Neutral Citation Number: [2015] EWCA Civ 407

Case No: A1/2014/2078

IN THE COURT OF APPEAL (CIVIL DIVISION)
ON APPEAL FROM THE HIGH COURT OF JUSTICE
THE QUEEN'S BENCH DIVISION
TECHNOLOGY AND CONSTRUCTION COURT
THE HONOURABLE MR JUSTICE EDWARDS-STUART
HT-12-148

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 30/04/2015

Before :

LORD JUSTICE JACKSON
LORD JUSTICE PATTEN
and
LORD JUSTICE UNDERHILL

- -

Between :

MT HØJGAARD A/S	**Appellant/ Claimant**
- and -	
(1) E.ON CLIMATE AND RENEWABLES UK ROBIN RIGG EAST LIMITED	**Respondents/ Defendants**
(2) E.ON CLIMATE AND RENEWABLES UK ROBIN RIGG WEST LIMITED	

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- -

Mr David Streatfeild-James QC and **Mr Mark Chennells** (instructed by **Fenwick Elliott LLP**) for the Appellant/Claimant
Mr John Marrin QC and **Mr Paul Buckingham** (instructed by **Wragge Lawrence Graham & Co**) for the **Respondents/Defendants**

Hearing dates: 10th and 11th February 2015

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Judgment

Lord Justice Jackson:

1. This judgment is in eight parts, namely:

Part 1. Introduction

2. This is an appeal by a contractor against a finding that it warranted that the foundation structures which it designed and installed for an offshore wind farm would have a service life of 20 years. Those foundations failed shortly after completion. So if there was such a warranty, the contractor was in breach of it. There is a cross-appeal by the employer against a finding that there were no other breaches of contract by the contractor. The principal issue of law which arises is how the court should construe the somewhat diffuse documents which constituted, or were incorporated into, the 'design and build' contract in this case.

3. I shall now identify the principal protagonists in the litigation:

• The contractor is MT Højgaard A/S, to which I shall refer as "MTH".

- The employer under the contract is E.ON UK Solway Offshore Limited and E.ON UK Offshore Energy Resources Limited. Those two companies have now changed their names to E.ON Climate and Renewables UK Robin Rigg East Limited and E.ON Climate and Renewables UK Robin Rigg West Limited. I shall refer to those two companies collectively as "E.ON".

- Rambøll Danmark A/S ("Rambøll") is a company which MTH engaged to carry out design work on the project.

- Offshore Design Engineering Limited ("ODE") is a company which E.ON engaged to act as Engineer's Representative on the project.

- Det Norske Veritas ("DNV") is an independent classification and certification agency. DNV is based in Norway.

4. In this judgment I shall use the abbreviation "TCC" for Technology and Construction Court. I shall use the term "turbine" to mean a wind turbine generator. In an offshore location the turbine stands on a single pile, known as a "monopile", which is driven into the sea bed.

5. The foundations of the turbines in this case comprise two elements, namely the monopile and the transition piece. I shall explain the function of the transition piece in Part 2 below.

6. In the context of this case "axial load" means the downward load imposed by the turbine and the transition piece. "Axial capacity" means the capacity to resist axial load. I shall use the abbreviation "ULS" for ultimate limit state. That means the limit of load carrying capacity.

7. After these introductory remarks, I must now return to the facts.

Part 2. The facts

(i) Background

8. An offshore wind farm is a cluster of turbines standing on monopiles driven into the sea bed. This is a relatively new form of electricity generation. The advantages are that stronger winds are available at sea. Also there is less opposition to the structures from land owners and others. On the other hand it is more expensive to construct turbines offshore than on land. Also the technology presents some challenges.

9. One of those challenges is how to connect the bottom of the turbine tower to the top of the monopile. One form of connection is illustrated in the plan appended to this judgment. A steel cylinder, known as a transition piece, is fitted over the top of the monopile. The gap between the transition piece and the pile is filled with grout. The transition piece projects above the top of the pile. The tower which supports the electricity generator fits onto the transition piece. The grouted connection works by friction between the grout and the two steel surfaces between which it sits.

10. The first offshore wind farm which had this form of grouted connection was built in about 2002. It is known as Horns Rev 1 and stands off the coast of Denmark.

11. One issue which arises concerning grouted connections for wind turbines is whether to insert shear keys. These are small horizontal projections from the outside surface of the pile and the inside surface of the transition piece. They usually take the form of weld beads. Shear keys project into the grout and thus increase the interface shear strength of the grouted connection. There is, however, a risk. Stress lines passing between the outer and inner shear keys might cause failure of the grout.

12. At around the turn of the century the University of Aalborg carried out tests on grouted connections with and without shear keys. Those tests were concerned to simulate the overturning moment imposed by wind and waves. These forces would be much more powerful in the case of wind turbines than in the case of conventional offshore structures such as oil rigs. The conclusion drawn from the Aalborg tests was that shear keys were not necessary. The Aalborg team did not, however, test the axial capacity of grouted connections. This was probably because they assumed that the axial capacity of such connections was sufficient.

13. Following the Aalborg tests, Horns Rev 1 was built without shear keys in the grouted connections. Five other offshore wind farms were built without shear keys over the next few years. This approach was not, however, universal. Two offshore wind farms were built with shear keys in the grouted connections. These were at Barrow and Arklow Bank.

(ii) International standard J101

14. In June 2004 DNV published an international standard for the design of offshore wind turbines, entitled “DNV-OS-J101”. It is generally referred to as “J101”.

15. Section 1 of J101 sets out its objectives as follows:

> “**A200 Objectives**
>
> **201** The standard specifies general principles and guidelines for the structural design of offshore wind turbine structures.
>
> **202** The objectives of this standard are to:
>
> — provide an internationally acceptable level of safety by defining minimum requirements for structures and structural components (in combination with referenced standards, recommended practices, guidelines, etc.)
> — serve as a contractual reference document between suppliers and purchasers related to design, construction, installation and in-service inspection
> — serve as a guideline for designers, suppliers, purchasers and regulators
> — specify procedures and requirements for offshore structures subject to DNV certification
> — serve as a basis for verification of offshore wind turbine structures for which DNV is contracted to perform the verification.”

16. Paragraph 501 of section 1 states:

> "The aim of a project certification of an offshore wind farm is to assure an acceptable quality of the wind farm project. This is achieved by measuring the wind farm project against agreed standards and project specifications and by verifying that the project complies with these standards and specifications. The project certification is carried out by a third-party certification body. The successful project certification results in the issue of a project certification, which allows owners, investors, insurance companies, authorities and other interested parties to place confidence in the project and trust that the project meets the agreed standards and specifications."

17. Section 2 of J101 sets out the design principles. The approach is probabilistic, namely to achieve a very high likelihood of stability. The annual probability of failure is to be in the range of 10^{-5}–10^{-4}. Section 2 does not say that the risk of failure must be non-existent, since that is impossible.

18. Section 2 specifies four methods of design of which the second is:

> "101
>
> …
>
> — design by partial safety factor method with direct simulation of combined load effect of simultaneous load processes."

This method is sometimes referred to as "integrated analysis" and is explained in section F.

19. Paragraph F301 provides:

> "**Characteristic load effect**
>
> **301** The characteristic combined load effect S_k may be established directly from the distribution of the annual maximum combined load effect that results from a structural analysis, which is based on simultaneous application of the two or more load processes. In the case of ULS design, the characteristic combined load effect S_k shall be taken as the 98% quantile in the distribution of the annual maximum combined load effect, i.e. the combined load effect whose return period is 50 years."

In other words the risk of the characteristic combined load effect, which is to be used in design, being exceeded in practice in any given year is 2%: see table B2 in section 4.

20. Section 7 of J101 deals with the design of steel structures. Paragraph K104 of section 7 provides:

> "The design fatigue life for structural components should be based on the specified service life of the structure. If a service life is not specified, 20 years should be used."

21. Section 9 of J101 deals with the design and construction of grouted connections. Paragraph A204 of section 9 states:

> "A grouted connection can be established with or without shear keys as shown in Fig.1.
>
> **Guidance note:**
>
> Shear keys can reduce the fatigue strength of the tubular members and of the grout due to the stress concentrations around the keys. If shear keys are used in a grouted connection subjected to bending, they should be placed at the mid level of the connection in order to minimise the influence on the fatigue damage, because the maximum grout stresses from bending will develop at the top and the bottom of the grout member."

22. Section B of section 9 provides a number of parametric equations to be used in design. In particular it states that the interface shear strength due to friction may be taken as:

$$^{\tau}kf = \frac{\mu \cdot \mathrm{E}}{\mathrm{K}} \cdot \left[\frac{\delta}{Rp} \right]$$

23. Although J101 contains numerous equations, it is this one which is of particular importance in the present case. I shall therefore refer to it as "the parametric equation". In the parametric equation μ is the coefficient of friction. E is the modulus of elasticity for steel. K is the stiffness factor. δ is the height of surface irregularities. Rp is the pile outer radius.

24. There is a statement beneath the equation that δ "should be taken as 0.00037 Rp for rolled steel surfaces". As we now know, that statement is incorrect. The height of surface irregularities does not vary in proportion to the pile radius, as there described. Any designer who takes 0.00037 Rp as the value for δ will substantially overestimate the axial capacity.

25. Paragraph D101 of section 9 of J101 states:

> "**Experimental verification**
>
> If no sufficient documentation of the behaviour of a grouted connection is available, experimental verification of the behaviour must be carried out."

26. Section 12 of J101 deals with corrosion protection. The guidance note following paragraph B206 states what corrosion allowance should be made for a 20-year design life.

<u>(iii) E.ON sends out tender documents</u>

27. In the mid 2000's E.ON decided to construct two adjacent wind farms in the Solway Firth, which would be known as "Robin Rigg East" and "Robin Rigg West". I shall refer to them compendiously as "Robin Rigg wind farm" or "Robin Rigg". In May 2006 E.ON invited tenders from a number of contractors including MTH for the design, fabrication and installation of foundations for the 60 turbines which would comprise Robin Rigg wind farm. The foundations of each turbine were to comprise a monopile and a transition piece.

28. The tender documents sent to MTH included the Employer's Requirements. The relevant parts of the Employer's Requirements for present purposes are to be found in Part I, the Technical Requirements. I shall refer to this volume within the tender documents as "TR".

29. TR section 1 contains a general description of the works. Paragraph 1.6 states:

> "The Wind Farms are to be designed, constructed and operated to provide the lowest lifetime cost option capable of meeting the full requirements of this Specification. Maximum output with minimum maintenance and maximum availability to generate are the prime requirements of the scheme.
>
> …
>
> The Works, together with the interfaces detailed in Section 8, shall be designed to withstand the full range of operational and environmental conditions with minimal maintenance.
>
> The Works elements shall be designed for a minimum site specific 'design life' of twenty (20) years without major retrofits or refurbishments; all elements shall be designed to operate safely and reliably in the environmental conditions that exist on the site for at least this lifetime."

The TR contain numerous other references to the required design life of 20 years, for example in paragraph 3.2.6.

30. TR paragraph 3.1 includes the following passage:

> "It is stressed that the requirements contained in this section and the environmental conditions given are the MINIMUM requirements of the Employer to be taken into account in the design. It shall be the responsibility of the Contractor to identify any areas where the works need to be designed to any additional or more rigorous requirements or parameters."

There are other references elsewhere to the stated requirement being a minimum.

31. TR paragraph 3.1.2 requires the contractor to submit a detailed Foundation Design Basis document. The first part of paragraph 3.2.2.2 requires the contractor to prepare the detailed design of the foundations in accordance with J101, using the "integrated analysis" method. The second part of paragraph 3.2.2.2 then states:

> "The design of the foundations shall ensure a lifetime of 20 years in every aspect without planned replacement. The choice of structure, materials, corrosion protection system operation and inspection programme shall be made accordingly."

I shall refer to the first part of paragraph 3.2.2.2 as "3.2.2.2 (1)" and the second part (i.e. the passage quoted above) as "3.2.2.2 (2)".

32. TR paragraph 3.2.3.2 requires the contractor's design to accord with national and international rules, as listed. The first item in the list is stated only to be valid if formally published, which it never has been. The second item in the list, which therefore occupies the top place, is J101 (2004).

33. TR paragraph 3.2.5 requires the contractor to design and construct grouted connections in accordance with J101.

34. TR paragraph 3b.5.1 states:

> "The design of the structures addressed by this Design Basis shall ensure a lifetime of 20 years in every aspect without planned replacement. The choice of structure, materials, corrosion protection system operation and inspection programme shall be made accordingly."

35. TR paragraph 3b.5.6 states:

> "All parts of the Works, except wear parts and consumables shall be designed for a minimum service life 20 years."

36. TR paragraph 4.4.3 provides that the contractor shall obtain a Foundation Design Evaluation Conformity Statement from the Certifying Authority within six months of the commencement date. TR paragraph 10.1.1 states:

> "The Contractor shall appoint an accredited Certifying Authority (e.g. DNV – the Norwegian Veritas or GL – Germanischer Lloyd) to independently evaluate the adequacy of his foundation design."

37. TR paragraph 10.5.1 states:

> "The Contractor shall determine whether to employ shear keys within the grouted connection. If shear keys are used, the design and detailing shall take due account of their presence for both strength and fatigue design to the satisfaction of the Certifying Authority and the Engineer. If shear keys are to be omitted then the Contractor shall demonstrate with test data that the grouted connection is capable of transmitting axial loads at the grout/steel interface without dependence upon flexural (normal) contact pressures, which may not always be present, to the satisfaction of the Certifying Authority and the Engineer. Such demonstration shall also account for joint performance under different temperature conditions."

<u>(iv) Tender and acceptance</u>

38. MTH duly prepared its tender in accordance with the Employer's Requirements and J101. MTH's design provided for (i) monopiles with a diameter of just over 4 metres, (ii) transition pieces about 8 metres long, weighing approximately 120 tonnes, (iii) grouted connections without shear keys. The reason why MTH did not specify shear keys was this. On applying the parametric equation for interface shear strength due to friction set out in section 9 of J101 and taking δ as 0.00037 Rp, it appeared that the grouted connections had more than sufficient axial capacity to take the axial load.

39. MTH submitted its tender on 19th July 2006. MTH stated in answer to a specific question that shear keys would not be included. A memo from Rambøll dated 6th July 2006 ("the Rambøll memo"), which was attached to MTH's tender, explained the reasons as follows:

> "The grouted joint between pile and transition piece has an effective length of 1.5*D, i.e. 6.45m. The thickness of the grout is 75 mm. This allows for some adjustment of the inclination of the transition piece if necessary. No shear keys are included as the connection easily can transfer the axial force through friction between steel and grout."

40. In due course E.ON accepted MTH's tender. MTH duly commenced design work. On 28th November 2006 MTH and Rambøll submitted their detailed Foundation Design Basis document, as required by TR paragraph 3.1.2.

<u>(v) Contract</u>

41. On 20th December 2006 E.ON and MTH entered into a written contract under which MTH agreed to design, fabricate and install the foundations for the proposed turbines at Robin Rigg. The contract incorporated amongst much else:

Part C: List of Definitions

Part D: Conditions of contract

Part I: Technical Requirements

Part M: Volumes 2A, 2B and 3 of MTH's tender return.

42. Part C, the List of Definitions, contained the following:

"Employer's Requirements" were defined as including the Technical Requirements ("TR") which I have referred to above.

The Engineer was said to be Mr Adrian Chatterton.

The Engineer's Representative was whoever Mr Chatterton appointed, in fact ODE.

"Fit for Purpose" was defined as "fitness for purpose in accordance with, and as can properly be inferred from the Employer's Requirements".

43. Part D, the conditions of contract, included the following:

Clause 2.1 provided that any failure by the Engineer or his Representative to spot defects or mistakes by the contractor would not exempt the contractor from liability.

Clause 5.3 provided that in the event of inconsistencies, the order of precedence of the contractual documents should be as follows:

(a) the form of agreement

(b) the conditions of contact and the List of Definitions

(c) the commercial schedules and the schedule of prices, payment profile and draft programme

(d) the Employer's Requirements

(e) the annexes to the Employer's Requirements

(f) volumes 2A, 2B and 3 of the contractor's tender return.

Clause 8.1 set out the contractor's obligations as follows:

8 OBLIGATIONS OF THE CONTRACTOR

8.1 GENERAL OBLIGATIONS

The Contractor shall, in accordance with this Agreement, design, manufacture, test, deliver and install and complete the Works:

(i) with due care and diligence expected of appropriately qualified and experienced designers, engineers and constructors (as the case may require);

(ii) within the Time for Completion;

(iii) providing all necessary Contractor's Equipment, superintendence, labour and, (except as stated in the Employers Requirements) all necessary facilities therefor;

(iv) in a professional manner in accordance with modern commercial and engineering, design, project management and supervisory principles and practices and in accordance with internationally recognised standards and Good lndustry Practice;

(v) using only materials and goods which are new, unused and factory fresh and of a sound satisfactory quality and workmanship, manufactured and fabricated in accordance with internationally recognised standards, codes of practice and in accordance with Good Industry Practice;

(vi) so that each item of Plant shall, upon Completion in accordance with this Agreement, satisfy the Tests on Completion set out in this Agreement unless otherwise agreed in writing by the Employer;

…

(viii) so that the Works, when completed, comply with the requirements of this Agreement and shall comply with all Legal Requirements other than the consented construction noise limit at the onshore receptors until Taking-Over of the Works and so that no infringement of any patent, trademark, copyright or other intellectual property right of any kind, whether in the United Kingdom or elsewhere, shall result from the performance of this Agreement or the use or ownership of the Works by the Employer;

(ix) so that the Contractor shall comply at all times with all Legal Requirements and the standards of Good lndustry Practice;

(x) so that each item of Plant and the Works as a whole shall be free from defective workmanship and materials and fit for its purpose as determined in accordance with the Specification using Good Industry Practice;

> …
>
> (xv) so that the design of the Works and the Works when Completed by the Contractor shall be wholly in accordance with this Agreement and shall satisfy any performance specifications or requirements of the Employer as set out in this Agreement; and
>
> …"

44. Part I comprised the Technical Requirements ("TR") which I have referred to in paragraphs 28-29 above.

45. Part M of the contract included MTH's response to the question about shear keys and the Rambøll memo.

(vi) Subsequent events

46. MTH duly proceeded with the works. Rambøll on behalf of MTH developed the detailed design for the grouted connections, which it set out in a report dated June 2007. This detailed design did not include shear keys.

47. Pursuant to TR paragraph 10.1.1 MTH appointed DNV as the Certifying Authority. DNV evaluated and approved MTH's foundation designs. Pursuant to TR paragraph 4.4.3 DNV issued Foundation Design Evaluation Conformity Statements for the various phases of the works.

48. MTH commenced the installation of foundations in the Solway Firth in December 2007. MTH completed those works in February 2009.

49. During 2009 a serious problem came to light at Egmond aan Zee wind farm. The grouted connections did not have shear keys and they started to fail. The transition pieces started to slip down the monopiles.

50. DNV carried out an internal review during August/September 2009. They discovered that there was an error in the value given for δ to be used in the parametric equation. It was wrong by a factor of about 10. This meant that the axial capacity of the grouted connections at Horns Rev 1, Egmond aan Zee, Robin Rigg and certain other wind farms had been substantially over-estimated.

51. On 28th September 2009 DNV sent a letter to MTH and others in the industry, alerting them to the situation. DNV subsequently revised J101 to correct the error, but that revised edition of J101 is not relevant to the present case.

52. In April 2010 the grouted connections at Robin Rigg started to fail. The transition pieces began to slip down the monopiles.

53. Very sensibly E.ON and MTH put on one side the question of legal liability and set about finding a practical solution to the problem. It was agreed between the parties

that E.ON would develop a scheme of remedial works. Those remedial works were commenced in 2014 and are ongoing.

54. In order to ascertain who should bear the cost of the remedial works, the parties embarked upon the present proceedings.

Part 3. The present proceedings

55. By a claim form issued in the London TCC on 10th May 2012 MTH applied for declarations as to the cost of the remedial works and who should bear that cost. In its amended particulars of claim MTH contended that it had exercised reasonable skill and care; also it had complied with all its contractual obligations. Therefore, said MTH, it should have no liability for the cost of the remedial works.

56. E.ON in their amended defence and counterclaim alleged numerous breaches of contract on the part of MTH. E.ON counterclaimed for declarations to the effect that MTH was liable for the defective grouted connections.

57. The litigation proceeded in tandem with the development of the remedial works scheme. In due course the parties agreed the cost of the remedial works in the sum of €26.25 million, leaving the court to decide who should bear that cost.

58. The action came on for trial before Mr Justice Edwards-Stuart in November 2013. The trial lasted two weeks. The principal witness for the claimant was Mr Henrick Carstens, an engineer employed by Rambøll. Mr Carstens had designed the grouted connections at Robin Rigg. He maintained that he had complied with good industry practice and all the provisions of J101.

59. Mr Matthew Swanwick, who had been E.ON's senior project engineer, was the principal witness for the defendants. He said that in relation to the omission of shear keys he had been content to rely upon the advice of Rambøll and MTH. They both had a strong track record in the area.

60. Turning to the expert evidence, Professor Peter Schaumann gave evidence on behalf of the claimant, MTH. Dr Colin Billington gave evidence on behalf of the defendants, E.ON. In certain respects the judge found Professor Schaumann's expert evidence to be more satisfactory than that of Dr Billington.

61. The experts produced a joint statement for the assistance of the court, setting out the areas of agreement and disagreement. One matter agreed was this: if shear keys had been included in the grouted connections, there would have been sufficient axial capacity. In other words the transition pieces would not have slipped down the monopiles.

62. The judge handed down his reserved judgment on 15th April 2014. The judge held that MTH was liable for breach of contract and E.ON were entitled to the following declarations:

> "The Claimant's design of the foundations and/or grouted connections:
>
> (i) in breach of clause 8.1(x), was not fit for purpose; and

> (ii) in breach of clauses 8.1 (viii) and 8.1 (xv), was not wholly in accordance with the requirements of the Contract
>
> in that the Claimant was in breach of Clause 3.2.2.2 of the Employer's Requirements.
>
> 2. That the Problem (as referred to in the Grouted Connection Agreement) is therefore a defect and a Defect within the meaning of the Contact and a matter which has arisen as a consequence of a breach of contract by the Claimant.
>
> 3. That the slippage of the transition pieces due to a lack of axial strength is therefore a defect and a Defect within the meaning of the Contract and a matter which has arisen as a consequence of a breach of contract by the Claimant."

63. I would summarise the judge's reasoning as follows:

    i) TR paragraph 3.2.2.2 (2) required MTH to achieve a result, namely foundations with a service life of 20 years. This provision was additional to, but not inconsistent with, MTH's other less onerous obligations such as compliance with J101.

    ii) MTH was in breach of clause 8.1 of the contract conditions read in conjunction with TR paragraph 3.2.2.2 (2), because the foundations did not have a service life of 20 years.

    iii) Rambøll was not negligent in its design of the grouted connections. It was reasonable to comply with the provisions of J101 and, in particular, to adopt the stated value for δ in the parametric equation.

    iv) MTH was not in breach of a number of other specific contract terms upon which E.ON relied.

64. In reaching his conclusions on the construction of the contract the judge cited a number of English and Canadian authorities. I shall return to these in Part 5 below.

65. MTH was aggrieved by the judge's decision. Accordingly, with the leave of the judge, it appealed to the Court of Appeal.

<u>Part 4. The appeal to the Court of Appeal</u>

66. By an appellant's notice filed on 26th June 2014 MTH appealed to the Court of Appeal, essentially on the ground that the judge had erred in his construction of TR paragraph 3.2.2.2 (2) and clause 8.1 of the contract conditions.

67. By a respondent's notice filed on 9th July 2014 E.ON applied for permission to cross-appeal on the grounds that MTH had committed further breaches of contract, which the judge ought to have found proved. These were breaches of TR paragraph 10.5.1 and J101 section 9 paragraph D101.

68. On 11th August 2014, whilst sitting as vacation judge, I considered this application on the papers and granted E.ON permission to cross-appeal.

69. The appeal and cross-appeal were heard on 10th and 11th February 2015. Mr David Streatfeild-James QC, leading Mr Mark Chennells, appeared for the appellant, MTH. Mr John Marrin QC, leading Mr Paul Buckingham, appeared for the respondents, E.ON. I am grateful to counsel on both sides for the excellence of their skeleton arguments and oral advocacy.

70. Before tackling the issues raised by the appeal and cross-appeal, I must review the legal principles.

Part 5. The legal principles

71. The court is confronted in this case with contractual documents of multiple authorship, which contain much loose wording. The task of the court is to identify the precise extent of the obligations imposed upon MTH.

72. Ultimately the court must decide which party should pay the bill for repairing foundation defects in a situation where, (on the judge's findings) there has been no negligence or want of professional skill on either side. The problem arises because MTH was required to comply with J101, which contained a significant error.

73. That error led to the failure of the grouted connections. The result was that the foundations could not fulfil their intended purpose for a period of 20 years, as envisaged by a number of contractual provisions.

74. The editors of the eighth edition of Hudson's Building and Engineering Contracts (1959) addressed a related problem at page 147:

> "Sometimes, again, a contractor will expressly undertake to carry out work which will perform a certain duty or function in conformity with plans and specifications, and it turns out that the work constructed in accordance with the plans and specifications will not perform that duty or function. It would appear that generally the express obligation to construct a work capable of carrying out the duty in question overrides the obligation to comply with the plans and specifications, and the contractor will be liable for the failure of the work notwithstanding that it is carried out in accordance with the plans and specification."

75. The Supreme Court of Canada approved and applied that passage in *The Steel Company of Canada Limited v Willand Management Limited* [1966] SCR 746. In that case the contractor agreed to carry out roof works in accordance with the employer's specification and it also furnished a guarantee that the roof would be weathertight for five years. The roof failed during the five year period because one of the materials specified was unsuitable. The Supreme Court held that the contractor

was liable under the guarantee, even though it had fully complied with the specification.

76. The passage in the eighth edition of Hudson now re-appears at paragraph 3-103 of the current edition, citing *The Steel Company of Canada* as one of the supporting authorities.

77. The Court of Appeal for British Columbia has recently reached a similar decision in *Greater Vancouver Water District v North American Pipe & Steel Ltd and Moody International Ltd* [2012] BCCA 337. In that case the defendants agreed to supply water pipes to the plaintiff. The defendants agreed to comply with the specifications provided to them. They also warranted that the goods would be fit for purpose and free from any defects arising from faulty design. Unfortunately the specified coating was unsuitable and the pipes failed. The court held that the defendants were liable even though they had complied with the specifications. The court approved the following statement of principle of the trial judge:

> "The general rule is that defects caused by an owner's specification are not the responsibility of the contractor, unless the contractor expressly guarantees that the construction would be fit for a specific purpose, or a warranty can be implied by the owner's actual reliance on the contractor's skill and judgment."

78. The decisions of the Canadian appellate courts are not of course binding, but they are persuasive authority and they were relied on by the judge in this case. The passage quoted from the eighth edition of Hudson may now be cited as an authority, since the authors of that passage (but happily not the present editors of Hudson) are dead.

79. It is not unknown for construction contracts to require the contractor (a) to comply with particular specifications 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. As Mr Marrin points out, the design and build agreement in *Independent Broadcasting Authority v EMI Electronics Ltd* (1980) 14 BLR 1 was a contract of that character.

80. The question which I must address is whether the agreement negotiated between E.ON and MTH is a contract of that character. This involves applying the rules of contractual interpretation to the somewhat diffuse contract documents in the present case. I must now turn to those rules of contractual interpretation.

81. In *Chartbrook Ltd* v *Persimmon Homes Ltd* [2009] UKHL 38; [2009] 1 AC 1101 the court was called upon to construe a contract relating to the development of a building site in Wandsworth. The issue between the parties was the amount of a balancing payment which was owed by the developer to the landowner under schedule 6 to the contract. In construing the clause which defined this balancing payment, the House of

Lords (reversing the majority decision of the Court of Appeal) departed from the literal interpretation of that clause.

82. Lord Hoffmann formulated the correct approach at paragraph 14 of his speech as follows:

> "There is no dispute that the principles on which a contract (or any other instrument or utterance) should be interpreted are those summarised by the House of Lords in *Investors Compensation Scheme Ltd v West Bromwich Building Society* [1998] 1 WLR 896, 912-913. They are well known and need not be repeated. It is agreed that the question is 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. The House emphasised that "we do not easily accept that people have made linguistic mistakes, particularly in formal documents ..." but said that in some cases the context and background drove a court to the conclusion that "something must have gone wrong with the language". In such a case, the law did not require a court to attribute to the parties an intention which a reasonable person would not have understood them to have had."

This speech is a helpful re-statement of the principles which Lord Hoffmann had articulated in *Bank of Credit and Commerce International SA v Ali* [2001] UKHL 8; [2002] 1 AC 251 (an authority upon which Mr Marrin relies).

83. When there is tension between different provisions within contractual documents, the guidance given by Lord Mance in *Re Sigma Corp (in administrative receivership)* [2009] UKSC 2; [2010] 1 All ER 571 at [12] is of assistance. He said that the resolution of a construction issue is an iterative process. It involves checking each of the rival meanings against the other provisions of the document and investigating its commercial consequences. Lord Hope DP, Lord Scott and Lord Collins SCJJ agreed with the judgment of Lord Mance.

84. Lord Collins SCJ in his concurring judgment observed at [35]:

> "In complex documents of the kind in issue there are bound to be ambiguities, infelicities and inconsistencies. An over-literal interpretation of one provision without regard to the whole may distort or frustrate the commercial purpose."

Lord Hope and Lord Mance SCJJ agreed with the judgment of Lord Collins.

85. In *Rainy Sky SA v Kookmin Bank* [2011] UKSC 50; [2011] 1 WLR 2900 Lord Clarke (with whom all other members of the court agreed) helpfully re-stated the principles of construction emerging from earlier authorities: see in particular paragraphs 14 and 21-23. Lord Clarke observed that if there are two possible interpretations of a provision, the court is entitled to prefer the construction which is consistent with business common sense.

86. Let me now stand back from the authorities and formulate the legal principles which must guide the court in determining whether MTH warranted that the foundations would have a 20 year life.

87. In essence, a court seeking to construe the contract between E.ON and MTH must postulate a reasonable person (X) having all the knowledge available to those two parties. The court must consider what X would have understood clause 8.1 of the conditions and TR paragraph 3.2.2.2 (2) to mean. This is an iterative process, which involves checking each of the rival meanings against the other contractual provisions and investigating its commercial consequences. The court must accept that there are likely to be ambiguities and inconsistencies within the documents. It must not allow itself to be led astray by those ambiguities and inconsistencies. Approaching matters in that way the court must determine whether or not clause 8.1 of the contract conditions in conjunction with TR paragraph 3.2.2.2 (2) required MTH not only to comply with J101, but also to achieve a result, namely foundations with a service life of 20 years.

88. Having identified the relevant legal principles, I must now reach a decision on MTH's appeal.

Part 6. Decision on MTH's appeal

89. The starting point must be consideration of TR paragraph 3.2.2.2 (2). This is the provision which was critical to the judge's decision.

90. That paragraph undoubtedly says that the foundation design shall ensure a lifetime of 20 years. At first sight, such a provision, if incorporated into the contract, is a warranty that the foundations will function for 20 years.

91. On the other hand, all of the other provisions in the TR are directed towards a design life. If a structure has a design life of 20 years, that does not mean that inevitably it will function for 20 years, although it probably will. As noted in Part 2 above, the TR contain many references to the requirement for the foundations to have a design life of 20 years. See, for example, TR paragraphs 1.6 and 3.2.6.

92. Clause 8.1 (iv) of the contract conditions required MTH to comply with international recognised standards. J101 (2004 edition) was an internationally recognised standard at that time. TR paragraph 3.2.2.2 (1) meshes in with clause 8.1 (iv) and requires the contractor to comply with J101. Clause 3.2.3.2 places J101 at the top of the hierarchy of standards: see paragraph 32 above. J101 is a detailed standard, which is intended to lead to offshore structures with a design life of 20 years. See, for example, section 7 paragraph K104 and section 12 paragraph B206.

93. J101 is, as Mr Streatfeild-James submits, stochastic. Weather conditions at sea and the forces which will be imposed upon offshore structures cannot be predicted with certainty. The authors of J101 prescribed what needed to be done in order to create a structure which has a sufficiently high probability of functioning for 20 years. Paragraph F301 in section 2 provides a good illustration. In ULS design the designer is required to assume a characteristic combined load which is likely to occur once in 50 years. In any given year the chance of that load being imposed upon the structure is only 2%. Nevertheless this is not a matter about which there can be certainty. It is

possible, although unlikely, that that combined load effect will be exceeded in year 1, again in year 2 and so forth. The authors of J101 regarded paragraph F301 as appropriate for a structure with design life of 20 years. No-one suggests that that provision would achieve a structure with a guaranteed life of 20 years.

94. Mr Marrin draws attention to the repeated use of the word "minimum" in the TR. See, for example, paragraphs 1.6 and 3.1. This word certainly means that, insofar as MTH departs from the specification, such departure should be improvement upon rather than detraction from the contractual requirements. Nevertheless such a provision cannot convert the requirement for a design life into a requirement for a guaranteed operational life.

95. Mr Marrin also refers to the word "ensure" which appears in both paragraph 3.2.2.2 (2) and also in paragraph 3b.5.1. I accept that TR paragraph 3b.5.1 is supportive of Mr Marrin's interpretation of paragraph 3.2.2.2 (2). On the other hand, the whole scheme of the TR and J101 is pointing in the opposite direction. If the contractor was really required to produce a guaranteed operational life of 20 years, the rest of the TR and J101 (even absent any error in respect of δ) would not be the right way to set about the task.

96. I turn now to the contract conditions. Under clause 5.3 these take precedence over other contractual documents.

97. Clause 8.1 of the contract conditions sets out the contractor's obligations. As Mr Streatfeild-James points out, if the contract required an absolute warranty of quality, one would expect to see it in clause 8.1, not tucked away in the Technical Requirements. The TR are a detailed document which comes fourth in the order of precedence.

98. In fact the obligations imposed by clause 8 are the opposite of requiring an absolute warranty of quality. What they require is due care, professional skill, adherence to good industry practice, compliance with the Employer's Requirements and so forth.

99. The judge took the view that sub-paragraphs (viii), (x) and (xv) of clause 8.1 were the critical provisions. See the declaration which he granted after hearing argument following the hand down of his judgment.

100. Sub-paragraphs (viii) and (xv) of clause 8.1 require the works, when completed, to be compliant with the provisions of the contract and the Employer's Requirements (which of course include the TR). But those sub-paragraphs do not contain or require any free standing warranty or guarantee of the kind that there was in *The Steel Company of Canada Limited* or *Vancouver Water District*, two authorities on which the judge placed particular reliance.

101. Clause 8.1 (x) requires that the works as a whole shall be "fit for purpose". Those words are qualified, however, by the phrase "as determined in accordance with the Specification using Good Industry Practice".

102. The phrase "Good Industry Practice" is defined in the List of Definitions (a document which has parity with the conditions of contract in the order of precedence) as:

> "those standards, practices, methods and procedures conforming to all Legal Requirements to be performed with the exercise of skill, diligence, prudence and foresight that can ordinarily and reasonably be expected from a fully skilled contractor who is engaged in a similar type of undertaking or task in similar circumstances in a manner consistent with recognised international standards."

That obligation requires the exercise of reasonable skill and care, as well as compliance with J101. It does not require or impose any form of warranty as to the length of operational life.

103. The phrase "Fit for Purpose" is defined in the List of Definitions as "fitness for purpose in accordance with, and as can properly be inferred from, the Employer's Requirements". That definition therefore takes us back to the TR and J101.

104. A reasonable person in the position of E.ON and MTH would know that the normal standard required in the construction of offshore wind farms was compliance with J101 and that such compliance was expected, but not absolutely guaranteed, to produce a life of 20 years. If one adopts an iterative approach to the construction of TR paragraphs 3.2.2.2 (2) and 3b.5.1, it does not make sense to regard them as overriding all other provisions of the contract and converting it to one with a guarantee of 20 years life. Put another way, there is an inconsistency between TR paragraphs 3.2.2.2 (2) and 3b.5.1 on the one hand and all the other contractual provisions on the other hand. The court must not be led astray by that inconsistency.

105. In the course of argument the court pressed Mr Marrin with the question what extra steps MTH was required to take beyond compliance with J101 and the TR, in order to achieve a guaranteed operational life of 20 years. Mr Marrin parried our questions with his customary dexterity and courtesy. He said more than once that the contractor had to "go the extra mile". It is not clear to me what that "extra mile" comprised. I do not see how a contractor proceeding in accordance with J101 and the TR (excluding paragraphs 3.2.2.2 (2) and 3b.5.1) could ramp up his activities so as to achieve a guaranteed operational life of 20 years. If the contractor was given such a guarantee or a warranty, he would need to make allowance for that in his tender. The need for such allowance should have been clearly flagged up in the contract documents.

106. Let me now come to a conclusion. TR paragraphs 3.2.2.2 (2) and 3b.5.1 are inconsistent with the remainder of the TR and J101. They are too slender a thread upon which to hang a finding that MTH gave a warranty of 20 years life for the foundations. If TR paragraph 3.2.2.2 (2) and paragraph 3b.5.1 do not have that effect, then without them clause 8.1 of the conditions cannot avail E.ON. Clause 8.1 does not contain any warranty that the foundations will have a 20 year life.

107. I would therefore allow MTH's appeal. I must now turn to E.ON's cross-appeal.

<u>Part 7. Decision on E.ON's cross-appeal</u>

108. E.ON contend that MTH was in breach of TR paragraph 10.5.1 and in breach of J101 section 9 paragraph D101 ("paragraph D101"). E.ON contend that the judge erred in

holding otherwise. E.ON maintain that each of these breaches of contract, on its own, is a sufficient basis for holding MTH liable for the failure of the foundations.

109. I must now deal with these two issues separately.

(i) TR paragraph 10.5.1

110. I have set out the relevant part of TR paragraph 10.5.1 in paragraph 37 above.

111. Section 9 of J101 identified the pros and cons of using shear keys. It provided a parametric equation for calculating the axial capacity of a grouted connection without shear keys, unfortunately giving the wrong value of δ. Section 9 then explained how to calculate the (substantial) additional axial capacity which shear keys would provide.

112. In my view TR paragraph 10.5.1 meshes in neatly with section 9 of J101. This was a design and build contract, in which the contractor had to make some fundamental decisions, one of which was whether to use shear keys. In two out of the eight existing offshore wind farms shear keys were used and in the other six cases they were not used (see paragraph 13 above).

113. Section 9 of J101 told the contactor how to calculate the axial strength of grouted connections with and without shear keys. It explained the downside risk of shear keys, namely reduced fatigue strength of the tubular members and the grout. It also explained how to minimise that risk.

114. TR paragraph 10.5.1 requires the contractor to justify his decision:

i) If the contractor decides to use shear keys, then he must produce a design which will alleviate – to a sufficient extent – the risk of reduced fatigue strength. He must present this to the Certifying Authority and the Engineer. He must secure from them a statement that they are satisfied in that regard.

ii) If the contractor decides to omit shear keys, he must demonstrate "with test data" that the grouted connection has sufficient axial capacity. This demonstration must ignore the additional frictional strength which the connection will gain from bending or overturning moments when the wind is blowing.

115. Paragraph 10.5.1 makes it plain that the contractor cannot simply sit back and say that his calculation in accordance with the parametric equation proves that there will be sufficient axial capacity. The contractor is required to do more than a desk exercise.

116. It is common ground that in this case MTH did not carry out any test as envisaged by TR paragraph 10.5.1 or present any such test data to the Engineer or the Certifying Authority.

117. The judge held at [114] that the design contracted for did not include shear keys. The Rambøll memo formed part of MTH's tender and was incorporated into the contract. In those circumstances MTH was not under a duty to carry out the tests or produce the test data referred to in TR paragraph 10.5.1.

118. Mr Marrin submits that the judge fell into error. TR paragraph 10.5.1 was an obligation which survived beyond the tender stage and continued after the parties had entered into their formal contract. Mr Streatfeild-James seeks to support the judge's reasoning in paragraph 114 of the judgment.

119. I take a different view from the judge on this issue. It is perfectly true that the Rambøll memo was one of the tender documents which became incorporated into the contract. On the other hand those documents came at the bottom of the order of precedence: see clause 5.3 of the contract conditions. At the time of tender MTH's and Rambøll's design work was not complete. For example, Rambøll's detailed report on the design of grouted connections was dated June 2007 (six months post-contract). Design was a major element of the work which the contract required the contractor to carry out. The Rambøll memo of 6th July 2006 was a statement of current intention. It was not, and could not be transmuted into, a binding contractual obligation to build without shear keys.

120. Therefore TR paragraph 10.5.1 survived as a contractual obligation after 20th December 2006.

121. Mr Streatfeild-James points out that both the Engineer and DNV (as Certifying Authority) were satisfied with the design of the grouted connections. I have followed up all of the references in Mr Streatfeild-James' skeleton argument (including those not pursued at the hearing) and I accept that submission. Indeed on 26th June 2010 (after the problems had come to light) DNV issued a project certificate pursuant to J101 section 1 paragraph 501. On the other hand, no error or omission on the part of the Engineer could relieve MTH of liability for breach of contract: see clause 2.1 of the contract conditions. Nor could the approval of the Certifying Authority (an appointee of the contractor) have that effect.

122. The simple fact is that MTH did not provide the test data referred to in TR paragraph 10.5.1 and neither the Engineer nor the Certifying Authority asked for such test data. Under the contract the duty to take the initiative lay on the contractor. MTH should have carried out appropriate tests and submitted the resulting data to the Engineer and the Certifying Authority. It did not do so. The failure of the Engineer and the Certifying Authority to chase up the contractor cannot excuse that omission.

123. Mr Streatfeild-James submitted at trial that DNV and the engineer "must be taken to have been satisfied that the omission of shear keys was appropriate". The judge appears to have accepted that submission: see [111] and [114]. Mr Streatfeild-James makes the same submission to this court and relies upon the judge's finding in that regard.

124. In my view the fact that the Engineer and DNV were satisfied with MTH's calculations and design on paper is not an answer to E.ON's claim. TR paragraph 10.5.1 required the production of test data. The Engineer and the Certifying Authority were authorised to evaluate the test data, when produced. They had no authority to relieve the contractor of the obligations (a) to carry out tests and (b) to submit the resultant data.

125. The sequencing of work was a matter for the contractor. It is no answer to this claim to say that there was insufficient time to carry out the tests.

126. The next question to consider is what tests should have been carried out and what those tests would have shown.

127. There was extensive debate at trial as to what form the testing should have taken and what the results of such testing would have been. The judge held that large scale static load tests may have been appropriate, but on the balance of probabilities such tests would not have revealed the potential weakness of the connection or the problem with the value of δ: see paragraphs 142 and 144 of his judgment.

128. As requested by counsel, I have read the underlying evidence on which these findings are based, including the cross-examination of Mr Carstens, Dr Billington and Professor Schaumann. In my view the findings of fact in paragraphs 142 and 144 were open to the judge on the evidence which he heard. This court should not interfere with those findings. Furthermore, for good reason, the Court of Appeal is always slow to overturn findings of fact on technical issues made by TCC judges: see *Yorkshire Water Services v Taylor Woodrow Construction Northern Ltd* [2005] EWCA Civ 894; [2005] BLR 395 at [27].

129. I therefore conclude that MTH was in breach of TR paragraph 10.5.1, but that breach of contract has not caused any loss. Even if MTH had complied with TR paragraph 10.5.1, this would not have led to any change in design. The grouted connections would still have been constructed without shear keys and failure would have occurred in 2010.

130. In those circumstances, E.ON are entitled to recover no more than nominal damages for breach of contract. I would assess nominal damages at £5 for each of the two E.ON companies, making a total of £10.

<u>(ii) J101 section 9 paragraph D101</u>

131. I have set out paragraph D101 in paragraph 25 above. E.ON contend that MTH was in breach of that provision because "sufficient documentation" was not available and MTH did not carry out experimental verification.

132. The judge rejected that claim, principally because clause D101 was directed to DNV, the Certifying Authority, rather than MTH the design and build contractor. The judge's second reason for rejecting the claim was that there was sufficient documentation of the behaviour of the grouted connections to be used at Robin Rigg.

133. In my view paragraph D101 is directed to the designer, in this case MTH acting through Rambøll. J101 is a design code for designers to follow. If at any point the code is placing an obligation on someone other than the designer it says so in terms.

134. I accept that in this case the Certifying Authority was DNV, who drafted J101, but that need not always be the case. A number of offshore wind farms have been certified by bodies other than DNV. It seems odd that such an onerous obligation as that contained in paragraph D101 should be imposed by implication upon a body which is neither the designer nor the author of J101.

135. Dr Billington was of the view that sufficient documentation of the behaviour of the grouted connections proposed for Robin Rigg was not available. Professor Schaumann accepted that proposition in cross examination: see day 5 page 128.

136. Paragraph D101 is similar in effect to TR para 10.5.1. It required experimental justification of the design of grouted connections, even though those connections had been designed in accordance with J101.

137. As to what would have happened, if MTH or Rambøll had undertaken "experimental verification", my conclusions are the same as those set out in the preceding section of this judgment. No loss flows from MTH's breach of paragraph D101.

Part 8 Executive Summary and Conclusion

138. E.ON engaged MTH to design and construct the foundations for offshore wind turbines in accordance with an international standard known as J101. MTH did so, subject to one issue as to whether it carried out adequate testing. Unfortunately there was an error in J101, as a result of which the foundations failed. Remedial works cost €26.25 million.

139. The judge held that MTH warranted that the foundations would have a 20 year service life. He found that MTH was in breach of that warranty but not in breach of any other contractual terms.

140. MTH appeals against the finding that it was in breach of warranty. E.ON cross-appeal against the finding that MTH was not in breach of any other contractual terms.

141. In my view, the contract properly construed did not contain a warranty for 20 years service life. Therefore MTH succeeds on its appeal.

142. Turning to the cross-appeal, MTH was in breach of two contractual provisions which required testing to be carried out. However, even if MTH had carried out the required testing, that would not have revealed the foundation defects which occurred. Therefore MTH's breaches of contract did not cause any loss. In those circumstances E.ON is entitled to recover only nominal damages for breach of contract. I would assess nominal damages at £10.

143. If my Lords agree, both the appeal and the cross-appeal will be allowed. The declarations granted in favour of E.ON will be set aside. There will be substituted judgment in favour of E.ON for £10 damages.

Lord Justice Underhill:

144. I would allow MTH's appeal for the reasons given by Jackson LJ. As to E.ON's cross-appeal, I was initially attracted by Mr Streatfeild-James's contentions that MTH was not in breach of contract by failing to supply "test data" under para. 10.5.1 or documentation/verification under para. D101 of J101; but in the end I have been persuaded by Jackson LJ's reasoning on those points. I also agree with his conclusion on the issue of loss, but I should like briefly to state my reasons in my own words.

145. There was a conflict in the expert evidence about whether it was likely that large-scale static testing would have revealed the problem which arose. Dr Billington said

that it would (and was supported in this by Mr Carstens). The oral evidence of Prof Schaumann was that he was "not convinced". Mr Marrin described that position as "neutral", but if the evidence is read as a whole it is clear that that is not a fair characterisation. Prof Schaumann was expressing real doubt as to whether testing of the kind hypothesised would have revealed the problem; and he gave detailed reasons for those doubts, to which he adhered despite probing cross-examination from Mr Marrin (day 5, pp. 110ff), which it is clear from the transcript that the Judge followed with care.

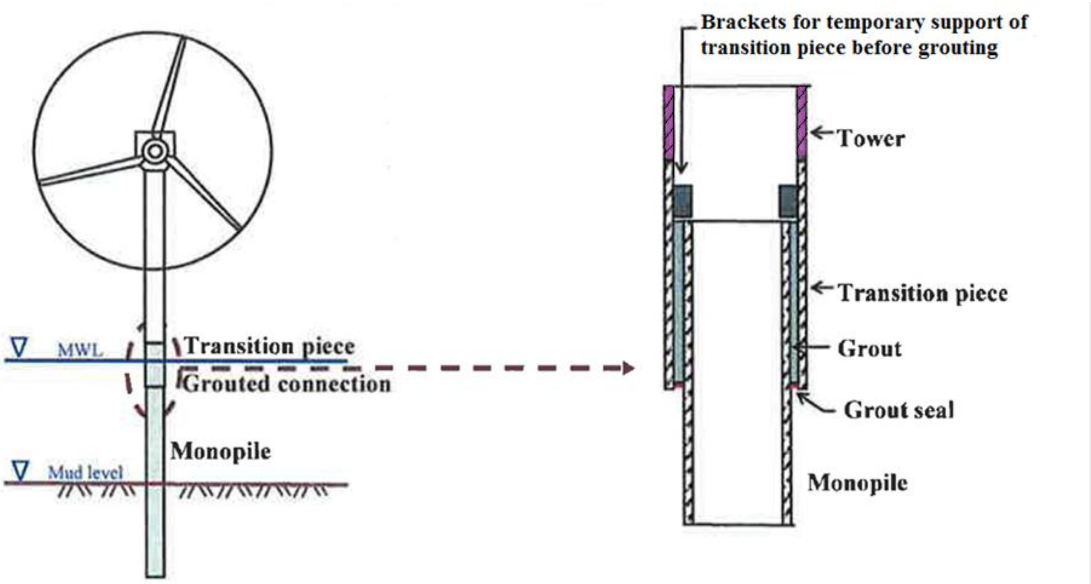
146. Prof Schaumann's evidence thus afforded a clear evidential basis for the Judge's conclusion, at para. 144, that he was not satisfied that testing would have revealed the problem. The Judge had earlier expressed the view that Prof Schaumann's expertise in this field was greater than Dr Billington's, and also that Dr Billington's evidence was "a little tainted by hindsight" (para. 104). However, Mr Marrin submitted that the particular reason which the Judge gave, at para. 143, for discounting Dr Billington's evidence – namely that he had in his evidence treated δ as a measurement rather than a best fit with the test data – could be shown to be wrong; and he also said that that criticism was never put to Dr Billington in cross-examination. He showed us the particular passage in Dr Billington's first report (para. 6.3.1.5) to which the Judge referred, which he said did not justify the Judge's reading of it. But that is not the totality of the relevant evidence. Mr Streatfeild-James showed us other passages in Dr Billington's evidence, and in particular a passage in his supplemental report (at para. 3.3) in which he said that "the actual surface calculated by Ramboll was not credible" (which is essentially the same point as he was making in his first report) and his extensive cross-examination on that passage (day 6, pp. 104-9). I do not intend to fall into the trap of re-trying the evidence on paper, particularly as the submissions that we heard on this issue were, though lucid, very short. I need say only that the passages in question and the cross-examination satisfy me that the Judge did have a rational basis for treating Dr Billington's evidence on this issue with caution, even if he may have expressed it rather over-succinctly in para. 143 of his judgment, and certainly not to treat it as so compelling as to require him to prefer it to Prof Schaumann's scepticism. The exercise of going over this evidence, both at the hearing of the appeal and since, re-affirms to me the importance of the point made by Jackson LJ that this Court should be very slow to overturn the finding of the trial judge who has had the benefit of a full immersion in the evidence and has listened with evident care to extensive cross-examination.

147. I would add that I see force in the observation made by the Judge at para. 145 of the judgment that it was always open to E.ON to carry out for the purpose of the litigation the tests which it said that MTH should have carried out at the time. If it was right that those tests would have revealed the problem, the Judge would not have had to decide the causation issue on the basis of contested expert opinion which was inevitably speculative.

Lord Justice Patten:

148. I agree with both judgments.

Appendix


MWL
Transition piece
Grouted connection
Monopile
Mud level
Brackets for temporary support of transition piece before grouting
Tower
Transition piece
Grout
Grout seal
Monopile