnes of glass. That said, and for the reasons set out above, I would expect 1 breakage per 400 tonnes of glass to be a reliably indicative order-of-magnitude figure against which it is reasonable and correct to compare the performance of a selection of 300 tonnes of glass. I will therefore adopt that approach when coming to decide whether or not the glass that went onto 125 OBS was properly heat soaked in accordance with the 2005 Standard.

40. For the reasons set out above, I accept that it is not appropriate to apply a rate of 1 breakage per 400 tonnes mechanistically to a given quantity of glass to arrive at a single "expected" number of breakages. Instead, it is appropriate to have regard to a Poisson distribution as relevant evidence when assessing a numerical range of potential breakages. If a rate of 1 breakage per 400 tonnes were to be adopted in order to arrive at a Poisson distribution of potential breakages for 300 tonnes of glass, the result would be:

Number breaking	Probability % of that number of panels breaking (300 tonnes):
0	47.24
1	35.43
2	13.29
3	3.32

[2] Day4:76-77

4	0.62
5	0.09
6	0.01
7	0 ($1x10^{-3}$)
8	0 ($1x10^{-4}$)
9	0 ($1x10^{-5}$)
10	0 ($7x10^{-7}$)
11	0 ($5x10^{-8}$)
12	0 ($3x10^{-9}$)
21	0 (2×10^{-21})

In summary, application of the Poisson distribution provides evidence to support a finding that the most probable anticipated number of breakages for the glass on 125 OBS if it had been properly heat soaked would have been none or one. It also provides evidence to support a finding that the likelihood of more than about 5 or 6 breakages on 125 OBS if the glass had been properly heat soaked was extremely small. I return to this later.

41. Disputed Issue 3 is: To what extent does heat soaking in accordance with the requirements of the 2005 Standard (i) eliminate or (ii) reduce the risk of NiS failure? For the reasons set out above, I make the following findings:

i) If carried out properly in accordance with the 2005 Standard, heat soaking of toughened glass will reduce the risk of NiS induced failure so that it is no more than 1 breakage per 400 tonnes on a statistical basis in very large quantities;

ii) When translated to smaller quantities, such as the 300 tonnes placed on 125 OBS, the residual risk is in the order of 1 breakage per 400 tonnes, but this should be regarded as an indicative order-of-magnitude risk which may vary slightly from project to project;

iii) It is appropriate to adopt a Poisson distribution based on a rate of 1 breakage per 400 tonnes as evidence of the likely number of breakages on a given building, while taking into account that the results will provide indicative order-of-magnitude evidence rather than mathematically hard-edged precision.

Background Narrative

42. The Claimants were incorporated in August 2006 as a special purpose joint venture vehicle and were at all material times the owners of the building. At the time of the development, the joint venture partnership was owned by Hammerson plc (50% shareholding), GE Real Estate (25%) and Bank of Ireland (Private Banking) (25%). Hammerson as the major joint venture partner was closely involved throughout the events with which this litigation is concerned, attending meetings and, in turn, reporting to its Joint Venture partners. For many purposes it was regarded as synonymous with the Claimants, and I shall frequently refer rather loosely to "the Claimants" when greater precision would identify Hammerson as the legal entity involved.

43. The First Defendant is a construction company, whose parent company is the Second Defendant. Unless the context requires otherwise, I shall refer to them collectively as "Lend Lease".

44. By a building contract executed as a deed on 26 January 2006 ("the Contract") Lend Lease was engaged to carry out and complete the design and construction of the development works to the building. The original parties to the Contract were Dominion Corporate Trustees Limited and Dominion Trust Limited ("Dominion") and the First Defendant. By a novation agreement dated 2 November 2006, the Contract was novated to the Claimants in place of Dominion. The parties to the Contract for the purposes of this action are therefore the Claimants and Lend Lease.

45. The design, supply and installation of the Curtain Walling System was subcontracted to the Third Party, who sub-subcontracted them to the Fourth Party. I shall refer to the Third and Fourth Party collectively as "Pisa" unless the context otherwise requires. This sub-contracting arrangement was achieved by Dominion initially contracting direct with Pisa on 26 January 2006 by a contract known as the "Designated Contract", and the Designated Contract being novated to Lend Lease on 3 May 2006.

46. The manufacturer of the glass for the Units was Zadra Vetri ("Zadra Vetri") a manufacturer based in Belluno, Italy. Zadra Vetri went into liquidation in approximately 2010. Zadra Vetri in turn procured the outer panes from AGC Glass Europe ("AGC"), a Belgian glass manufacturer and processor formerly known as Glaverbel. The annealed glass used for the outer panes was floated in several batches at AGC's float glass plant in Boussis, France. The batches of annealed glass intended to form the outer panes were then sent to AGC's factory in Lodelinsart, Belgium to be processed to form the heat soaked toughened glass that was to be used in the panels for 125 Old Broad Street.

47. I refer to the relevant contractual provisions in greater detail later in this judgment and at Annexe 1. For present purposes it is sufficient to introduce that the contract included express terms that:

    i) The outer panes were to be heat soaked to meet the 2005 Standard, save that the parties agreed that the holding phase at the stipulated temperature of 290 ºC +/- 10 ºC was to be extended from 2 hours to 4 hours;

ii) Lend Lease was required to provide the Claimants with documentation to show the glass had been heat soak tested and the frequency of failures during the test;

iii) The Units would have a service life of 30 years;

48. There is ample contemporaneous evidence that the parties in the supply chain fully understood the significance of providing documentation to show that the glass going onto the building had been heat soak tested and the frequency of failures during the heat soak testing. On 12 December 2005, before it entered into the Designated Contract, an internal email from Pisa UK's Head of Risk and Legal Management set out the sort of information Pisa required when ordering heat soak tested toughened glass. It included that "records are … very important to verify that the work has been done, to the required standards, and that ALL relevant panes of glass can be traceable back through the HST process to the original panes of the float glass"; and, after setting out a list that included "records for heat soak testing (including all breakages and reasons)(temperature and time records are very important and the graphs must be very clear and auditable)" said "this is quite a detailed list but it needs to be to give sufficient assurance that each pane of toughened glass that was delivered and incorporated in the building was heat soak tested."

49. By May 2006, Pisa knew that it was not being provided with sufficient documentation to demonstrate that all glass had been heat soak tested properly. An internal email on 29 May 2006 enclosed Zadra Vetri's response to Pisa's request for documentation and concluded "Moral: what we are getting today is not in line with what Pisa UK is asking for." On 30 May 2006 an internal Pisa email pointed out the need to address the issue of traceability both generally and specifically for 125 OBS. It stated the minimum requirements that "must be" provided by Zadra Vetri to Pisa and emphasised that "our minimum target is to prove that all the glass has been processed as required by the spec. …" An email from Pisa to Zadra Vetri on 22 June 2006 acted as minutes of a meeting that day and pointed out that its recent requests for information had not been complied with. It concluded that "It was made clear that Pisa (and therefore Zadra and Glaverbel) has to be able to demonstrate that all the glass is in compliance with the contract specifications, hence that all the glass is toughened and HST. At the moment the issued documentation do not show this." The need for traceability was restated at a meeting of Pisa, Zadra and Glaverbel on 5/6 July 2006. Glaverbel is reported to have said that it would send all appropriate documentation at the end of the job.

50. The works commenced in 2006. Practical Completion was certified on 25 July 2008. Shortly thereafter, on 8 September 2008, the first of the spontaneous breakages caused by NiS inclusions occurred. In summary:

i) 17 outer panes failed on the Property between September 2008 and July 2012;

ii) Following the removal of the glazing in the course of remedial works, approximately half of the glass was put into storage. A joint inspection on 10 June 2015 disclosed that a further 4 outer panes had failed;

iii) It is probable that, had the other half of the glass been put into storage, there would have been some breakages there too, though the precise number cannot be determined;

iv) I shall therefore refer to 17 breakages on the building and 21+ breakages overall.

The sequence of breakages is important for a proper understanding of the Claimants' developing thinking and response with time. I therefore set it out in greater detail below.

51. Some of the glass from the pane that broke on 2 September 2008 fell to the ground from the second floor, where the unit had been. It was not appreciated at the time that the cause may be (as now agreed by the experts) NiS inclusions and the glass was not tested.

52. On 14 April 2009 a crack was observed in a glazing pane at level 27. Pisa attended site and advised that the panel was safe as the crack was in the middle laminate layer: this is not pleaded as a NiS failure. Thereafter:

i) On 30 July 2009, the outer pane of a unit located on the 11th floor of the building broke but remained in place; and

ii) On 19 August 2009, the outer pane of a unit located on the 18th floor of the Property broke and fell to the ground at 12:49 hours, falling onto the reception canopy and onto the public road below. Five double glazing units ("DGUs") were damaged by the falling glass.

53. The 19 August 2009 failure prompted an immediate emergency response. Within six minutes, security cordoned off the footpath below and the police closed Old Broad Street. Eleven minutes after the failure it was reported that two pedestrians were injured from falling glass. The police contacted the Health and Safety Executive, and the District Surveyor. Lend Lease and Pisa were informed. Between 3 and 4 pm Pisa begin to remove glass from Level 18 and the reception canopy and the City of London Corporation began to clean Old Broad Street. Shortly after 5 pm police removed cordons. The failure hit the national press, with the Daily Mail reporting:

> "***Miracle escape for City workers as giant plate glass window falls from 17th floor into busy street***
>
> *City workers had a narrow escape yesterday when a giant plate glass window fell 17 storeys, shattering on the street below.*
>
> *The 15ft high pane just missed office workers enjoying an early lunch and a group of people standing at a bus stop on Threadneedle Street in the heart of London's financial district.*
>
> *…*
>
> *The building is co-owned by Hammerson Plc, the Bank of Ireland and GE Real Estate, however it is not yet known who is in the frame for the accident."*

54. Pisa soon reported that the suspected cause of the breakage was NiS inclusions. At a Technical Review Meeting held on 24 August 2009, Pisa advised that close visual inspection was unlikely to reveal the presence of NiS inclusions; and that replacement with laminated glazing could be considered as an alternative specification for the cost of around £3.5m. At the same meeting Lend Lease agreed to carry out a full audit of the glazing QA process.

55. The Claimants were, of necessity, in close contact with the District Surveyor, Mr Martin. At his insistence, the Claimants agreed to erect scaffold tunnels around the base of the building and to close and cover the passageway between 125 OBS and the neighbouring building at 60 Threadneedle Street. Erection of the scaffolding began on 31 August 2009. The initial hope was that the scaffold tunnels would be in place for about one month and the scaffolding around the entry to the building would be in place for about four months. In the events that occurred subsequently, the scaffolding was progressively extended and remained in place for approximately four years, being finally struck in 2013. Photographs taken periodically show the extent and impact of the scaffolding on what was intended to be a very prestigious building and its neighbours in what is an area of the highest quality.

56. In early September 2009, Lend Lease and Pisa undertook what was described as an audit review of the glazing quality assurance process. Lend Lease prepared a report that was issued on 18 September 2009. The report concluded that Pisa had "adequate quality control procedures in place". It recorded Zadra Vetri's confirmation that the normal failure rate of glass in the heat soaking ovens was 1%. It also recorded that Lend Lease had viewed records for the heat soak tests for the 125 OBS project which showed that 2 failures in 2053 panels had taken place (rather than something of the order of 20 as would be indicated by Zadra Vetri's confirmation). Glaverbel was recorded as saying that further records would be available in a month. The report concluded that, subject to receipt of further documents from Glaverbel, the glass was produced to the correct standard and that the heat soak test results supported the fact that the glass was of good quality.

57. Hammerson appointed Dr Stephen Ledbetter of the Centre for Window & Cladding Technology ("CWCT") at the University of Bath to report on the glass failures. On 24 September 2009 he provided his initial comments following a review of documentation provided by Lend Lease and Pisa. He adopted the average failure rate for very large quantities of 1 in 400 tonnes, advising that this implied a 30% probability that there would be no failures in a batch of 400 tonnes but that some batches would have two or more failures. He advised that the reported failure rate during heat soaking of the 125 OBS glass (2/2053) raised questions as to whether heat soaking had been carried out correctly which had not been fully answered. He also questioned whether the method of retention used for the outer toughened glass in the DGUs was adequate. The risk of glass falling from the DGU was confirmed by a report from Pisa dated 12 November 2009 which stated that, where failure of outer panes was induced in testing, two out of six panels fell from the frame: one fell after just over one minute, the other in just under five minutes.

58. In December 2009, CWCT concluded and advised that the failures on the building were caused by the presence of NiS inclusions. On 4 December 2009, it provided a

draft report that confirmed the cause of failure and stated that the risk of a fatal event occurring round the building was 3.6 in 100,000 per year, which was in excess of the risk that was considered acceptable by the London District Surveyors' Association. On 18 December 2009 the CWCT final report highlighted the apparent inconsistency between two failures occurring on the building and only two failures being reported in the heat soak process. Based on the work of Bordeaux and Kaspar, CWCT said it could be assumed that there could be another two NiS crystals present in the glass that had not yet manifested themselves in failure. As later became clear, this was a substantial under-estimate. On the basis of the assumptions set out in the report, which included re-affirmation of the risk analysis it had provided in the earlier draft report, CWCT raised the prospect of extending a canopy around the façade of the building or providing a mesh or grillage.

59. In the light of CWCT's advice, the Claimants reviewed their possible options which were identified as including: (i) doing nothing; (ii) modifying the existing glass; (iii) replacing all of the existing glass; and (iv) installing a canopy grille. At that stage their favoured option was to install a canopy grille around the building. Advice was obtained from architects and Pisa put forward proposals, which were discussed at a meeting on 23 February 2010. In March 2010 Pisa provided a quotation in the sum of c. £620,000 for a limited canopy which extended a relatively short distance from the building, as can be seen in a photograph mock-up provided at the time. Meanwhile, the scaffolding remained in place.

60. In April 2010, GMW Architects issued a report, the purpose of which was to consider the issues surrounding the failures that had occurred in July and August 2009. It concluded that the choice of heat soaked toughened glass had been appropriate and that it had been used effectively in the specification of similar buildings in the City of London for many years; it referred back to the conclusions of the Lend Lease audit report that the QA procedures during manufacture had been adequate; and it recorded that "in order to further reduce any potential risk however it is proposed to install a projecting grille around the podium building at first floor level together with the installation of a laminated glass canopy around the base of the Tower elevations."

61. A planning application for the external canopy was submitted in May 2010. Planning permission was granted on 1 July 2010. The works were due to start in August 2010. However, between 1 July and the projected start date for the works, three further failures occurred which transformed the Claimants' assessment of the seriousness of the situation.

62. On 8 July 2010 at about 4 pm the outer pane of a DGU overlooking Threadneedle Walk and located on the 14th floor of the building broke. The shattered glass remained in situ. Cordons were put in place and pre-arranged procedures implemented. Pisa finished removing toughened glass at about 10pm and added cross stitching to ensure that the pane stayed in the frame.

63. Pisa returned to site in the morning of Saturday 10 July 2010 to replace the broken Unit on the 14th floor. During the afternoon of that same day a further outer pane failed and fell to the ground, this time from the 4th floor of the podium overlooking Old Broad Street and above the premises of Turnbull & Asser. Security cordoned off the area and the police were called. Although much of the glass was caught by the scaffold, some fell onto the carriageway of Old Bond Street, which had to be closed

for about 2 ½ hours. The scaffold projected further from the building than the proposed canopy and, although the primary purpose of the scaffold was to break up glass rather than to contain it, I accept Mr Cheshire's evidence that the fact that glass fell to the street undermined the Claimants' confidence in the canopy.

64. On 12 July 2010, a review meeting took place attended by the Claimants, Pisa, Lend Lease, and GMW to agree actions following the failures on 8 and 10 July. The immediate decision was to suspend the installation of the proposed canopy. It was agreed that all remedial options would be reviewed, including surveying the remaining glass, covering it with a film and full reglazing. At the same time, the extent of the existing scaffolding was reviewed and the decision taken in conjunction with the District Surveyor to increase it so that it extended further out across and to the far pavement of Old Broad Street, across Throgmorton Street to the far pavement, across the remainder of Threadneedle Walk so as to abut 60 Threadneedle Street, as well as over the main entrance glass canopy. Consideration was also given to the provision of a netting canopy. Photographs of the extended scaffolding show the pervasive extent and effect which, in lay terms, constituted a serious blight on the area, the building and its neighbouring properties.

65. I accept the evidence of Mr Mulqueen that, by the time and in the light of the July 2010 failures, the Claimants were becoming increasingly concerned that there was a fundamental problem with the glazing: indeed, it would be frankly astonishing if such concerns had not existed and increased in the light of the building's experience to date, with its obvious implications for public health and safety, the adverse impact of the continued presence of the scaffolding and associated reputational damage. On 16 July 2010 Mr Mulqueen reported to the Joint Venturers that "until the event on Saturday 10 July, it was believed that the number of further potential [NiS] inclusions was very limited and, furthermore, from research and experience of this product, it was believed that in all likelihood the glass would remain in situ and could be replaced in the usual way. In light of the fact, however, that the building has now suffered four failures, of which two have fallen to street level, a fundamental review of the appropriate response is in progress." I accept that to be an accurate summary of the Claimants' thinking, which was entirely justified, given the relatively sanguine advice they had previously received and the recent failures which cast doubt on the correctness of that advice. I also accept that, as recorded in that note, the base build team (i.e. Lend Lease and Pisa) had been instructed to advise whether the existing glass could be retained, modified or replaced; and that the specification of the proposed canopy was also being reconsidered in the light of the new information available to the Claimants. These steps were, in my judgment, reasonable and proportionate responses to the crisis (properly so called) now facing the Claimants.

66. The seriousness of the situation was reflected in the Claimants' decision (noted in the minutes of a meeting held on 20 July 2010) to engage two independent experts to advise them, Dr Bill Wolmuth and Mr Colvin. They were to review existing reports, undertake an audit of procurement and manufacture of glazing, comment on why glass was falling from frames after failure, comment on non-destructive tests that were available, and other related topics. The minutes of the 20 July 2010 meeting also record (and I accept as fact) that Herbert Smith had been instructed to conduct a legal review to advise Hammerson of the potential liability of third parties under the

main build contract; and that liaison with tenants was established to ensure that they were kept advised of progress.

67. On 27 July 2010 Hammerson received a preliminary opinion from Grendon Design Agency Limited that "even if all adjoining thoroughfares were completely bridged over, there remains a risk of glass scatter beyond the confines of the scaffolding. Therefore I conclude by advising that there needs to be a remedy applied to the external glass to prevent further shattering and drop out while a long term study/solution is developed."

68. The following day, 28 July 2010, the outer pane of a DGU located on the 7th floor shattered. It remained in situ. Pisa was called to make the glass safe. On the same day, Mr Marshall wrote to Mr French of Pisa confirming that Dr Wolmuth and Mr Colvin had been commissioned to advise the Claimants, with a broad brief including a detailed audit on the manufacture of the glass. Mr Marshall included a list of requests from the experts, which included a request for "full records for each heat soaked batch of glass for the project, including the schedule of glass include[d] in each batch, the time/temperature graph; and which panes broke in the oven." This was the first direct request by the Claimants for such information. Its significance was not lost on Mr French, who passed it on to others with the observation that "Clearly [Hammerson] is pinning all their hopes on trying to find something in our glass process that is not in compliance with the standards. We must collectively ensure that any cooperation we extend to [Hammerson] or its appointed consultants is done in such a way as to defend the company at every level." One recipient responded "Bill Wolmuth is a strong supporter of the toughened glass properly checked under soak test and always asking for impossible tracking of datas or special measures not in line with a typical industrial product. We are playing a very dangerous game, so be prudent, please." Another noted "Part of the requested documents has been already given to the client because contractually defined. For other document we need to stop client request. Please keep in mind that no collaboration or very poor support will be given by our chain supply." As will be seen, this last comment proved to be an understatement; and the tension between the provision of information and attempting to defend the company continued right up to and throughout trial.

69. On 2 August 2010 a review meeting took place, which was attended by the Claimants, Pisa, Lend Lease, GMW and GVA. Pisa tabled options for alternative glass specifications for the Claimants' consideration. That was followed on 5 August 2010 when GMW circulated a draft Glass Replacement Specification to Pisa, Lend Lease and the Claimants. The next day, on 6 August 2010, formal notice was sent to Lend Lease requesting Lend Lease's cooperation and reserving the Claimants' rights in respect of the five glazing failures that appeared to be NiS-induced failures. Lend Lease responded by assuring the Claimants that they would continue to assist and co-operate on a without prejudice basis and reserving all of Lend Lease's rights on 25 August 2010.

70. Before that response from Lend Lease there were two more failures. First, on 6 August 2010 the outer pane of a DGU located on the 19th floor broke and fell to the ground. The panel fell from the building in two large sections, mostly onto the scaffolding below, but some rebounded onto Old Broad Street and Threadneedle Walk. Pisa's reaction to the news of the failure is instructive. A sequence of three emails included the following internal observations which demonstrate a clear

appreciation of the seriousness of the situation: (i) "Another unit gone. This is getting a little bit uncomfortable. Hammerson will surely go for us now. We need to make sure our position is watertight and I would suggest an internal review by PQ ahead of the anticipated audit by Bill Wolmuth." (ii) "This is unfortunate! It is really urgent to find an expert in glass that could support us. I will ask AGC." (iii) "I understand that the corporation of London has such a reduced confidence in the building that they are considering closing the roads…"

71. Between 7 and 8 August 2010, a further extension to the scaffolding canopy was erected over Turnbull & Asser's premises with the installation of additional boarding: the extent of the scaffolding is shown in drawings produced by BNP Paribas on 13 August 2010. Then, on 24 August 2010, during a meeting arranged to discuss the glass failures, the outer pane of a DGU located on the 24th floor shattered and almost immediately fell to the ground. The falling glass damaged a number of panels below level 24 and also damaged windbreaks and glass screens below. As with previous failures, barriers were erected at street level for public protection.

72. On 27 August 2010 GMW provided a report on the two replacement glass options which had been tabled by Pisa on 2 August. GMW advised that "Option 1", namely replacement of the Units with a laminated inner pane and laminated outer pane, should be adopted.

73. On 1 September 2010 Hammerson wrote again on behalf of the Claimants to Lend Lease, thanking Lend Lease for its letter of 25 August 2010. The Claimants stated that their primary concern (which they anticipated would be shared by Pisa and Lend Lease) was the safety of people using the building and members of the public who pass it. They stated "given the number of glazing units which have failed and the time frame over which these failures have occurred, we think it likely that we will conclude that we have no choice but to re-glaze the entire building and from our discussions to date we understand you concur with that assessment." Lend Lease's reply on 14 September "noted … that [it] has not concurred or endorsed the option to re-glaze the entire building." Lend Lease did not, however, then or at any stage suggest that the option to re-glaze was either unreasonable or wrong, or that it should not be pursued. Nor did Lend Lease suggest an alternative solution.

74. On 8 October 2010 a meeting took place to discuss an audit that the Claimants had asked Dr Wolmuth to undertake. The meeting was attended by the Claimants, Lend Lease, Pisa, IBT (Dr Wolmuth) and Arup (who were advising Lend Lease). Pisa advised the meeting that it would not be possible to trace single panes back to the manufacturing process. However, it also said that it had (and would provide to Dr Wolmuth) full heat soak documentation for all glass supplied up to the end of 2009.

75. On 18 October 2010 a pane located on the 5th floor of the property broke, showing the tell-tale "butterfly" sign of a NiS-induced failure. Over the course of the next six hours, the necessary steps were taken, including cordoning off the floor near the affected window, informing the District Surveyor and the City of London, and removal of the glass (which on this occasion had remained in the DGU).

76. On 12 November 2010, GMW issued a revised version of its report on the replacement glass options and other potential options that might be considered to avoid wholesale replacement of the glass. The report advised that any projecting

canopy would only be allowed to project a small distance from the building, in which case protection of the public could not be guaranteed. It also advised that it was highly likely that glass fragments would bounce off the canopy into the street even if the canopy was of sufficient projection to prevent the failed glass falling directly onto the pavement below the building. GMW advised that installation of a canopy "is not considered a practical proposition." This advice was supported by a further report on 25 November 2010, from BMT Fluid Mechanics, which concluded that the incidents to date did not represent potential annual worst-case scenarios and that the potential for wind-born debris to carry beyond the extent of the current canopy could not be ruled out. To similar effect, GMW and Wintech issued a joint report on proposed glass replacement strategy on 3 December 2010. It concluded that the best option for the Property was to proceed with Pisa's "Option 1", namely reglazing with a laminated glass inner and outer pane.

77. On 6 December 2010 Lend Lease submitted a tender for the Reglazing Works in the sum of £9,021,379

78. By November 2010, it was being reported to the Claimants' Board that reglazing looked like the only viable option. An update paper was sent to the Claimants' Board in December 2010 recommending that, regardless of the potential to recover the cost, re-glazing be pursued without delay. In due course, and in the light of the successive failures, glass falling from the DGU frames and the perceived inability to ensure the reasonable safety of the general public by the installation of a permanent canopy or other practicable solution, the Hammerson Board and the Joint Venture partners took the decision to re-glaze the building.

79. On 22 February 2011, Dr Wolmuth provided a report which concluded (amongst other things) that (i) the failures analysed by the laboratory had revealed that the cause of breakage was NiS inclusions; (ii) the inclusions in question should have responded to heat soaking; (iii) he was confident that further failings would occur, but the frequency, timing and position of such failures could not be reliably forecast; and (iv) although he had been provided with extensive documentation by Pisa, he was not yet satisfied that all of the glass was heat soaked properly or at all. Dr Wolmuth advised that the most practicable option in all the circumstances was to replace the existing DGUs to the entire installation.

80. Dr Wolmuth's reference to documentation being provided by Pisa is now given additional colour by disclosed documents showing that Pisa was itself acutely aware that the documentation it had (and which it passed to Dr Wolmuth) was inadequate. On 4 November 2010, Pisa emailed AGC acknowledging that it had received some documents from AGC, emphasised that it was in their common interest to demonstrate to the claimants that all the glass had been correctly heat soaked, and pointed out that if they were unable to do so "we are faulty in the compliance to client specification." Five days later, Pisa wrote to AGC again pointing out that, of 2852 pieces of glass "in total 846 pieces without clear documentation" (more than one third of the total glass). On 10 November 2010 Pisa passed on to Dr Wolmuth the documentation that had been provided by AGC, without further comment. However, within a week Pisa wrote to AGC again, referring back to its email of 9 November 2010 and to a meeting held with Lend Lease and the Claimants and stated "Pisa position related to the documentation released to the Client and related to all the glass installed were correctly heat soak tested is really weak, as you already know… the

situation is really critical now and AGC response till now is not absolutely aligned with our expectations." Pisa wrote again on 19 November complaining that AGC had not provided the necessary information and that they were not in a position to reply to the Claimants. On 29 November they wrote again demanding clear explanations and stating that "during the meeting we have not clearly proven that HST process was performed correctly. The number [of] breakages during your HST process was zero but we have had 8 spontaneous breakages in site, were (sic) for sure 3 of them due NiS inclusions very big."

81. An internal Pisa document on 7 December 2010 referred to AGC's suggested evidence that there had been no breakages during heat soak testing of about 2500 panes and observed "this is absolutely unusual: the usual average value of breakages during HST is 1 to 2%". It also noted that 8 breakages on site (to that date) was well outside what was considered to be the residual risk after heat soak testing. Pisa had identified that the dates written in temperature diagrams provided by AGC appeared to be postwritten and that diagrams that would have been expected to be different were identical and requested an explanation from AGC. Later in the document, Pisa stated that "considering the result of the [heat soak testing as reported] and the fact that the diagram data [in the documents provided by AGC] appears to be postwritten, AGC is in position to not clearly prove that HST process was correctly performed."

82. That same day, 7 December 2010, Pisa wrote to AGC that "we are not in position to confirm to the client that HST process was correctly performed by you. This situation is absolutely critical for [Pisa] and therefore for AGC."

83. Returning to the failures on the building, on 14 June 2011 an outer pane located on the 6th floor broke but remained in place until secured and made safe by Pisa by applying film and holding plates. Protective barriers were put in place and the District Surveyor was informed.

84. On 5 August 2011, the Claimants entered into a contract with Lend Lease pursuant to which Lend Lease agreed to remove all of the glass panes and replace them with new units of a different design, comprised of a laminated heat strengthened outer pane with a laminated glass inner pane. The works started in early 2012. Lend Lease and Pisa set up a site office on the 9th floor of the building. Practical completion was achieved on 23 April 2013. The works were managed by Hammerson with a view to reducing third party claims to a minimum. I shall consider that in more detail when dealing with quantum below.

85. Meanwhile, on 7 October 2011 Dr Wolmuth issued a further report in which he concluded that he was unable to confirm that every pane was definitely heat soaked. He also reported that the heat soak records with which he had been provided had been created retrospectively, were not complete, and could not be confirmed to be accurate. And he expressed doubts over whether the heat soaking process had been undertaken in accordance with the German Building Regulations.

86. Soon after the re-glazing works began, more failures happened to the original glass on the building. Typically on each occasion, cordons were erected as temporary safety measures round potentially affected parts of the building; and the District Surveyor was informed. In short:

i) On 19 January 2012, the outer pane of a DGU on the 3rd floor broke. The glass shattered and scattered across a wide area with some fragments landing on the scaffold platform close to buildings on the opposite side of the road;

ii) On 23 February 2012 the outer pane of a DGU on the 21st floor broke. Over the next hour the glass fell from the unit, spreading across the crash deck and with some glass coming though the crash deck lower gantry. Some glass fell onto Throgmorton Street. As a result of this failure, the re-glazing works were halted while additional safety measures were put in place to protect Land Lease's workers and subcontractors. These additional measures added 50 days to the works programme;

iii) On 1 March 2012 the outer pane of a DGU on the 2nd floor broke and fell onto the scaffold. The District Surveyor was informed;

iv) On 16 May 2012, the outer pane of a DGU on the 2nd floor broke. It had previously been taped over and, although it buckled, it remained in place;

v) On 23 July 2012, the outer pane of a DGU located on 15th floor broke. The glass had been taped and remained in place;

vi) On 25 July 2012, the outer pane of a DGU located on the 18th floor broke but remained in place long enough for Pisa to apply film and stitching over the affected panel;

vii) On 30 July 2012, the outer pane of a Unit located on the 6th floor of the Property broke but remained in place.

87. Approximately half of the Units from the Property were put into storage at a facility in Burt's Wharf, Belvedere. The remainder of the Units were disposed of. It was later discovered that four further outer panes had broken in the storage facility.

The Contract in Greater Detail

88. The contract was a collection of documents which were bound together in a number of volumes. It incorporated the terms of the JCT Standard Form of Building Contract With Contractor's Design 1998 edition, including Amendments 1-5. The standard form was further amended very substantially by bespoke deletions, substitutions and additions. The Contract Documents were defined to include "the Articles of Agreement, and Conditions (including the Table of Amendments modifying the Conditions and the Appendices annexed hereto, together with the Employer's Requirements, the Contractor's Proposals and the Contract Sum Analysis, each initialled by or on behalf of the Parties".

89. The contract contained no term establishing a hierarchy giving precedence to one Contract Document over another. Normal principles for the construction and interpretation of commercial contracts therefore apply.

90. For convenience, I set out the most relevant terms of the contract at Annexe 1 including extracts from:

i) The Articles;

ii) The JCT Conditions (as amended);

iii) The General Specification, which formed part of the Employer's Requirements as defined;

iv) The Performance Specification for Curtain Wall and Cladding Atrium, External Wall and Roof dated 16 November 2005 ("the Curtain Walling Specification"), which formed part of the Contractor's Proposals and is described as a Performance Specification; and

v) Technical Clarifications issued by Davis Langdon to Pisa.

91. There was a pleaded case that there were also relevant terms to be implied. That case is no longer pursued and there is no need to say more about it save that the Defendants accept that they were under a duty to exercise reasonable skill and care [Defence paras 15-16].

92. The Claimants' case, as pleaded and as pursued at trial, is that the contract imposed a number of discreet obligations upon the Defendants. The primary clauses giving rise to those obligations are Clause 2.1.1, which requires the Contractor to carry out and complete the Works "in accordance with" the Employer's Requirements and the Contractor's Proposals", and Clause 8.1.1, which requires that all materials shall be "of good quality, appropriate for their purpose, to the reasonable satisfaction of the Employer and in accordance with the Contractor's Proposals and/or the Employer's Requirements and any performance specification."

93. On the basis of those two primary clauses, the Claimants submit that the following obligations are imposed upon the Defendants, each of which is said to be a separate and discrete obligation:

i) Arising out of the Employer's Requirements as set out in the General Specification:

a) the service life [i.e. the actual period of time during which no excessive expenditure is required on operation, maintenance or repair of a component or construction] of the glass used in the curtain walling shall be no less than 30 years [Section 33G];

b) the contractor shall be responsible for the final selection of materials, all in accordance with specified standards [Section 34G(a)];

c) the contractor shall guarantee that the materials, type of construction, dimension, size and thicknesses stated in the working drawings shall satisfy the design intent and the performance requirements [Section 34G(b)];

d) the contractor shall be entirely responsible for achieving the completed installation, and any proposal submitted, for all components, and assemblies of the installation, shall achieve or surpass the design and performance criteria stated in the General Specification [Section 60G];

e) The contractor shall use specialist skill and expertise to develop the design taking into account the selection of suitable materials [Section 85G]; and

f) Where and to the extent that materials and workmanship are not fully specified they shall be suitable for the intended purpose in the works, stated in or reasonably to be inferred from the design intent drawings and other contract documents [Section 90G];

ii) Arising from the Contractor's Proposals as set out in the Curtain Walling Specification (as subsequently varied in relation to the required heat soak testing):

a) The secondary elements of the curtain walling system, which included the outer panes of glass, will have a design life of at least 30 years [Section H11/440];

b) The outer panes were to be constructed from heat soaked toughened glass to BSEN 14179, save that the time for which the glass was to be heated at 290^{o}C +/- 10^{o}C was extended from 2 hours to 4 hours.

94. The Defendant's case as pleaded is that:

i) The Technical Clarification under H11/742 meant that "as between the Claimants and the First Defendant, the Claimants expressly took the risk of NiS breakage, together with replacement and installation, from the expiry of the Defects Liability Period, and the Claimants took responsibility for the risk posed by any NiS breakages to third parties after practical completion" [Defence para 14(d)]; and/or

ii) The Technical clarification amounted to an Employers' Instruction which bound the First Defendant to use heat soaked toughened glass for the outer panes [Defence para 14(e)]; and/or

iii) The Curtain Walling Specification anticipated there to be failures in the toughened glass due to NiS inclusions, even once it had been heat soaked. The Building Contract did not contain any other requirement in respect of treatment to prevent NiS failures in toughened glass or in respect of the permitted rate or extent of NiS failures in heat soaked toughened glass. The operation, repair and maintenance costs associated with the NiS failures that happened were not "excessive" because the failures (and therefore any associated costs) were anticipated in the Building contract. Any failures and associated costs were therefore anticipated and permissible [Defence para 31]; and/or

iv) The Claimants selected heat soaked toughened outer panes in the knowledge, and adequately warned, that there was a residual risk of NiS failures [Defence para 62] and thereby took responsibility for the risk of NiS failures and their subsequent replacement and reinstallation [Defendants' Opening para 49].

95. The Defendants accept that losses attributable to a failure to heat soak the glass in accordance with the 2005 Standard (as amended by the contract) would be their responsibility, while denying that there was any such failure. In essence, therefore, they contend that the only effective contractual obligation imposed upon them in relation to NiS inclusions was to heat soak in accordance with the 2005 Standard. They submit that this does not deprive the other provisions on which the Claimants rely of all content because there may be other reasons than NiS inclusions why a design life or service life of 30 years may not be achieved, or why glass might not be suitable for its intended purposes. So far as I am aware, no evidence was led to identify realistic alternative causes of substantial failures of heat soak tested toughened glass.

96. The normal principles for the construction and interpretation of commercial contracts have been set out, often with only minor variations or glosses on what has gone before, in many cases of the highest authority to which I neither need to nor can add anything of real value. The parties referred me to the statements of principle to be found in *Arnold v Britton* [2015] UKSC 36 at [14]-[23], which themselves refer back to previous authorities starting with *Prenn v Simmonds* [1971] 1 WLR 1381 and culminating with *Rainy Sky SA v Kookmin Bank* [2011] UKSC 50, while mentioning others along the way including *Chartbrook Ltd v Persimmon Homes Ltd* [2009] UKHL 38.

97. Although the variations that may be detected in these cases occasionally mark a significant development of the law, quite often they are a reflection of the need to address the particular facts of the case being decided. I therefore remind myself of the major pillars of principle, summarised or referred to in *Arnold v Britton* and limit myself to the briefest outline of what I understand that the Court should do when applying those principles, which I adapt from the summary in [15] of *Arnold*.

98. Interpretation of a contract is the process by which the Court decides what it means. The Court does that by identifying "what a reasonable person having all the background knowledge which would have been available to the parties would have understood them to be using the language in the contract to mean." It does so by focussing on the meaning of the relevant words, which is to be assessed in the light of (i) the natural and ordinary meaning of the words in question, (ii) any other relevant provisions of the contract, (iii) the overall purpose of the words in question and the contract, (iv) the facts and circumstances known or assumed by the parties at the time that the contract was executed, and (v) commercial common sense, but (vi) disregarding subjective evidence of any party's intentions. The process of interpretation is sometimes described as iterative, which indicates that there is no hard and fast order for the application of the various tools of interpretation, and that the Court always has the prospect of revisiting or taking an overview of the effect of the application of those tools at every and any moment before the end of the interpretative process.

99. In a contract of any complexity there will typically be a number of separate clauses or provisions that cover the same or similar territory. The reasons for this may vary from being accidental (as where a contract is compiled from various different sources or documents, more than one of which addresses a particular point) to deliberate (as where the parties have deliberately imposed multiple obligations upon one party in order to protect the position of the other). The contractual dispute in the present case

raises a question that is familiar when the Court is required to interpret multiple provisions covering the same or similar territory: are the provisions all effective to impose the several obligations that their terms suggest, or is the effect of one or more provisions that they modify or exclude the apparent meaning of another provision or provisions. Sometimes the contract provides for resolution of this question by expressly creating a hierarchy of precedence so that, in the event of conflict, the superior provision overrules the inferior. There is no such hierarchy established in this case.

100. The interpretative question for the Court in this case is whether the obligation upon the Defendants to heat soak the toughened glass in accordance with the 2005 Standard (but for 4 hours) is additional to the other obligations that appear to be imposed by the contract or whether it qualifies or supersedes those other obligations. The answer to that issue will, as always, depend upon the terms of the contract in the case being considered, interpreted in accordance with the established principles to which I have referred; and, in searching for that answer, it will be important (and may in an appropriate case be determinative) to identify whether the clause that is said to qualify or supersede others is inconsistent with them. The importance of frank inconsistency is that if two clauses dealing with the same area are mutually consistent, good reason will be required before the Court holds that one clause is effective to the exclusion of the other.

101. A similar issue was considered by the Court of Appeal in the recent case of *MT Hojgaard A/S v E.ON Climate and Renewables UK Robin Rigg East Ltd* [2015] EWCA Civ 407, though the wording of that contract differed substantially from the wording of the contract in issue in the present case[3]. The issue was whether the Contractor had warranted that the off-shore turbines would last for 20 years or whether the Contractor's obligation was merely to design in accordance with a specified standard that was expected, but not guaranteed, to produce a life of 20 years. The Court of Appeal identified the issue it had to resolve in the following terms at [79]-[80]:

> *"[79] It is not unknown for construction contracts to require the contractor (a) to comply with particular specification and standards and (b) to achieve a particular result. Such a contract, if worded with sufficient clarity, may impose a double obligation upon the contractor. He must as a minimum comply with the relevant specifications and standards. He must also take such further steps as are necessary to ensure that he achieves the specified result. In other words, he must ensure that the finished structure conforms with that which he has warranted. ….*
>
> *[80] The question which I must address is whether the agreement negotiated between [the parties] is a contract of that character."*

102. After reviewing the various provisions of the contract the Court of Appeal concluded at [106] that:

[3] The Court of Appeal's decision is of course binding notwithstanding the fact that permission to appeal has been granted by the Supreme Court.

> *"[106] Let me now come to a conclusion. TR paras 3.2.2.2. (2) and 3b.5.1 [which appeared to impose an absolute obligation] are inconsistent with the remainder of the TR and 1101. They are too slender a thread upon which to hang a finding that MTH gave a warranty of 20 years life for the foundations."*

103. I start by considering the terms of the present contract before addressing the Defendants' case as summarised above.

104. Clause 2.1.1 of the JCT Conditions, read in isolation, identifies the Employer's Requirements and the Contractor's Proposals separately and requires the Contractor to carry out and complete the works in accordance with each of them. To that extent it indicates the existence of separate and discrete obligations arising under the Employer's Requirements and the Contractor's Proposals respectively. It does not, however, give any indication of what is to be done if it were to be found that different obligations so arising were to be found to be inconsistent with each other.

105. Clause 8.1.1 repays close attention. As a matter of syntax and by its use of punctuation, it imposes four separate obligations upon the Contractor. Those four separate obligations can be indicated as follows: all materials and goods shall be (1) of good quality, (2) appropriate for their purpose, (3) to the reasonable satisfaction of the Employer and (4) in accordance with the Contractor's Proposals and/or the Employer's Requirements and any performance specification. It can therefore be seen that Clause 8.1.1 by itself means that the Contractor is under obligations that are separate and discrete from the obligation to provide materials and goods in accordance with the Contractor's Proposals and the Employer's Requirements and any performance specification – namely the obligation that goods and materials shall be of good quality and appropriate for their purpose.

106. I leave over for the moment what is meant by "good quality" in this context. However, the meaning of "appropriate for their purpose" demands and (subject to one reservation) receives a contractual answer when applied to the curtain wall glazing: the purpose of the curtain wall glazing is to is to provide the outer skin of the building with a *service* life of 30 years with no excessive expenditure on operation, maintenance or repair: see Section 33G of the General Specification. The separate contractual statement that the *design* life of the panels shall be *at least* 30 years is cross-referred to section 33G of the General Specification and emphasises that the purpose of the toughened glass panels was to provide an outer skin that would last for 30 years: see Section H11/440 of the Curtain Walling Specification. In the context of a design and build contract for the provision of a highly prestigious building in a prime position in the City of London this purpose seems almost self-evident, quite apart from being found in the contract itself, *unless* it is precluded by some other provision of the contract. I therefore suspend judgment on the contractual meaning of the "purpose" of the outer panes until later.

107. Subject to the same suspension of judgment, Clause 2.1.1 gives contractual force to the obligations arising out of the Employer's Requirements, including the obligation pursuant to Section 33G of the General Specification that the service life of the insulating glass units was 30 years. It also gives contractual force to the obligations arising out of the Contractor's Proposals, including the obligation under Section H11/440 of the Curtain Walling Specification that the outer panes of glass would have

a design life of at least 30 years. It is a moot point whether the obligation to heat soak in accordance with the 2005 Standard (but for 4 hours) should be regarded as arising under the Contractor's Proposals or by virtue of a separate agreement. In either event, it is expressed as a separate obligation.

108. Whatever the residual risk of spontaneous breakage after heat soaking in accordance with the contract, I see no intrinsic inconsistency between the contractual obligation to heat soak and the other obligations to which I have referred. On the contrary, the existence of any residual risk of spontaneous breakage after heat soaking may be said to reinforce the commercial sense (or even necessity) supporting the inclusion of other effective obligations upon the contractor to provide a satisfactory outcome under this design and build contract. As it happens, the findings I have made on the scale of the residual risk at [41] above mean that there should probably have been either no breakages or one breakage, with an absolute maximum of about 3-6 breakages, if the obligation to heat soak had been discharged properly, which does not imply an inconsistency with the requirement of a design life or at least 30 years and a service life (as defined) of 30 years. If, which I reject for the reasons set out elsewhere, the residual risk of failure after heat soaking was or should have been understood to be a risk matching what in fact happened, the commercial utility of a separate provision that puts additional and more onerous obligations on the design and build contractor are obvious.

109. Looking at the contract terms more generally, I would not conclude that the contract provides too slender a thread upon which to hold that the Defendants submitted to other obligations in addition to the obligation to heat soak. For the reasons I have set out above, the contract makes sufficiently clear the existence of separate and discrete obligations both by the incorporation of obligations arising under the Employer's Requirements and Contractor's Proposals and, separately, by Clause 8.1.1: see [105] above. It does so in mandatory terms in what can reasonably be described as core provisions of the JCT Conditions as amended.

110. Up to this point, therefore, applying the principles I have summarised above, I would say that a reasonable person having all the background information available to the parties would have understood the contract to mean that it imposed several obligations upon the contractor in relation to the curtain walling glass in addition to the obligation to heat soak. That is the natural and ordinary meaning of the words. There is no intrinsic inconsistency between the obligation to heat soak and the other obligations upon which the Claimants rely and, if there is, it merely emphasises the commercial common sense that could underlie the imposition of multiple other obligations. The overall purpose of the words in question and the contract in general is to provide a prestigious building that will last, which is commercially sensible without having regard to any evidence of the parties' subjective intention.

111. Having concluded that there is no intrinsic inconsistency between the various obligations, I return to the Defendants' case on the scope of their contractual obligations: see [94] above.

112. The Technical Clarification cannot carry the weight that the Defendants seek to place upon it. Acceptance and guaranteeing that NiS breakages and the subsequent replacement and installation rests with the contractor at no additional cost to the client up to the end of the defects liability period neither says nor necessarily implies that all

risk of NiS breakage thereafter rests with the client. All that is said about the period after Practical Completion is that 3rd party risks rest with the client after practical completion. This is notably vague in its lack of definition of what is meant by 3rd party risks. If the intention was to exclude all liability that would otherwise be incurred as a consequence of NiS induced breakages, much clearer language was required. Whether or not it would be fair to describe this provision as "tucked away", I do not accept that a reasonable person having all the background knowledge which would have been available to the parties at the time of the contract would have understood the language of the Technical Clarification as having the dramatic effect for which the Defendants now contend. I also reject the contention that the Technical Clarification amounted to an Employer's Instruction which bound the First Defendant to use heat soaked toughened glass for the outer panes. The obligation to heat soak the glass came from the contract documents and not from the Technical Clarification.

113. The assertion that "the Curtain Walling Specification anticipated there to be failures in the toughened glass due to NiS inclusions, even once it had been heat soaked" requires consideration. It is correct that heat soaking in strict compliance with the 2005 Standard carries with it a residual risk of NiS induced failure on a project involving about 300 tonnes of glass at a rate in the order of 1 breakage per 400 tonnes. If nothing more were said in the Curtain Walling Specification or the wider contract terms, a provision for compliance with the 2005 Standard admits the possibility of that residual risk. However, even on that basis, the anticipated residual risk in practice would be that there would probably be no breakages or one breakage on a project such as 125 OBS with the outside possibility of a few more, as explained above. The anticipated residual risk would not be anything like 21 with more probably to come.

114. However, the contract requirement for heat soaking, as varied, was not that it should be heat soaked strictly in accordance with the 2005 Standard: it was that it should be heat soaked in accordance with the 2005 Standard but with an extended holding phase of 4 hours instead of 2. In the light of the expert evidence in this case, it would be possible to spend considerable time on the actual impact of that extension of the holding phase; but the relevant question is what, if anything, it says about contractual intention. It is safe to assume that the change was intended to improve the reliability of the glass; in other words, it was to reduce the residual risk that would have existed after a 2 hour holding phase. The comment on the Technical Clarification is that "toughened glass will be reduced to an absolute minimum". That was incorporated into the Contract Documents, the contract being executed on 26 January 2006. The design change occurred later in 2006. There is no sound basis for the Defendant to assert that the contractual anticipation was that there would even be the residual risk of breakage contemplated by the 2005 Standard itself. If anything, the contractual anticipation taking into account the extended holding phase was that any residual risk of breakage contemplated by the 2005 Standard would be reduced.

115. This leads to the Defendant's pleaded assertion that the Claimants selected heat soaked toughened outer panes "in the knowledge, and adequately warned, that there was a residual risk of NiS failures" and thereby took responsibility for the risk of NiS failures and their subsequent replacement and reinstallation. There is no evidence that anyone warned the Claimants of a risk of failure that bore any relation to what happened on 125 OBS. The Defendants refer to Pisa's tender offer and tender offer

covering letter in May 2005. Those documents referred to a risk of breakage but did not quantify it. The terms of the documents do not suggest a risk of breakage that could compromise the integrity and use of the building as occurred with 125 OBS. I find that the Claimants were not warned or provided with information that could or should have led them to anticipate a risk of failure such as subsequently happened (or anything like it), for two reasons. First, there is no evidence that they were so informed or warned; and, second, on the basis of all the evidence in the case, if anyone had attempted to quantify the risk so as to enable the Claimants to reach an informed choice, they would have identified the risk as being in the order of 1 breakage per 400 tonnes as explained above. Translating that into the anticipated number of breakages on 125, if advice had been given I am confident that it would have been comforting, suggesting a very small number of breakages as the realistic risk, far short of the number that in fact occurred. There is no basis for the suggestion that the Claimants knowingly or with adequate warning accepted the risk of breakages at the rate that occurred, or anything like it.

116. I return to review the meaning of the contract in the light of these considerations. To my mind there is no reason to depart from the ordinary and natural meaning of the words used, which were apt to impose several obligations upon the Contractor. There is no inconsistency between the obligation to heat soak and the other obligations, particularly when the residual risk is appreciated to be at the level that I have found and all the more so when it is appreciated that the contractual heat soak regime was more onerous than that set out in the 2005 Standard. Once it is appreciated that any residual risk inherent in the contractual heat soaking obligations was at or below the level I have found, it was entirely consistent with an absolute obligation to provide curtain walling (a) with a design life of at least 30 years and (b) a service life of 30 years because a rate of breakage consistent with that residual risk would not defeat the purpose of the curtain walling or lead to a breach of the two absolute obligations. If the residual risk had been at large, so that it could comprehend what in fact happened, there would be obvious commercial sense in maintaining the natural meaning of the words of the other obligations since no one in their commercially right minds would have contemplated that what in fact happened could be acceptable. In this context, Mr Marshall's evidence indicates that the Claimants were in their commercially right minds and would not have accepted such risks: see paragraph 72 of his statement. I rely upon that evidence not as an indication of subjective intention but as support for my view of what would be commercially sensible (or absurd) and what a reasonable person having the knowledge of the parties at the time of entering into the contract would have understood the words used to mean.

117. For these reasons I reject the interpretation for which the Defendants contend and hold that the contract imposed obligations several obligations, including that:

i) The Contractor was obliged to carry out and complete the Works in accordance with the Employer's Requirements, including the requirement under Section 33G of the General Specification that the service life (as defined) of the glass was to be 30 years [Clause 2.1.1];

ii) All materials and goods should be of good quality and appropriate for their purpose (which in the case of the outer panes of glass was that they should have a service life of 30 years) [Clause 8.1.1];

iii) The glass was to have a design life of at least 30 years [Clause 2.1.1; Section 34(G) of the General Specification; and Section H11/440 of the Curtain Walling Specification].

118. In the light of these findings I can provide short answers to the following Disputed Issues:

i) Disputed Issue 1 is: (a) Did the contractual requirement for Lend lease to comply with the Employer's Requirements include the obligations referred to at paragraph 12(9) of the Particulars of Claim, and (b) if so what did such obligations entail? Answer: (a) Yes, in the terms set out at [92]-[93] above. (b) The obligations were, as explained above, several obligations which required compliance with their terms.

ii) Disputed Issue 4 is: What risks, if any, were agreed to be borne by the Claimants in relation to NiS breakage? Answer: Taking the heat soak testing obligation in isolation, there was a risk of a rate of breakage that was contractually anticipated to be less (by an unspecified and unknown amount) than the rate to be anticipated from the application of the 2005 Standard without the extended heating time. That risk is explained in greater detail elsewhere in this judgment. But the effect of the other contractual obligations discussed above was that the rate of breakage (a) should not be excessive in the terms of Section 33G of the General Specification; and (b) should be consistent with a design life for glass of at least 30 years; and that the glass should be of good quality and appropriate for its purpose (as explained above);

iii) Disputed Issue 9 is: (a) What records were the Defendants required to keep under the Building Contract in relation to heat soak testing, and (b) did the Defendants meet those requirements? Answer: (a) The contractor was obliged to keep documentation to show that the glass had been heat soak tested and the frequency of failures during the test. That documentation was to be kept for 5 years and was to be produced to the Claimants on request. (b) No, though it was requested.

119. Disputed Issue 3 is: To what extent does heat soaking in accordance with the requirements of the Building Contract (i) eliminate or (ii) reduce the risk of NiS failure? On reviewing the issue, it is answered elsewhere in this judgment.

120. Disputed issue 13 is: (a) Should the Defendants have warned that there was a risk that the heat soak tested toughened glass, when broken, might not be restrained by an open jointed curtain walling system, and (b) did the Defendants so warn? Answer: (a) Although some evidence was led on this point, I am not able to reach a reliable conclusion on it. It was clearly unexpected that the glass was on occasions not restrained by the frame. However, the trial did not concentrate upon the design of the frame in detail and it has not been established that there was a design defect of which the Defendants should have been aware or that there is a general tendency for glass to be ejected on shattering. There is therefore no sufficient basis for a finding that the Defendants should have warned the Claimants that glass, when broken, might not have been restrained. (b) No.

Was the Glass Heat Soaked in Accordance with the 2005 Standard?

121. There were 21 identified failures of the glass on the building and the half of the glass that was subsequently put into storage. That is the minimum working figure because it takes no account of (a) breakages that would have occurred in the glass that was removed but not stored or (b) further breakages that would have occurred with time, following the general shape of the S-curve to which I have referred at [11] above. I shall refer to 21 breakages bearing in mind that there would have been more and that the figure of 21 is therefore unduly favourable to the Defendants when comparing actual with anticipated breakages.

122. In their Joint Statement Mr Colvin's evidence was that, if heat soaking had been carried out properly, there should have been no failures of the glass which had been installed on 125 OBS. His fall-back position was that no more than 5 units would have been expected to fail. Mr Josey's evidence was that "six or seven failures could have been anticipated, there might be none or there might be more." The views of both experts are consistent with the view expressed internally by Pisa in December 2010 that the 8 breakages on site to that date was well outside what was considered to be the residual risk after heat soak testing. No one with any expertise has expressed the view that the rate of breakages that occurred on 125 OBS could reasonably have been anticipated if the glass had been heat soaked.

123. For the reasons set out at [17] to [40] above, I have concluded that the residual risk after proper heat soaking of the 300 tonnes of glass on 125 OBS would have been in the order of 1 breakage per 400 tonnes, this being regarded as an indicative order of magnitude risk, which may vary slightly from project to project. At [40] I set out the Poisson distribution of potential breakages for 300 tonnes of glass assuming a rate of 1 breakage per 400 tonnes. That supports findings that (a) the most likely outcome would have been that there were either no breakages or one breakage and that (b) the likelihood of more than 5 to 6 breakages was extremely small. Mr Colvin also calculated the Poisson distribution assuming a residual risk of 1 breakage per 200 tonnes or 1 breakage per 100 tonnes. These rates of residual risk would be of a different order of magnitude than should have existed if the glass had been properly heat soaked, but the results are informative none the less. They are set out below:

Number breaking	Probability % of that number of panels breaking (300 tonnes)		
	Residual risk		
	1 in 400 Tonnes	1 in 200 tonnes	1 in 100 tonnes
0	47.24	22.31	4.98
1	35.43	33.47	14.94
2	13.29	25.10	22.40
3	3.32	12.55	22.40
4	0.62	4.71	16.80

5	0.09	1.41	10.08
6	0.01	0.35	5.04
7	$1x10^{-3}$	0.08	2.16
8	$1x10^{-4}$	0.01	0.81
9	$1x10^{-5}$	$2x10^{-3}$	0.27
10	$7x10^{-7}$	$4x10^{-4}$	0.08
11	$5x10^{-8}$	$5x10^{-5}$	0.02
12	$3x10^{-9}$	$6x10^{-6}$	$6x10^{-3}$
21	$2x10^{-21}$	$2x10^{-15}$	$1x10^{-9}$

124. This evidence indicates that, even if a rate of 1 breakage per 100 tonnes is adopted, the chance of 10 breakages would be of the order of 1 in a 1000 (i.e. very unlikely) and the chance of 21 breakages would be vanishingly slight. For the reasons set out above, I do not accept that a rate of 1 breakage per 100 tonnes is remotely realistic on the facts of this case.

125. Adopting the approach to this evidence that I have set out above, I conclude that the most likely anticipated outcome from using the specified glass on 125 OBS would have been that there would be either no failures or one failure, though the possibility of 2 to 6 failures remained. I prefer the view of Mr Colvin that the maximum number that should reasonably have been anticipated was about 5 breakages, though that was very unlikely. More than 5 was so unlikely as to be negligible.

126. I note in passing that it was the consistent view of all other experts who advised on the problems at 125 OBS and of Pisa itself that the rate of breakage being experienced by 2010 was excessive and not consistent with what could reasonably have been expected. I do not rely upon those views as necessary for my conclusion, but they provide additional support for the view that I have reached on the basis of the expert evidence of Mr Colvin and Mr Josey in any event. Similarly I also note (but do not rely upon as necessary to my conclusion) the view of Mr Marshall who, though not an expert witness in the litigation, had experience of using toughened glass on a number of buildings from the refurbishment of 99 Bishopsgate after it had been bombed by

the IRA in 1993 to 2006 and was aware of publications referring to a residual risk. Toughened glass had been "a very good servant to [Hammerson] over a period of time"; and his anticipation was that "if we were lucky, we would get zero [breakages on 125 OBS], of were unlucky we would get one, if we were very unlucky, we would get two, if we were seriously seriously unfortunate we would get three." I accept that as an accurate reflection of what a professional user of toughened glass might reasonably have anticipated when the decision to use heat soaked toughened glass on 125 OBS was taken.

127. Whether no failures, or 5-7 failures, or even 10 failures is taken as the maximum number of panes that might have been expected to fail, the actual number of 21 failures is so far in excess of the expected maximum as to justify Mr Constable QC's describing it as a "gulf" and to provide strong prima facie evidence that some or all of the glass was not properly heat soaked.

128. The importance of documentation to show that glass was properly heat soaked before installation was recognised by the obligation imposed by Section H11/742 of the Curtain Walling Specification and by the Defendants' extreme concern as it became clear that the supply chain was not providing and would not provide the necessary documentation. Mr Josey also (and rightly) recognised its importance in the course of his oral evidence. At its most extreme, the purpose of the contractual requirement was to enable the employer to refuse to accept glass onto the building if the necessary audit trail of documentation was not there.

129. From November 2015 to trial the Defendant's pleaded case has been that "The documentation provided to the Claimants from the Defendants' supply chain … shows that the glass had been heat soak tested in accordance with the Building Contract and shows the frequency of failures during testing." This plea proved to be quite unsustainable for the reasons summarised below, which were largely not in dispute by the end of the hearing.

130. *The AGC Documents*:

i) The first category of document provided by AGC was a summary document provided in November 2008. It purported to be a compilation of accurate records of the manufacturing process that identified the Pisa order number, the AGC Order number, the pallet number, the heat soak testing date, the quantity of panes that survived the heat soak testing and the quantity rejected. The document:

a) Shows that only 2 panes out of 2053 broke during heat soaking. It is now common ground that those two panes related to glass treated elsewhere, so that this record shows no panes breaking during heat soak testing. That is incredible: it is common ground that accurate records of proper heat soak testing would have shown a large number of breakages in the oven. Therefore either (i) it is fundamentally unreliable so as to provide no evidence of heat soak testing or (ii) it shows that any heat soak testing was not carried out properly;

b) Did not include all of the glass that was used on 125 OBS. A later list was more extensive but, for good reason, is not relied upon by the Defendants;

ii) The second category has been referred to as Heat Soak Temperature Traces, though they are composite documents which purport to show not only thermocouple air temperature readings from various parts of the oven but the start date and time for the heat soaking process, the duration of the process and its finish time. It was known from the start that these were composite documents created by AGC after the event, purportedly on the basis of contemporaneous VAX records. The letter of instruction to Mr Josey in April 2013 identified a number of queries or anomalies which rendered their reliability questionable. By 9 November 2016 at the latest Mr Josey had been told by the lawyers that the documents were false ("a tissue of …. false"). In his oral evidence, he accepted that they had been fabricated. It is an irresistible conclusion that they had been fabricated in order to mislead the reader about what, if anything, had happened by way of heat soaking the glass that went onto 125 OBS. No weight can be placed upon them. In addition, the fact that they were deliberately fabricated is of itself sufficient to raise doubts and questions of any other unverified information coming from AGC. In my judgment it removes any possibility of assuming in the Defendants' favour (or even being tempted to assume) that, because AGC were substantial producers, they would have carried out heat soaking which is not clearly and reliably evidenced. Mr Josey clung to that assumption: it was neither expert nor rational for him to do so;

iii) The third category is VAX records. They at least appear to be contemporaneous heat soak batch lists. They do not make it possible to determine for each pane of glass either that it was submitted to heat soaking, or the temperature control during the heat soaking if it was, or the time dwell phase. They do not show breakages during heat soaking;

iv) In May 2011 Dr Wolmuth was provided with a document that appeared to be derived from the VAX records and listed 23 "broken pieces". It is accepted by Mr Josey that this document is unreliable. Further confusion is generated by a similar document which, while referring to a total number of 23, provided three subsets of that number which added up to 14 and were said on the face of the document to be "breakages." Mr Josey accepted that the second document could be no more reliable than the first. I agree. There is therefore no reliable record of any breakages occurring during heat soak testing by AGC. Even if those documents had been reliable and it had been proved that there were either 14 or 23 breakages during heat soak testing of the 125 OBS glass, that number would be so low as to evidence that something had gone seriously wrong.

131. *The F&K evidence*: in addition to providing documentary records, FriedmanN and Kirchner GmbH provided a witness statement from its owner and CEO, Mr Robert Kirchner. His witness statement was provided to and submitted in evidence by the Defendants without his being called. His evidence was that his company installed an automatic monitoring system in AGC's oven in June 2003. The system should automatically switch to "record mode" when the oven was on. It was connected by a

telephone line to F&K's offices in Germany and was operational from June 2003 until July 2009. In the relevant period, from 6 January 2006 to 11 January 2007 the monitoring system recorded 116 occasions when the heat soaking oven was operating. Four occasions were artefacts and one data file got lost in transfer, leaving 111 successfully transferred. Those data transfers formed the basis for the F&K documentation analysed by the experts.

132. The F&K records do not identify individual loads or for which project the oven was being used at the time. However, cross-checking between the F&K documentation and the VAX records enables links to be made that support the inference that the oven was being used for 125 OBS glass where the records coincide. It is, however, common ground that the analysis only supports that inference for approximately 60% of the glass for 125 OBS. There are minor wrinkles in the F&K records, which could account for a small additional amount of 125 OBS glass, but Mr Constable QC was constrained to accept that it would not make a significant impact on the "missing" 40%: on rough calculations it could account for up to about another 5%. The crucial significance of this evidence and analysis is not so much that it can support the inference that 60-65% of the 125 OBS glass was heat soaked but that it is compelling evidence that 35-40% of the glass was not. Mr Josey accepted the logic underlying this proof and, in my judgment, he was right to do so. In closing submissions Mr Constable QC accepted that (subject to two relatively minor wrinkles) if, as I find to be the case, Mr Kirchner's evidence meant that whenever the oven was used for heat soaking during the relevant period it would be on the F&K records, the inevitable conclusion was that 40% of the 125 OBS glass was not heat soaked by AGC. There is no suggestion that it was heat soaked by anyone else. The first wrinkle was the possibility of up to an additional 5% over and above the documented 60%, which I accept as a possibility. The second is the suggestion made by Mr Josey that the VAX records themselves may be unreliable. There are two responses to that suggestion. The first is that it does not provide evidence that other glass was heat soaked. The second is that unreliable records are unhelpful to a party that relies upon those records to prove a positive case without the assistance of any witness evidence or explanation.

133. I therefore conclude that the documents provided to the Defendants by their supply chain do not prove that all of the 125 OBS glass was heat soaked in accordance with the requirements of the 2005 Standard or at all. To the contrary, the records support a positive finding that 35-40% was not heat soaked.

134. There is other evidence that supports such a finding, which may be more shortly stated. I have already commented on the gulf between the anticipated rate of failure on the building and the 21 documented failures that occurred; and I have noted the absence of any reliable record of breakages during heat soak testing. I have recorded at [15] above that critical NiS inclusions occur at an average rate of 1 per every 4-5 tonnes of toughened glass manufactured to normal Western European standards. In the absence of heat soaking, therefore, 300 tonnes of toughened glass may be anticipated to have about 60-75 critical inclusions. Mr Josey suggested 40-50, but those figures do not obviously relate to the agreed incidence of critical NiS inclusions to which I have referred. If 60-65% of the 300 tonnes were to be heat soaked, leaving 35-40% that was not, the anticipated figures might be 21-30[4] (or, adopting Mr Josey's

[4] (60 x 0.35) – (75 x 0.4)

figures, 14-20[5]). These figures bear comparison with the known 21 breakages of 125 OBS glass after delivery and lead to the corroborative conclusion that the number of breakages of the 125 OBS glass was consistent with a substantial proportion, in the region of 35-40% not being heat soak tested at all.

135. On all of the evidence available by the end of the trial, I find as a fact that a substantial proportion of the glass that was used on 125 OBS, probably in the region of 35-40% though possibly more, was not heat soaked in accordance with the requirements of the contract. If it had all been heat soaked properly, there would probably have been either no breakages or one breakage. It is possible (though not probable) that there might have been more. The absolute worst case that might have happened would have been about 5 breakages, but that number would have been very unlikely.

Questions of Breach

136. Disputed Issue 10 is: was the glass heat soaked in accordance with the requirements of the Building Contract?

No. At least 35% of the glass was not heat soaked. It is not necessary to decide whether the whole of the balance of the glass was heat soaked or, if it was, if it was heat soaked fully in accordance with the requirements of the Building Contract because it is acknowledged on all sides that a failure to heat soak 35% of the glass is a serious breach of contract that gives rise to liability on proof of causation of damage.

137. Disputed Issue 5 is: did the units meet (a) the specified service life and/or (b) the specified design life requirements of the Building Contract?

The answer to (a) and (b) is no. The Defendants (rightly) accept that if the obligation to satisfy the heat soaking requirements was not met, they are in breach of the service life/design life clauses. The failure to heat soak in accordance with the terms of the contract caused the rate of failure of the panels which required excessive expenditure on maintenance and repair of the glass during the period up to and including its wholesale replacement. The glass therefore did not meet the requirement for a service life of 30 years. If the glass had been heat soaked in accordance with the terms of the contract, the failure rate would have been so limited that expenditure on operation, maintenance or repair would not have been "excessive" within the meaning of Section 33G of the General Specification. In addition, that limited rate of failure would have been consistent with the design life specified by Section H11/440 of the Curtain Walling Specification. Because of the failure to heat soak in accordance with the terms of the contract, the quality of the glass as installed did not meet the 30 year life specified by design. In other words, the design itself met the required design life; but the glass as produced, provided and installed did not.

138. Disputed Issue 6 is: were the units, and/or the Works and/or the Curtain Walling System fit for purpose when competed and/or of satisfactory quality?

I answer this issue by reference to the terms of the contract as identified above. Neither the units, nor the Works, nor the Curtain Walling System as installed were (a)

[5] (40 x 0.35) – (50 x 0.4)

of good quality or (b) appropriate for their purpose. To be of "good quality" the glass should have been heat soaked in accordance with the terms of the contract, which would have led to the very low risk and rate of failure discussed above. The contractual purpose of the glass was to provide the outer skin of the building for a service life of 30 years, which the installed glass failed to satisfy. For the avoidance of doubt, if it had been shown that the glass had been heat soaked in accordance with the terms of the contract but had still failed as it did, the answer to this issue would be the same because the obligations to provide materials that were of good quality and appropriate for their purpose were separate and discrete obligations that existed in addition to the contractual obligation to heat soak. Irrespective of whether glass had been heat soaked in accordance with the terms of the contract, the rate of failure was so many times what could be acceptable on such a building such as 125 OBS as to compel the conclusion that the glass was neither of good quality or appropriate for its purpose.

139. Disputed Issue 7 is: Was Lend Lease in breach of the guarantee referred to at Clause 34G(b) of the General Specification?

Yes it was. The glass did not satisfy the design intent or the performance requirements of the contract in that it did not provide a service life of 30 years. Separately, the design intent was that the glass should be heat soaked in accordance with the terms of the contract, which the installed glass was not.

140. Disputed Issue 8 is: were the carrier frames of satisfactory quality and/or reasonably fit for their intended purpose? Disputed Issue 12 is: were the carrier units defectively designed? Would an alternative design have restrained the broken glazing and/or prevented the carrier frame from rotating under force?

The Claimants do not pursue Disputed Issue 12 "in light of all the other breaches in this case." I consider that the same applies equally to Disputed Issue 8 and will not decide it unless expressly requested to do so, in which case I will provide a supplemental ruling.

Quantum

141. Disputed issue 14 is: was the reglazing scheme adopted by the Claimants reasonable, or should the Claimants have adopted a permanent canopy, as alleged by the Defendants?

142. The relevant part of the Background Narrative is set out at [53] to [77] above. In the light of the expert evidence, the Defendants do not now submit that advice that reglazing should be carried out in order to eliminate any risk of any glass falling was or would have been unreasonable. That concession masks the real point that is taken, which is to assert that the decision to reglaze involved a decision fundamentally to change the risk profile of the building from that which had been accepted by the Claimants when commissioning the original refurbishment to a much more risk averse approach when carrying out the remedial works. That point is predicated on the false assumption that the risks known or assumed at the time of commissioning the original refurbishment were of an order that included the level of breakages that subsequently occurred. In fact, for the reasons given earlier, the original design and contractual obligations (if properly complied with) would probably have led to either no

breakages or one breakage. The problem arose, and the decision to reglaze was taken, because the actual risk profile presented by the building as originally refurbished bore no relation to what anyone could have expected or did expect.

143. Once this is appreciated, the evidence is all one way and is to the effect that the decision to reglaze was reasonable. In particular:

i) As I have found, the glass was not heat soaked. This was a breach of extreme seriousness;

ii) By 2010 at the latest, the rate of breakages was well outside what was considered to be the residual risk after heat soak testing, as Pisa recognised internally in December 2010. As the breakages continued to occur it became impossible to predict how many more there would be or when they would stop;

iii) The canopy that was being proposed (at a quoted price of £620,000) was less extensive than the protective scaffolding which itself was not sufficiently extensive to catch all of the glass that fell. Mr Josey accepted (as do I) that it would not have prevented all glass from reaching the street. For that reason, in my judgment, the canopy solution was inadequate for a highly prestigious building in the heart of the City after the sensitising experience of cladding failure and adverse publicity that had happened, even if (which must be highly doubtful) it would have satisfied the District Surveyor;

iv) A permanent scheme which addressed the underlying problem was both proportionate and necessary given the characteristics of the building described elsewhere and the disastrous nature and effects of the breakages that occurred. A canopy scheme would not meet those necessities;

v) The decision to reglaze was taken on the basis of professional advice from multiple reputable and highly qualified experts;

vi) Mr Josey would not have advised the Claimants to adopt a canopy that would not effectively guarantee that no glass could ever come down again;

vii) I accept Mr Colvin's evidence that the reglazing scheme was reasonable from a technical point of view. It is also one of the two schemes that Mr Josey would have recommended;

viii) Though both Pisa and Lend Lease were given the opportunity to assert and explain why (a) a canopy solution remained appropriate and (b) the reglazing scheme was not appropriate, neither did so. Lend Lease did not offer any alternative solution. It attempted to hedge its bets by "not concurr[ing with] or endors[ing] the option to reglaze the entire building"; but it then, without further reservation, tendered for and obtained the reglazing contract.

144. For these reasons I conclude that the decision to reglaze was reasonable and that a decision to rely upon a canopy solution would have been inadequate and unreasonable.

145. Disputed Issue 15 is: are the Claimants entitled to recover the costs of the reglazing scheme undertaken by the Defendants as claimed at paragraph 100(2) of the Particulars of Claim? The Defendants accept that the costs are recoverable subject to the points raised under Disputed Issue 14, which I have rejected. The costs of the reglazing scheme are recoverable in the agreed sum of £8,714,386.

146. Disputed issue 16 is: are the Claimants entitled to claim other amounts that are disputed by the Defendants? The claim was helpfully itemised in a schedule, on which there were many points of agreement. It is convenient to deal with the matters in dispute by reference to their position in the itemised schedule.

Remedial Works – Items 1-126

147. Rust removal (Item 11). This item is now agreed in the sum of £325.

148. Cleaning (Item 13). This item is claimed in the sum of £46,406.64. This item comprises four elements:

    i) Stone Repairs and Cleaning: £17,542.64;

    ii) Cleaning of anodised columns: claimed in the sum of £26,924; and

    iii) Provision of a roof top operator in connection with the cleaning: £4,060;

    iv) Façade hoists: £480

    less an allowance of £2,600 for cleaning that would have been required in any event.

149. The claim is based upon the unchallenged evidence of Mr Cheshire that these were repair and cleaning works to put the building back into the state it was in before the scaffold was put in place. The sums claimed were paid for works that I am satisfied were carried out. Mr King accepted that he had no first-hand knowledge of the state of the building immediately before the scaffold was erected. He was cross-examined by reference to an unsigned schedule of defects from July 2009 which contained entries that could have correlated with some of the work carried out by Szerelmy, who carried out the stone repairs and cleaning. Mr Morley was in no better a position than Mr King and could not give first hand evidence about the state of the building before the scaffold was erected. He was not able to make any assessment of what figure should be deducted, if any.

150. In relation to the claim for cleaning the anodised columns, the Defendants take the point that a firm called Brilliance quoted a price of £7,200 for what appears to have been the same specification as that for which Louis Francois, who were engaged and paid for doing the work, charged £26,924. Neither Mr Morley nor Mr King could say why the Claimants engaged the contractor who had tendered the larger price. Mr Morley accepted that BNP, who were advising the Claimants, are a well-known services company who are experienced in matters of building management. It is clear on the face of the document showing the tender breakdown that Louis Francois considered the job to be more extensive and to require more time than did other contractors. It is also clear from that document that Louis Francois' price for a detergent clean (which is less thorough and expensive than the deep clean that was

adopted) was roughly in line with the second price offered for that technique, at £15,282.

151. Dealing first with the stone cleaning, the evidence of causation is lightly sketched as is proportionate and in accordance with the manner in which the parties have approached quantum. I accept that it is *possible* that some of the matters dealt with by Szerelmy and paid for by the Claimants might have been included as works to be rectified as defects if the problems with the glass had not occurred. But they did occur, as a result of which the Claimants had to carry out the works years later at the cost charged by Szerelmy. It has not been shown as either probable or likely that the Claimants would have had to pay the same sums as were later paid to Szerelmy if the works had been carried out earlier as part of the process of rectifying defects. Therefore, even if is right that some of the items of work carried out by Szerelmy correlate with defects on the unsigned 2009 schedule, the sums paid to Szerelmy are a loss to the Claimants caused by the Defendants' breaches which delayed the carrying out of the works and required the Claimants to pay for them. The sums paid to Szerelmy are therefore recoverable as damages from the Defendants.

152. Turning to the sums paid to Louis Francois, there is no direct evidence about why BNP considered it right to engage Louis Francois; but there is no doubt that they did so and that, in general, the Claimants were acting on their advice. There is sufficient in the materials before the Court to justify the conclusion that the reason for choosing Louis Francois was because of their perception that the work was more involved than had been thought by Brilliance. Furthermore, the correlation in the two prices for detergent cleaning suggests that Louis Francois' pricing was not unreasonable. Once again, in circumstances where Mr Cheshire was not cross-examined on the point and the evidence is lightly sketched, I am unwilling to conclude that it was unreasonable of the Claimants to engage Louis Francois as opposed to Brilliance. On the basis that the decision was reasonable, the sum claimed is recoverable subject to a deduction for work that would have been required anyway. Mr King allowed a deduction of £2,600, which was reasonable in the light of the evidence of actual expenditure in 2013 of £2,060.

153. For these reasons the Claimants are entitled to recover the sum claimed under this item, namely £46,406.64.

154. Legal costs associated with the remedial works (Items 37-38). These are claimed in the aggregate sum of £112,567.64 and are based upon an analysis by RPC of the narrative of bills submitted by Herbert Smith Freehills ("HSF") to the Claimants. The bills were paid. On the face of the materials presented to the Court it appeared that Mr Morley was disputing the entirety of the sums claimed on the basis that they could not reasonably be attributed to the remedial works. However, it became apparent during his cross-examination that he had in fact done an analysis of his own, which largely confirmed the allocation exercise on which the Claimants were relying. That report had not been made available to the Court before his cross-examination; nor had he seen fit to make clear that his position had fundamentally changed in the light of his analysis.

155. Having reviewed the narratives on the bills, I agree with Mr King that they broadly support the allocation exercise carried out by RPC and that the evidence of Mr Morley does not cast material doubt on the allocation. While some of the fees charged by

HSF are substantial, the Claimants were justified in instructing a major firm; and there is no basis for a finding that the fees were unreasonable to the point that the Claimants should not have paid them.

156. The fees claimed under these items are recoverable in full in the sum of £112,567.64.

157. Fees for scaffold project management (Items 42-50). This is claimed in the sum of £50,380.29, which is 7% of the agreed cost of the scaffolding and was paid to the project managers, BNP. Mr Morley and the Defendants contend for a fee of £21,591.55, calculated as 3% of the scaffolding costs.

158. On 14 September 2009 BNP proposed a fee based on 7% in the fixed sum of £6,485. This was stated to be a reduction from 12% which had applied to a previous project. The proposal said that "if additional scaffolding becomes necessary we would be happy to review the fee basis accordingly at that time." This proposal was formalised in a written letter of appointment dated 20 October 2009 which essentially replicated the conditions as set out in the proposal, including the fixed fee of £6,485. There was no mention in the letter of the basis of that figure but it was obviously the same figure and reached in the same way as in the BNP proposal. It is also obvious that the proposal and appointment were entered into at a time when it was both hoped and anticipated that the scaffolding would be up for a limited period.

159. In fact, as set out before, the extent of the scaffold spread and it stayed up for years, not months. Mr Morley accepted that, in his experience at least, the scaffold contract became an extremely complicated and protracted project, ending up with tunnels over three streets and developing on the hoof pursuant to the strict supervision of the district surveyor and with scaffolding being modified to placate tenants as the Claimants reacted to matters as they emerged.

160. The parties did not investigate whether the increased (and agreed) scaffolding costs increased strictly in proportion to the extent or period and it is not self-evident that it would have done so. What is clear is that the underlying basis of the project management fee (7%) was not renegotiated. There was no cross-examination of the Claimants' witnesses to establish why not.

161. Mr Morley relied upon comparative evidence from projects in Liverpool and Leeds. However, the % rates quoted in those documents appear to be for appointments on standard projects, the scope of which can be identified in advance and which are based on different underlying hourly rates. Mr Morley's evidence was that an appropriate hourly rate for a project manager in London at the time would have been between £110-120 per hour. At these rates the fee claimed of £50,380.29 would represent c. 420-457 hours of project manager's time. Spread evenly over the period of the contract as it turned out to be (144 weeks) that equates to c.3-3.2 hours per week. No reasoned analysis has been presented to suggest that the project managers on this exceptional project would have spent significantly less than 3 hours per week. If higher hourly rates were adopted (as advocated by Mr King) the number of hours per week falls pro rata.

162. On the evidence before the court, which I have briefly summarised above, it has not been shown that 7% of the outturn scaffolding cost was unreasonable or that BNP (or another project manager) would have been ready, willing and able to project manage

the scaffolding for less. The sum claimed under this item is recoverable in full in the sum of £50,380.29.

163. In summary, the sums recoverable for remedial works are:

Issue	**Sum**
Rust Removal (agreed)	£325
Cleaning	£46,406.64
Legal costs	£112,567.64
Scaffold PM	£50,380.29
Total other items 1-126 (agreed)	£1,657,353.25
Total	**£1,867,032.82**

9th Floor Site Accommodation: Items 127-130

164. These items are claimed in the aggregate sum of £644,643.38. The Defendants' proposed figure is £370,557.90. The breakdown of the Claimants claim (with the Defendants' figures in brackets) is:

i) City of London Rates: £94,611.87 (agreed);

ii) Insurances: £1,602.18 (agreed);

iii) Loss of Rental: £425,566.48 (£151,481);

iv) Service Charges: £122,862.85 (agreed).

165. The claim for loss of rental is based on the period of 673 days (5 August 2011 to 7 June 2013) when it is common ground that an area of 5,129 sq/ft was occupied by Lend Lease as a site office for the carrying out of the remedial works. The Claimants adopting a rate of £45 per sq/ft p.a.. Their calculated basis of claim is therefore £(45 x 5,129) x (673/365) = £425,566.48.

166. The Defendants adopt a rate of £35 per sq/ft p.a. and allow for a void period of 1 year from August 2011. Their calculated basis of claim is therefore £(35 x 5,129) x (308/365) = £151,481.15.

167. By about May 2011 the building was nearly fully let. That does not provide the full picture of the availability and demand for space as some lessees within the building were looking to sub-let space as well as there being competition from other buildings nearby who were looking for tenants. The ninth floor was not fully let but it had been ring-fenced from about December 2010 to ensure that space was available for Lend Lease; and it was set in a building that was blighted as a result of the Defendants' failings. Mr Gore provided evidence of interest during the relevant period, none of which resulted in a lease being taken and some of which, on examination, was only evidence of distinctly "soft" interest. He also accepted that there could be a period of months between firm interest being shown and a lease being concluded. Having been cross-examined rigorously and well by Ms Williams, he gave as his assessment that a void period of a year from April 2011 was "highly improbable", and that it could have been void for three months or for slightly longer i.e. to July or August 2011. In

answer to a separate question he confirmed that he would have hoped to have let the space by August 2011 and that to have the tenant in by six months thereafter would be a worst case.

168. I have referred to the evidence of interest provided by Mr Gore as including "soft" interest. This applies both before and during the period that the 9th floor was ring fenced and then used during the remedial works. I do not consider that the level of interest shown during the time that the building was blighted and then subject to repairs is a reliable guide to the interest that would have been shown if the building had been trouble-free throughout. Mr Gore was an experienced asset manager and a good witness, whose evidence I generally accept. I can see no reason in logic why a void period of 12 months should be taken starting in August 2011. Equally, there can be no certainty that, but for the damage to the building, the 9th floor would have been let by December 2010 or April 2011, though it may well have been. In this sea of comparative uncertainty, it would be possible to assume that the floor would have been let throughout the period of claim subject to a discount for uncertainty. Alternatively it would be possible to make a finding that there would have been a letting after a particular period of void. While taking into account the theoretical evidence offered by both Mr King and Mr Morley about the possibility of void periods, I am inclined to accept Mr Gore's evidence that he would have hoped to have a tenant in within 6 months of August 2011 as a reasonable assessment of the worst case had the building not been damaged. On that basis, a claim for rental loss from about January 2012 (which I appreciate is slightly less than 6 months after August 2011) is the best approximation to justice between the parties, whether it is approached as being a discounted chance of there being no void or a finding of what would probably have happened. I would therefore adopt a period of 520 (673-150) days as the period of rental loss.

169. Turning to the effective rent, the £45 per sq/ft p.a. rate adopted by the Claimants takes no account of any rent free period. The granting of rent free periods was the norm, though the duration of the period varied depending upon many factors including the strength and desirability of the covenant, the length of the lease and the state of the market at any given time. There is no satisfactory evidence about how these variables would have played out in the hypothetical circumstance of an actual letting in an unblighted building during the time that the 9th floor was unavailable. Taking an average of the leases that were entered into at about the time of the Lend Lease occupation supports an effective rental in the region of £35 sq/ft p.a. or just above. However, that was a time of maximum disruption and blight on the building. Taking the average rent free period for the 45 leases identified in a schedule prepared by Mr Morley indicates an average of 10% of the duration of the lease. This would suggest a reduction of the £45 sq/ft p.a. to just over £40 sq/ft p.a. On this evidence, I conclude that Mr Morley's approach probably leads to an excessive reduction and that the appropriate figure to take is £40 sq/ft p.a.

170. On this basis the loss of rental is £(40 x 5,129) x (520/365) = £292,282.74

171. In summary, the sums recoverable in respect of the loss of the 9th floor are:

Issue	**Sum**

Loss of rental (Item 129)	£292,282.74
Total other items 127-128, 130 (agreed)	£219,076.90
Total	**£511,359.64**

Furniture Relocation Costs: Items 132-182

172. The sum claimed is £195,520.11, which is agreed. The expenditure was incurred because furniture removal contractors were at the building almost every day for planned and reactive moves as the remedial works were carried out.

173. The sum of £195,520.11 is recoverable as damages.

Professional Fees: Items 183-203

174. The sum claimed is £317,189.08, which is agreed. It represents fees for architects, project managers, and CDM supervisors as well as the professional fees of the experts who were involved in investigating the failures.

175. The sum of £317,189.08 is recoverable as damages.

Management Costs: Items 204-205

176. Item 204 is Additional Building Management Support, which is agreed in the sum of £147,022.

177. Item 205 is the cost of purchasing Active Plan Software, which is claimed in the sum of £16,250 and disputed in full.

178. Mr Cheshire's unchallenged evidence, which I accept, was that the Claimants worked with tenants, BNP and the Defendants to develop a building management strategy for the implementation of the glazing works. Mr Ketley, whose fees are reclaimed under Item 204, set up a document to allow the team to identify locations at a glance so that they could give tenants good notice of when changes that affected them were to take place. The layout of the curtain wall was drawn up into a series of spreadsheets identifying each pane, its location and the planned and actual dates of the replacement. This exercise was supported by the Active Plan Software which the Claimants acquired in order to assist with the tracking of glazing activities. According to Mr Cheshire, when a move took place Mr Ketley would keep a record of the affected area before and after the move and would obtain the tenant's signature to confirm that no items were damaged in the move. The report and supporting photographs would be stored on the server for future use. Following the purchase of the Active Plan management software, the records and photographs compiled in connection with the move would be uploaded onto the Active Plan system so that they could be accessed easily.

179. Mr King was not able to give useful evidence on this Item.

180. Mr Morley confirmed that Active Plan is in essence an archiving facility to give access to information; and he identified its functions as including uploading or

modelling the elevations, uploading the plans, and uploading photographs. He initially suggested that the Claimants should give credit for any residual value that the software might have; but in his oral evidence he then accepted that the residual value was likely to be negligible. He also at one point suggested that the functions of Active Plan could have been achieved by the use of spreadsheets. That might be so, but it is not self-evident that doing so would have led to a significant saving.

181. I regard Mr Morley's objections as inconsequential. The function which Mr Cheshire outlines and Mr Morley largely confirms is potentially useful for the complex operation that the Claimants had to undertake; and they bought it with the intention that it should be used and useful. Even if it had been shown to be useless in operation, it would still be a cost incurred by the Claimants in attempting to mitigate and remedy the damage which the Defendants had caused and, as such, would be an item that would be recoverable as damages unless the Defendants could show that it was unreasonable for the Claimants to have purchased it. The Defendants have not shown the purchase to be unreasonable and, on the basis of Mr Cheshire's evidence, the software performed a useful function. Its cost is therefore recoverable as damages in the sum of £16,250.

182. In summary, under the heading of management costs, the Claimants are entitled to recover:

Issue	**Sum**
Building management support: Item 204 (agreed)	£147,022.00
Active Plan Software: Item 205	£16,250.00
Total	**£163,272.00**

Third Party Claims: Items 206-236

183. The sum claimed is £792,785.77 which is the aggregate of the sums paid to third parties who made claims against the Claimants arising out of the damage to the building and its effect on the surrounding area. The sum claimed is identified and supported by Mr King. Mr Morley's suggested figure is £183,245.38.

184. It is common ground in respect of each of the third party claim items that (a) there was a dispute, (b) there was a settlement, and (c) the settlement sum was paid by the Claimants in the sums claimed. Mr Gore gave evidence, which I accept, that he spent about 50% of his time dealing with third party problems (including negotiating and reaching settlements of claims). Viewed overall, I have no hesitation in accepting the submission that he did a good job, as evidenced by the reductions that he achieved in the course of negotiations with third parties. Equally, I have no hesitation in accepting that the third parties who made claims were, as a generalisation, subjected to substantial blight and disruption over a sustained period such as was inevitably going to cause complaints and claims. Perhaps the only real surprise on re-surveying the evidence is that no one in fact issued proceedings. That alone would be a significant credit for Mr Gore and his negotiating skills. I would reject any suggestion that claims were knowingly settled at sums greater than was necessary to achieve the most economically beneficial settlements available. Mr Gore's evidence

was that he did his utmost to minimise the payments the Claimants had to make. I accept that evidence. Put shortly, Mr Gore did his best: and his best was good.

185. The Defendants did not plead any positive case that the settlements in general or any settlement in particular was unreasonable. Although Mr Morley spent time addressing the settlements in his evidence, he did not propose or put forward figures that would have been a reasonable range for any of the settlements. This was at least in part because he was not qualified to give expert evidence on the reasonableness or otherwise of any of the settlements. The most he could do was to point to aspects of the existing evidence that might be of interest as the basis of submissions to or findings by the Court.

186. There is no substantial dispute on the applicable principles of law. A useful summary, which I gratefully adopt, is provided by Ramsey J in *Siemens Building Technology FE Ltd v Supershield Ltd* [2009] EWHC 927 (TCC) as follows:

> *"(1) For C to be liable to A in respect of A's liability to B which was the subject of a settlement it is not necessary for A to prove on the balance of probabilities that A was or would have been liable to B or that A was or would have been liable for the amount of the settlement.*
>
> *(2) For C to be liable to A in respect of the settlement, A must show that the specified eventuality (in the case of an indemnity given by C to A) or the breach of contract (in the case of a breach of contract between C and A) has caused the loss incurred in satisfying the settlement in the manner set out in the indemnity or as required for causation of damages and that the loss was within the loss covered by the indemnity or the damages were not too remote.*
>
> *(3) Unless the claim is of sufficient strength reasonably to justify a settlement and the amount paid in settlement is reasonable having regard to the strength of the claim, it cannot be shown that the loss has been caused by the relevant eventuality or breach of contract. In assessing the strength of the claim, unless the claim is so weak that no reasonable party would take it sufficiently seriously to negotiate any settlement involving payment, it cannot be said that the loss attributable to a reasonable settlement was not caused by the eventuality or the breach.*
>
> *(4) In general if, when a party is in breach of contract, a claim by a third party is in the reasonable contemplation of the parties as a probable result of the breach, then it will generally also be in the reasonable contemplation of the parties that there might be a reasonable settlement of any such claim by the other party.*
>
> *(5) The test of whether the amount paid in settlement was reasonable is whether the settlement was, in all the*

> *circumstances, within the range of settlements which reasonable people in the position of the settling party might have made. Such circumstances will generally include:*
>
> *(a) The strength of the claim;*
>
> *(b) Whether the settlement was the result of legal advice;*
>
> *(c) The uncertainties and expenses of litigation;*
>
> *(d) The benefits of settling the case rather than disputing it.*
>
> *(6) The question of whether a settlement was reasonable is to be assessed at the date of the settlement when necessarily the issues between A and B remained unresolved."*

187. It is sufficient to add that:

i) The Court encourages reasonable settlements, particularly where strict proof would be very expensive;

ii) The test of reasonableness is generous, reflecting the fact that the paying party has put the other in a difficult situation by its breach;

iii) Reasonableness is evaluated as at the time of the settlement and in the chances of litigation at that time;

iv) A claim will generally have to be so weak as to be obviously hopeless before it can be said that settling it is unreasonable;

v) The evidential burden of proving unreasonableness of any settlement falls upon the defendant: see *Mander v Commercial Union Assurance* [1998] Lloyds Rep IR 93, 148 col 2 per Rix J, *BP plc v AON* [2006] EWHC 424 (Comm) at [281]-[282]. However, my conclusions as set out below do not in any case depend upon where the burden of proof lies.

188. Some insight was to be found in the papers into the legal advice that the Claimants were given. In broad summary, the legal advice recognised that the leases of tenants permitted some interference and disruption from the erection of scaffolding for maintenance. It was not submitted on behalf of the Defendants that the terms of the leases gave carte blanche to the landlord to erect scaffolding of unlimited extent and duration; and, had such a submission been made, I would have rejected it. The practicalities of the situation facing the Claimants was summarised in an email from a solicitor at Nabarro to Mr Gore in relation to the Turnbull & Asser claim, who said:

> *"The lease envisages that the scaffold will cause some disruption to business and that is permitted. So showing disruption is not sufficient – the disruption has to be "material". That is likely to mean disruption which is significant. … If all the above is the case, then it is difficult to see how [Turnbull & Asser] will prove that the scaffold has had*

> *a material affect (sic) on business. It may be that a small cash payment avoids the possibility of a claim."*

189. In my judgment this advice (and other advice from Herbert Smith) fell far short of saying that there was no legal basis for the claims. In the light of the facts as revealed by the evidence in this litigation, I do not think it is difficult at all to envisage that businesses in the position of the third party claimants would be able to evidence significant disruption that would have a material effect on their business and so form the basis of a valid claim, even on the basis of Nabarro's advice. My reaction, whether adopting the perspective of the Claimants at the time or the fuller vision that may be afforded by hindsight, is that the Claimants had good reason not to want to test the legal validity of the claims that were being brought (and the relatively bullish advice they were receiving) through the courts. The Claimants recognised that claims would have to be settled, at one time suggesting they might need a fund of £2 million to do so. I consider that was a realistic and reasonable assessment, subject of course to trying to reach settlements that were reasonable in individual cases.

190. With these principles in mind, I turn to the individual settlements.

Brasserie Blanc: Item 206

191. The sum claimed is £85,000, which is contested in full. Brasserie Blanc held a lease of a unit at 60 Threadneedle Street and ran a restaurant. They also held a licence to have seating outside which was terminable on 14 days notice. But for the damage to 125 OBS and the scaffolding which effectively boxed in the restaurant, there is no reason to suppose that the licence for the external seating would have been terminated; but that is what happened in or about August 2010 in the context of the damage and blight. I infer and find that the termination of the licence was caused by the damage and blight and that the termination would not otherwise have occurred.

192. A claim was brought by Brasserie Blanc based on alleged loss of evening trade. Brasserie Blanc were represented by well-known solicitors and backed by loss assessors. Initially it was a claim for just over £130,000, which was brought in November 2011. In May 2012 Mr Gore proposed a settlement of £30,000 to cover the period to the end of May 2012 with £1,250 per month thereafter up to a maximum of £46,250. That was not accepted. Instead, a revised claim was presented in the sum of just over £432,000 in September 2012. That was updated and presented with various alternative calculations in October 2012. In December 2012 the claim was settled for £85,000, which represents a significant increase on what was proposed by Mr Gore in May 2012 and just under 20% of the sum being claimed by Brasserie Blanc. Each party bore its own legal costs. The settlement agreement was drafted by HSF who advised the Claimants throughout.

193. The experts did not know and were not able to offer an opinion on the validity of the calculations that were advanced by Brasserie Blanc. Mr Gore was not cross-examined about the settlement other than to confirm that the external seating was permitted by licence. There is nothing in the information available to the court to suggest that the settlement was unreasonable or that a settlement in a lesser sum could have been achieved.

194. The sum of £85,000 is recoverable as damages.

Drapers: Items 207-227

195. The sum claimed is £170,479.32. Mr Morley was prepared to make an allowance of £9,199.50.

196. Photographs show the scaffold extending across the street and right up to the walls of Drapers Hall. There was a dispute in evidence about whether the scaffold actually touched or was connected to the fabric of the Hall. Whether or not it actually touched the Hall, the photographs show it to be particularly invasive, oversailing, obscuring the frontage, and trespassing into the Drapers Hall airspace. That was the basis upon which Jones Lang LaSalle advanced their clients' claim. They relied upon two comparator properties, one of which was a licence fee in respect of Warnford Court, the building next door to Drapers Hall. The licence fee for Warnford Court was £1,500 per week. The licence fee that was agreed with Drapers' Hall was £1,000 per week.

197. Mr Morley was not prepared to attribute any weight to the fact of the Warnford Court licence on the basis that he did not know the relative impact on Warnford Court and Drapers' Hall respectively; and he questioned whether a licence was required at all for the impact of the 125 OBS scaffold on Drapers Hall. I did not find his evidence on this settlement to be helpful. He concentrated on what he said he did not know to the exclusion of what he did. First, as I have said, the impact of the scaffold was highly invasive. Mr Morley accepted that it was unsightly and obstructive and "pretty dark" at ground floor level. Second, both Jones Lang LaSalle and BNP, who were advising the Claimants, accepted that there was a need for a licence. Third, the licence fee agreed for Drapers Hall was £1,000 per week which, on any view, was substantially less than the fee for the comparator next door. Fourth, the Claimants were advised by solicitors throughout. And, fifth, Mr Gore attempted to get the best deal available.

198. The licence required the Claimants to remediate when the scaffold came down. In the event, the Claimants released a £12,000 deposit on terms that the Drapers would carry out the cleaning. There is no basis for concluding that the release of the deposit was unreasonable.

199. On this evidence I conclude that the settlement with the Drapers was reasonable and that the Claimants are entitled to recover £170,479.32.

Gatebox: Item 228

200. The sum claimed is £112,152. Mr Morley was prepared to make no allowance.

201. Mr Sashou of Gatebox was a persistent and vociferous complainer about the impact of the scaffolding on the trade of his restaurant, L'Entrecote, from September 2009 (when he complained about the effect of the closure of the walkway between Old Broad Street and Throgmorton Street) to November 2011 (when the Claimants and Gatebox entered into the settlement agreement) and thereafter when it came to computing the final amounts payable. The claim by Gatebox included an element in respect of the termination of its licence to have seating outside. As elsewhere, the effective cause of the termination of the licence was the damage to the building: there is no reason to suppose that it would otherwise have been terminated within the relevant timeframe. The settlement included a lump sum for historical damage and

disruption to the date of the settlement and a monthly payment going forward. The overall effect of the settlement was to achieve a reduction from the sum claimed of £176,000 to £112,152.

202. The history of the complaints and negotiations is set out in the evidence of Mr Gore. In cross-examination it was established that Mr Sashou's initial complaints included reference to the effect of roadworks with barricades in Throgmorton Street, which were being carried by the Council and were not caused by damage to 125 OBS. Any influence that might have had on the final settlement figures would surely be negligible in the overall scheme of things even if it could be shown (which it cannot) that the eventual settlement with the Claimants included anything at all for that initial complaint about roadworks.

203. It was also established, by reference to the terms of the settlement agreement, that the payment of the second tranche of the settlement sum was made subject to Gatebox complying with obligations it had in respect of the extraction of fumes. Mr Gore accepted that the provision formed part of an overall commercial settlement which not only dealt with the consequences of damage to 125 OBS but also gave the Claimants the benefit of some financial leverage in relation to the problem of odour extraction. However, the fact that making the payment was *contingent upon* compliance with Gatebox's obligations about odour extraction does not mean that any part of the payment was *for* compliance with those obligations. Viewed overall, the sums that were payable under the settlement agreement were assessed by reference to and were payments for the disruption and damage caused to Gatebox by the 125 OBS works. There is no part of the payment sum that is separately assessed or quantified by reference to (or as a price for) compliance with Gatebox's existing obligations. If Gatebox had not complied and the second payment had been withheld, it would have been accurate to say that the withholding of part of the settlement sum for the damage and disruption caused by 125 OBS was because of that non-compliance: but what would have been withheld was part of the settlement sum that, if paid, was part of the compensation for the disruption and damage caused by 125 OBS. Since the second payment was in fact made, no deduction should therefore be made when assessing damages in this case.

204. The Defendants submit that the financial information permitted by Gatebox in support of its claim was not comprehensive and had problems. I agree; and had the Claimants simply paid over the sums being demanded by Gatebox, it would have been unreasonable. In fact, the Claimants settled at approximately 64% of the sum claimed. There is no basis upon which I could find that it would have been open to the Claimants to achieve a settlement for less or that it was unreasonable to settle as they did.

205. On this evidence I conclude that the settlement with Gatebox was reasonable and that the Claimants are entitled to recover £112,152.

Landmark: Item 229

206. The sum claimed is £66,592.

207. Landmark Business Centres took a lease of the 6th and 7th floors at 125 OBS with a term from 18 May 2009 to 17 May 2024. They sub-let office space and had the

benefit of access onto a terrace. From about June 2010 they were told not to use the terrace; and from about March 2011 they complained that they were losing occupiers and were unable to charge clients their full rates. The ultimate settlement of the dispute between them and the Claimants was out of the ordinary in that it involved a comprehensive commercial settlement containing a number of elements. It was agreed that the rent review period that was due on 18 May 2012 would not be implemented; but Landmark agreed a collar on the 2014 rent review of £1,024,440; and it was agreed that there would be a rent holiday of 6 weeks rent amounting to £66,592. It is the six week's rent holiday that is claimed as damages.

208. In April 2012 Mr Gore wrote to the JV partners about the proposed settlement. In doing so he commented that foregoing the 2012 rent review but having a collared rent in the 2014 rent review led to a capital uplift of £0.75million for the property as a whole. His assessment was that foregoing the 2012 rent review meant that the Claimants would be foregoing £159,000 over two years; and the rent holiday which he was then proposing (which was 4 weeks) would bring the overall cost to Hammerson of about £225,000. He juxtaposed that £225,000 against the £0.75million capital uplift that was attributable to the collared 2014 rent. When cross-examined about this arrangement he agreed with the proposition that there was a net benefit to the Claimants in doing the deal and that what was being done was taking a small hit immediately for a bigger gain later.

209. The mere fact that the settlement agreement can be seen to provide a net benefit if one sets off the uplift in capital value against the rent foregone over the period to 2014 plus the rent free period does not mean that there was no loss to the Claimants arising out of Landmark's claim. However, in order to establish a loss, the Claimants need to show that, taken overall, the terms of the settlement were less favourable to them than if the building had not been damaged and no claim had been made. I can infer that, in the absence of Landmark's claim, there would have been a rent review in 2012; and that there would have been another one in 2014 without a collared rent. What is completely lacking is any evidence about what the outcome of those 2012 and 2014 rent reviews would have been, whether the overall financial effect would have been more beneficial than the settlement terms and, if so, by how much they would have been better. Furthermore, there is no evidence about whether in the absence of Landmark's claim, there would have been a rent free period as part of the negotiations in 2012 or 2014 or both. While it seems intuitively likely that there would either have been no rent free period or a reduced rent free period, there is no evidence on the basis of which I can make a proper finding.

210. I recognise that the Claimants considered that they were being forced to the terms of the settlement agreement by Landmark's claim. I therefore am prepared to accept that the settlement terms are likely to have been less favourable to the Claimants than the financial outcome had there been no problems on 125 OBS and no Landmark claim. But that does not enable a court to quantify any detriment that there may have been. What is certain is that it is wrong in principle to take one aspect of the overall settlement (i.e. the rent free period) and to treat that as if it were not merely an adverse element of the settlement but "the" loss suffered by the Claimants. The rent free period was an integral part of the whole package of terms; and the question which has not been answered is whether that whole package gave rise to a quantifiable loss that should be recovered as damages.

211. For these reasons, though I strongly suspect that the Landmark claim gave rise to a loss that could have been quantified on the basis of appropriate evidence, the Claimants have not proved this item of claim.

Third Party Legal Fee Costs: Item 230

212. The sum claimed is £119,516.57. Mr Morley would allow £40,000 on the basis that the Claimants should not have paid more than £5,000 in lawyers' fees per settlement. He is not qualified to express that opinion.

213. The allocation of these fees to this item is based upon RPC's assessment of the narratives from the solicitors' bills. The sums involved might well seem eyewatering to anyone who is not accustomed to the speed with which legal fees can mount up. As I have indicated before, in the unusual, complex and demanding circumstances of this case, the Claimants cannot be criticised for engaging lawyers of the highest calibre and expertise. There is nothing in the materials before the court to suggest that it was unreasonable for the Claimants to instruct the lawyers and to incur the fees; nor is there any material before the court to suggest that it was unreasonable of the Claimants to pay the fees, substantial in real terms though they undoubtedly were.

214. The Claimants are entitled to recover the sum of £119,516.57 as damages under this Item.

Sigma: Items 231-232

215. The claim is for £100,000 plus legal fees of £1,017.98. Mr Morley would allow £50,000 in respect of the settlement sum and would allow the legal fees.

216. Sigma was a trading floor which was disrupted by the works. It threatened claims for relocation, loss of use of space, loss of quiet enjoyment and nuisance, initially in the sum of £441,000, but later rising to £471,000. Mr Gore's view at the time was the Claimants were not obliged to make any payment in respect of Sigma's office moves, which formed the substantial part of the quantum of Sigma's claim. He was thinking in terms of offering about £25,000 to buy off the claim. An independent report estimated that for a third party to move and relocate Sigma's desks would cost about £50,000-85,000. However, the dynamics were complicated by the fact that Sigma intimated an interest in obtaining additional space on the eighth floor. There was also a sprinkler claim which was not related to problems caused by the Defendants.

217. Mr Gore had left before the claim was settled. The basis upon which the Claimants decided to settle Sigma's claim for £100,000 is therefore not part of his evidence and does not otherwise appear. In other words, there is no explanation of why the Claimants went up from offering something in the region of £25,000 as had been suggested by Mr Gore, to settling for £100,000. In particular, there is no evidence suggesting that the Claimants had reason to be significantly more pessimistic than Mr Gore had been about the legal merits and demerits of the claim against them.

218. On this evidence, the Claimants have not satisfied me that the decision to pay £100,000 was caused by Sigma's claims that were attributable to the damage caused by the Defendants. It seems highly likely that the settlement included a significant sop to enhance the prospects of Sigma taking the additional space on the 8th floor. Mr

Gore did not say in his evidence in chief and was not asked in his oral evidence what sum he would have regarded as reasonable to pay purely to buy off the Sigma claims that were attributable to the Defendants. The tenor of his evidence as a whole and the specific evidence about what he advised should be proposed to Sigma leads me to conclude that he would have gone up above £25,000, as that was consistent with his conduct on other claims where he was driven up. My conclusion on this evidence is that a settlement of £50,000 would have been reasonable and it has not been shown that more than that sum is attributable to the Defendants rather than to other considerations.

219. I therefore award £50,000 under Item 231 as the amount within the settlement sum that can probably and properly be attributed to the Defendants; and because a settlement of £50,000 would have been reasonable. Legal fees of £1,017.98 are also recoverable under Item 232.

Turnbull & Asser: Items 233-234

220. These items are agreed as recoverable in the sums claimed, which amount to £83,027.90.

Taylor Street Barristas: Item 235

221. The sum claimed is £25,000 and is contested in full by Mr Morley.

222. As their name suggests, Taylor Street Barristas (TSB) were a coffee shop. There was evidence that they were virtually a start-up, at least in that location. They advanced their claim by solicitors. Mr Gore commented in the course of negotiations that the shop always seemed virtually full whenever he walked past it. The sum paid was based on the sums paid to other claimants reduced on a pro rata basis. It was not based upon figures presented by TSB. The photographs show that the unit was very substantially blocked and access obstructed by the scaffolding, though the precise extent varied from time to time. TSB had a licence for external seating which was terminated in the same way and for the same reasons as others to which I have referred.

223. Mr Gore's evidence was that, notwithstanding his observation made in the course of negotiations, TSB had suffered some disruption from the re-glazing works and scaffolding. He initially offered £500 per month that the scaffolding remained, and negotiations led to the settlement which involved the payment of the sum of £25,000.

224. I am satisfied that the payment was reasonably made because a claim based on disruption to trade was being brought by solicitors which, in Mr Gore's estimation, had substance. The sum of £25,000 was modest in the overall scale of things and could easily have been exceeded by the costs of continued opposition to the claim.

225. The Claimants are entitled to recover £25,000 under this Item.

Warnford Court: Item 236

226. The Claimants claim £30,000 under this Item, which is contested in full by Mr Morley.

227. Warnford Court were neighbours and were adjacent to Drapers Hall. They complained that the scaffolding was disrupting their business. Specifically they complained that they had lost the opportunity of renting premises at Warnford Court for £16,000 per annum for a period of 18 months. Though that remained the main complaint, there were others. Mr Gore attempted to settle the claim, first for £5,000 and later for £20,000 or £25,000 but was unable to do so. The claim ultimately settled for £30,000. He was not cross-examined about the basis of the settlement or its reasonableness.

228. Given the nature of the complaints, the length of time that the scaffold was in place, and Mr Gore's inability to settle the claim for less, I am satisfied that the settlement at £30,000 was reasonable.

229. The Claimants are entitled to recover £30,000 under this Item.

230. In summary, the Claimants are entitled to recover in respect of Third Party Claims:

Settlement	**Sum**
Brasserie Blanc (item 206)	£85,000
Drapers (items 207-227)	£170,479.32
Gatebox (item 228)	£112,152
Landmark (item 229)	Nil
Legal fees (item 230)	£119,516.57
Sigma (items 231-232)	£51,017.98
Turnbull & Asser (items 233-234)	£83,027.90
Taylor Street Baristas (item 235)	£25,000
Warnford Court (item 236)	£30,000
Total	**£676,193.77**

Costs associated with storing the Units which were removed from the building: Items 237-244

231. The sum claimed is £451,079.71, which is agreed save for a claim for £29,901.30 in respect of legal fees (Item 242). Mr Morley agreed and allowed £5,000 for Item 242. The balance represents the cost of storing half of the glass units from the building after they had been removed in the course of the reglazing works.

232. The sums claimed under Item 242 were paid to the Claimants' lawyers for work that was done. The fees were allocated to this item by RPC on the basis of the HSF narrative. Originally it appeared that Mr Morley disputed the allocation that had been made; but his late-disclosed schedule showed that he disputed allocation only as to £1,418.85. The reason for that reduction was neither clear nor compelling. I see no reason to doubt RPC's allocation. Nor does it appear that the legal fees were unreasonable in the sense that he Claimants should not have incurred them or should have refused to pay them. The sum of £29,901.30 is recoverable as damages.

233. In summary, the sums recoverable as damages in respect of the costs of storing the replaced glazing units are:

Issue	**Sum**
Legal fees (Item 242)	£29,901.30
Total all other items 237-241, 243-244 (agreed)	£421,178.41
Total	**£451,079.71**

Finance Charges and associated costs

234. Disputed issue 17 is: are the finance charges, pleaded at [101] of the Particulars of Claim, too remote? The claim arises out of a need to vary a refinancing agreement that was entered into by the Claimants in June 2010, the revised agreement being concluded in November 2011. It is agreed that the only issue is remoteness. It is therefore not in dispute that the Defendants by their breaches of contract caused the losses that are claimed. Those losses can be subdivided into three categories, namely (a) amendment fees payable as part of the price of varying the June 2010 agreement, (b) increased interest payments under the revised agreement in and from November 2011, and (c) associated legal fees. It is not suggested that there is any material distinction to be drawn between the various categories of loss: either all are recoverable or none is. The parties have agreed the sums that are the subject of this disputed issue in the aggregate amount of £1,819,263.14.

235. Each party referred to the classic statements of principle to be found in *Hadley v Baxendale* (1854) 156 E.R. 145, *Victoria Laundry (Windsor) Limited v Newman Industries Limited* [1949] 2 K.B. 528 and *Koufos v C. Czarnikow Limited ("The Heron II")* [1969] 1 A.C. 350. In their opening submissions (which were repeated in closing) the Defendants summarised the principle as:

> *"In summary, those cases state that a type or kind of loss is not too remote a consequence of a breach of contract if, at the time of contracting (and on the assumption that the parties actually foresaw the breach in question), it was within the parties' reasonable contemplation as a not unlikely result of that breach."*

The Defendants also relied upon the decision of the House of Lords in *Transfield Shipping Inc v Mercator Shipping Inc ("The Achilleas")* [2008] UKHL 48, [2009] 1 AC 61 where (adopting the Defendants' summary) it was held that:

> *"1. Whether loss is recoverable is determined by reference to the type or kind of loss, and not by its scale or its foreseeability. If a type of loss falls within the principles of Hadley v Baxendale, that type of loss will be recoverable irrespective of scale. On the other hand, even foreseeably large losses are not recoverable if the type of kind of loss was not one for which the Defendant assumed responsibility (paragraph 21).*

> *2. Assumption of responsibility is determined by more than what at the time of contract is reasonably foreseeable (paragraph 31).*
>
> *3. The critical question is whether the parties can be assumed to have contracted with each other on the basis that the Defendants were assuming responsibility for the type of loss (paragraph 30). The consequences for which the contracting party will be liable are those which the law regards as best giving effect to the express obligations assumed and not extending them so as to impose on the contracting party a liability greater than he could reasonably have thought he was undertaking (paragraph 16)."*

236. The Defendants realistically concede that, at the time of contracting, they might have assumed that funding arrangements were in place, though they had no reason to know (and, on the evidence, did not know) the terms of the Claimants' financing arrangements. I would go further and say that any contracting party of the substance of Lend Lease would know that a developer's financing arrangements will probably be for finite periods and will need to be re-negotiated at times that will be pre-determined even if not known to the other contracting party. Such a contracting party would also know (because of its financial sophistication and expertise) that the rate at which a developer can obtain finance will depend on variables that will include the LTV ratio and whether the Developer is or has been compliant or in breach of its existing covenants. This is absolutely basic for commercial contracting parties engaged in this line of business.

237. What happened in this case is that the Claimants' original finance arrangements were concluded by a Development Credit Agreement with a syndicate of lenders led by Hypo Real Estate Bank International AG. It was to provide a credit facility of £150 million for the development of 125 OBS and it had a maturity date of 30 June 2010. Though the Defendants did not know the date, if they had foreseen the breaches which had occurred by then, it would immediately have been in their contemplation that raising finance for a blighted building might be onerous and give rise to particular provisions for the protection of the lender. That is what happened. Negotiations for re-financing the Claimants' borrowing started in the latter part of 2009, when few panes had failed. Disclosure was necessarily made to the potential lenders. Euro Hypo were the preferred lenders, but they (not unreasonably and fairly predictably) insisted on a term that prohibited the borrowers from making any material alterations or modifications to the building without the prior consent of the majority lenders; and the agreement stipulated that the Claimants would install a protective canopy. By June 2010, when the Claimants executed the refinancing agreement, Pisa had quoted to provide such a canopy for £620,000 and the application for planning permission had been submitted. However, again because of the Defendants' breaches of contract, the disastrous sequence of events in and from July 2010 rendered the canopy solution inadequate and unfeasible. The result was that the Claimants had to go to their financiers to seek a release from the stipulation that the canopy be installed because, without a release, failure to install the canopy would have been an event of default. That, in colloquial terms, meant that the Claimants' financiers had them over a barrel, which was the predictable result of the continued deterioration of the building after

the Claimants had (reasonably) committed themselves to the canopy solution as part of the price for their renewed finance. The losses that are now claimed are the losses that flowed from the exceptionally disadvantageous position in which the Claimants found themselves vis-à-vis their financiers as a result of the Defendants' breaches of contract. As Mr Mulqueen explained, the choices facing the Claimants were to renegotiate as they did or to pull the loan and hope to find other sources of finance which, in Mr Mulqueen's view, would have proved to be more expensive if it was available at all.

238. Each of the steps leading to the losses that are claimed was foreseeable for anyone who applied their mind at the time of contracting to the consequences of breaches such as occurred. I recognise that a sequence of steps, each of which is individually foreseeable or even to be expected, does not exclude the possibility that the resulting loss is still too remote. I also recognise that, if circumstances had been different, losses such as are now claimed may not have occurred; but that is not the legal test of remoteness. Adopting *Hadley v Baxendale* language, these were losses that may fairly and reasonably be considered to have arisen naturally, i.e. according to the usual course of things, from the Defendant's breaches of contract. I do not consider that this conclusion is put in any doubt by *The Achilleas*. I see no reason why the Defendants either could or should have considered that, in the event of breaches such as occurred, they should be immune from responsibility for the predictable losses of this type.

239. For these reasons, I hold that the financing and associated losses are not too remote and are recoverable in the agreed sum of £1,819,263.14.

Collection

240. The Claimants are entitled to damages as follows:

Paragraphs above	**Description**	**Amount**
141-145	Reglazing Costs	£8,714,386.00
147-163	Remedial Works	£1,867,032.82
164-171	9th Floor Accommodation	£511,359.64
172-173	Furniture Removal	£195,520.11
174-175	Professional Fees	£317,189.08
176-182	Wasted Management Costs	£163,272.00
183-230	Third Party Settlements	£676,552.79
231-233	Glazing Storage	£451,079.71
234-239	Finance Charges	£1,857,162.03
Total		**£14,753,195.16**

241. Interest falls to be calculated separately. In the event of disagreement, I will hear further submissions on the proper calculation to be applied.

ANNEXE 1

EXTRACTS FROM THE CONTRACT PROVISIONS

The Articles

242. The first recital to the Articles of Agreement provided:

> *"The Employer is desirous of carrying out works in relation to (i) the demolition of the existing building known as the West or Market Building on the 60 Threadneedle Street site, generally down to the existing suspended ground floor slab level, (ii) the demolition of the existing building known as the East Building on the corner of 125 Old Broad Street and Throgmorton Street, down to the lowest ground bearing basement slab, and (iii) the design and construction of approximately 320,000 square feet (net internal area) of office space to Category A finish, comprising the existing tower, which will be reclad, and the design and construction of a new podium linked to the tower, and together also with approximately 6,400 square feet (net internal area) of retail space at ground level finished to shell and core and the provision of basement storage, plant and parking areas (together, the* ***"Project")****, for which the Employer has issued to the Contractor the Employer's Requirements."*

243. Article 10.3 provided:

> "The Contractor hereby confirms that it is satisfied that:
>
> 10.3.1 the Contract Documents, including the Contractor's Proposals, satisfy the Employer's Requirements;
> 10.3.2 the Contractor's Proposals make full allowance for all matters necessary to complete the specification and design details in accordance with the Employer's Requirements;
> 10.3.3 after taking account of any and all design carried out or to be carried out by the Employer's Design Team and/or the Contractor's Design Team, and after integrating that design with its own, the Works shall comply with the Employer's Requirements;
> 10.3.4 the Employer's Requirements and the design carried out or to be carried out by the Contractor and/or the Employer's Design Team and /or the Contractor's Design Team have been prepared in sufficient detail to allow the Contractors to confirm the Contract Sum and the Contract period."

The JCT Conditions (as amended)

244. Clause 2.1.1 of the JCT Conditions as amended provided:

> *"The Contractor shall upon and subject to the Conditions carry out and complete the Works referred to in the Employer's Requirements, the Contractor's Proposals (to which the Contract Sum Analysis is annexed), the Articles of Agreement, these Conditions and the Appendices in accordance with the aforementioned documents and for that purpose shall complete the design for the Works including the selection of any specifications for any kinds and standards of the materials and goods and workmanship to be used in the construction of the Works so far as not described or stated in the Employer's Requirements or Contractor's Proposals…"*

245. Clause 2.5.1 of the JCT Conditions as amended provided:

> ""2.5.1.1 The Contractor shall be fully responsible in all respects for the design of the Works, including all design work prepared before or after the date of this Contract, and shall Adopt any design contained in the Employer's Requirements.
>
> 2.5.1.2 The Contractor shall Adopt any design work in relation to Works which may be carried out or which may have been carried out by the Employer's Design Team, the Contractor's Design Team, Domestic Sub-Contractors or any other person employed by the Contractor at the request of the Employer.
>
> 2.5.1.3 For the avoidance of doubt, the Contractor shall remain responsible for any design work notwithstanding any comment made by the Professional Team in respect of any design reviewed by the Professional Team and (save as provided by clause 12) no such comment shall entitle the Contractor to an extension of time and/or loss and expense under clauses 25 and 26 of this Contract. Where in the Contractor's opinion the implementation of any annotation by any member of the Professional Team would require a Change to be instructed by the Employer, he shall forthwith notify the Employer prior to commencement of the relevant Works.
>
> 2.5.1.4 Without prejudice to the generality of clauses 2.5.1 to 2.5.3, the Contractor, acting as an independent architect, shall he fully responsible and liable to the Employer for all aspects of design and design development, the selection of goods and materials and the satisfaction of performance specifications or any requirement included or specifically referred to in the Contract Documents."

246. Clause 2.5.4 of the JCT Conditions as amended provided:

> *"Any references to the design which the Contractor has prepared or shall prepare or issue for the Works shall include a reference to any design which the Contractor has caused or shall cause to be prepared or issued by others, and any design relating to or for the Works forming part of the Employer's Requirements. The Contractor shall have the same liability as that set out in clauses 2.5.1.1 to 2.5.1.4 inclusive in respect of*

any defect or insufficiency in any such design forming part of the Employer's Requirements."

247. Clause 8.1.1 to 8.1.2A of the Conditions as amended provided:

"8.1.1 All materials and goods shall be of good quality, appropriate for their purpose, to the reasonable satisfaction of the Employer and in accordance with the Contractor's Proposals and/or the Employer's Requirements and any performance specification.

8.1.2 All workmanship shall be carried out in a good, proper and workmanlike manner in accordance with good building practice and to standards, if any, described in the Contractor's Proposals and/or the Employer's Requirements and in any performance specification and in accordance with the Health and Safety Plan and, to the extent that no such standards are described, workmanship shall be of a standard appropriate to the Works and to the reasonable satisfaction of the Employer.

8.1.2A Without prejudice to clauses 8.1.1 and 8.1.2 above, the Works shall be carried out in accordance with all applicable Statutory Requirements and all applicable British and relevant European Standards and Codes of Practice."

The General Specification

248. Section 33G of the General Specification provided:

"SERVICE LIFE OF COMPONENTS

1. The service life of components [i.e. actual period of time during which no excessive expenditure is required on operation, maintenance or repair of a component or construction] , as recorded in use — shall be no less than the following:

(b) Curtain Walling/Cladding Elements [Work Section H11]

Insulating Glass Units :30 years"

249. Section 34G of the General Specification provide:

"MATERIAL PREFERENCES

The Contractor shall be responsible for the final selection of materials, sizes, thicknesses, types, fixing details and associated work, all in accordance with specified standards.

> *The Contractor shall guarantee that the materials, type of construction, dimension, size and thicknesses stated in the working drawings shall satisfy the design intent and performance requirements.*
>
> *Acceptance of the Contractor's proposals by the Architect... shall not relieve the Contractor from responsibility to provide suitable materials, components and assemblies fit for purpose intended by the manufacturer and in compliance with the Design."*

250. Section 60G of the General Specification provided:

> *"SUBMITTED PROPOSALS: Following appointment, the Contractor shall be entirely responsible for achieving the completed installation, and any proposal submitted, for all components, and assemblies of the installation, shall achieve or surpass the design and performance criteria stated in this General Specification and the accompanying Trade Specification(s)/Work Section(s).*
>
> *Neither the acceptance of the design proposed by the Contractor, nor the successful testing of any prototype and/or sample and their acceptance by the Architect, shall relieve the Contractor of his responsibility for the adequacy of the work he carries out."*

251. Section 85G of the General Specification provided:

> *"DEVELOP THE DESIGN: Use specialist skill and expertise to develop the design from the drawings and specification supplied, taking into account the:*
>
> (a) Method of fabrication and installation of the products.
>
> (b) Selection of suitable materials for the purpose for which they are intended.
>
> (c) Design requirements of this General Specification and the Trade Specification(s)/Work Section(s).
>
> (d) Integration of the work(s) and/or products(s) with adjacent work by others.
>
> (e) Purpose and operation of the works."

252. Section 90G of the General Specification provided:

> *"MATERIALS AND WORKMANSHIP: Where and to the extent that materials and workmanship are not fully specified they shall be:*

(a) Suitable for the intended purpose in the works, stated in or reasonably to be inferred from the design intent drawings and other contract documents

(b) In accordance with good building practice including the relevant provisions of applicable current BSE [sic], CEN or ISO documents, whether or not these are specified in respect of a particular item.

(c) Handled, stored and incorporated into the work in accordance with the manufacturer's written recommendations.

Inform the Main Contractor/Architect where any of the foregoing conflict with each other or any specified requirements."

The Curtain Walling Specification

253. Paragraph 2.0 of the Curtain Walling Specification provided:

"This specification should be read in conjunction with the Contract Conditions, Preliminaries and A70 specification [i.e. the General Specification]"

254. Section H11/110 of the Curtain Walling Specification (in respect of External Wall System 1) provided:

"Curtain walling system type:

Unitised, structural silicone bonded via carrier frame, drained and vented via mullions

Performance criteria to comply with Design/Performance Requirements and Testing subsections. …"

255. Section H11/210 of the Curtain Walling Specification provided:

"DESIGN:

Complete the detailed design of the curtain walling and associated features shown on the preliminary design drawings to meet the requirements of this specification. Coordinate detailed design with that for all related works."

256. Section H11/440 of the Curtain Walling Specification provided:

"DESIGN LIFE

Refer to General Specification A70, clause 33G.

The facade shall be designed such that it has a life expectancy of not less than 60 years for the primary elements, which shall include all framing members, 'lashings, copings and similar weathering elements, and seals which cannot be readily inspected without dismantling the facade. All other items, which may be replaced during the life of the building will be regarded as secondary elements.

These items will include gaskets and mastic seals. Exposed finished to metal components. All of these items will have a design life of at least 30 years, with the exception of the internal blinds which shall have a design life of 15 years."

257. Section H11/742 of the Curtain Walling Specification provided:

"THERMALLY TOUGHENED GLASS:

All thermally toughened, glass shall be heat soak tested to reduce the risk of failure due to nickel sulphide inclusions (NiS). The process known as "double toughening" will not be permitted. Heat soaking shall be carried out to meet the requirements as called for within DIN 18516 Pt.4 at a temperature of 290°C +/- 10°C for a minimum of 8 hours. (or equal approved method).

The contractor shall provide the client with documentation to show that the glass has been heat soak tested and the frequency of failures during test.

The glass shall conform to BSEN 12150 in the horizontal toughening process..."

258. Section H13/620 of the Curtain Walling Specification provides:

"THERMALLY TOUGHENED GLASS Standard: To DIN 18516 Pt 4.

Toughening process: horizontal to eliminate tong marks and minimize dimensional inaccuracies.

Nickel sulfide inclusions: Heat soak toughened glass to minimise the incidence of failure in situ.

Period of heating: 8 hours.

Mean glass temperature: 290 +/- 10°C for not less than 8 hours."

259. Section M 1/910 of the Curtain Walling Specification provided:

"GENERALLY:

> *Fabricate and install curtain walling in accordance with this specification and the final detailed drawings …"*

260. It is common ground that, by an exchange of correspondence later, the obligation to heat soak treatment of the toughened glass for use on 125 OBS was varied so that the Outer Panes were to be constructed from heat soaked toughened glass to BSEN 14179, save that the time for which the glass was to be heated at 290^{o}C +/- 10^{o}C was extended from 2 hours to 4 hours.

The Technical Clarification

261. The relevant TC was as follows:

Clause	**Item**	**Comment**	**Resolution**
H11/742	General	Toughened glass will be reduced to an absolute minimum risk due to Nickel Sulphide inclusions by others.	Pisa have confirmed in their replacement guarantee that the risk of Nickel Sulphide breakage and the subsequent replacement and installation rests with them at no additional cost to the client, up to the end of the defects liability period. Pisa confirmed that 3rd party risks rest with the client after PC.