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<p>1 Thursday, 17 January 2019</p> <p>2 (10.20 am)</p> <p>3 MR PENNICOTT: Sir, before Mr Chow continues his questions</p> <p>4 to Mr Southward, could I just mention one administrative</p> <p>5 matter or in the nature of an administrative matter.</p> <p>6 Sir, you may or may not recall that so far as the</p> <p>7 COWI report is concerned, the government posed a number</p> <p>8 of questions in writing to COWI. Those were transmitted</p> <p>9 to COWI earlier this week, and last evening we received</p> <p>10 the answers from COWI, for which we thank them.</p> <p>11 Just so that everybody is aware of where they are</p> <p>12 now, they were circulated last evening, I am told, at</p> <p>13 about 7.40, with the daily bundle update, and they are</p> <p>14 in tab 4.5 in the expert report bundle.</p> <p>15 CHAIRMAN: Good. Thank you.</p> <p>16 May I also mention, just for public knowledge, that</p> <p>17 we've started some 20 minutes late this morning because</p> <p>18 there were administrative matters that required</p> <p>19 convening a very brief meeting of counsel. Those</p> <p>20 administrative matters have now been dealt with and we</p> <p>21 are able to proceed. Thank you.</p> <p>22 Yes, Mr Chow.</p> <p>23 MR NICHOLAS JOHAN SOUTHWARD (on former oath)</p> <p>24 MR CHOW: Good morning, Mr Chairman and Prof Hansford.</p> <p>25 Sir, before I continue with my discussion with</p>	<p>1 you have produced to assist the Commission.</p> <p>2 May I ask you to go to page 19 of your slides,</p> <p>3 regarding Atkins' calculation. Yesterday, you said</p> <p>4 that -- if I may just quote what you said -- for the</p> <p>5 purposes of the record, it's yesterday's transcript</p> <p>6 page 119, starting from line 6 -- you said:</p> <p>7 "So there are some aspects of this calculation that</p> <p>8 I don't fully understand. It's handwritten and so</p> <p>9 clearly it would be good to have a discussion with the</p> <p>10 actual engineer by himself who wrote that. But if this</p> <p>11 is the approach they have used, then this is very</p> <p>12 conservative, and it would certainly demonstrate</p> <p>13 compliance for both change 1 and for the issue of</p> <p>14 horizontal shear stresses for change 2."</p> <p>15 Mr Southward, have you had a chance to look at</p> <p>16 Prof Au's report, in particular his comment on Atkins'</p> <p>17 calculation?</p> <p>18 A. Yes, I have read his report.</p> <p>19 Q. I understand that Prof Au's criticism actually relates</p> <p>20 to four aspects of the calculations; do you recall that?</p> <p>21 A. Yes. Well, I can't remember the number, but yes. He</p> <p>22 was critical of those calculations, yes.</p> <p>23 Q. I'm not going to ask you for details, but am I right to</p> <p>24 say that basically you don't agree with Prof Au's</p> <p>25 comment; is that right?</p>
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<p>1 Mr Southward, may I just raise one point of correction?</p> <p>2 Mr Chairman, you will recall that yesterday, at one</p> <p>3 point, when the Commission was dealing with the test</p> <p>4 report, at that point I informed the Commission that the</p> <p>5 Buildings Department was notified of the date of the</p> <p>6 test and was requested to witness the test. Having</p> <p>7 taken further instructions, what I said was not entirely</p> <p>8 correct.</p> <p>9 It is still true that the test was not commissioned</p> <p>10 by the Buildings Department, but the Buildings</p> <p>11 Department was notified two to three days before the</p> <p>12 test and were invited to attend, and the Buildings</p> <p>13 Department was not supposed to validate or confirm the</p> <p>14 propriety of the testing process. So that is a more</p> <p>15 description of the position of the Buildings Department.</p> <p>16 COMMISSIONER HANSFORD: So their attendance was to witness</p> <p>17 the test?</p> <p>18 MR CHOW: That's correct.</p> <p>19 CHAIRMAN: Thank you.</p> <p>20 Cross-examination by MR CHOW (continued)</p> <p>21 MR CHOW: Good morning, Mr Southward.</p> <p>22 A. Good morning.</p> <p>23 Q. I still have some more questions for you, if I may.</p> <p>24 I would like to finish off the slides first, because</p> <p>25 yesterday I had been discussing some of the slides that</p>	<p>1 A. Well, I look at this calculation, which takes a bending</p> <p>2 moment and divides it by the lever arm between the top</p> <p>3 and the bottom of the wall section within the EWL and</p> <p>4 turns that into a shear force, and if -- and then</p> <p>5 there's a calculation for that shear force, for the</p> <p>6 capacity based on that shear force.</p> <p>7 And if that calculation is correct, then that is</p> <p>8 a very conservative approach because there can't be any</p> <p>9 more shear force. That shear force doesn't really</p> <p>10 exist, because there's solid concrete going out on one</p> <p>11 side and a third of the way out on the other side.</p> <p>12 So to consider the wall in isolation is really very</p> <p>13 conservative.</p> <p>14 Q. Right. Fine.</p> <p>15 A. So that was my opinion.</p> <p>16 Q. I think all I need to do is just to register the</p> <p>17 government's disagreement on that and I will move on;</p> <p>18 right?</p> <p>19 A. Sure.</p> <p>20 Q. Can I now refer you --</p> <p>21 COMMISSIONER HANSFORD: Sorry, Mr Chow, why does the</p> <p>22 government disagree on that point?</p> <p>23 MR CHOW: Perhaps I haven't made myself clear. What we do</p> <p>24 not necessarily agree with Mr Southward is in relation</p> <p>25 to the propriety of the way it was calculated. We rely</p>

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<p>1 on the evidence of Prof Au, the criticism raised by</p> <p>2 Prof Au in his report. It is to that extent that we</p> <p>3 cannot agree with Mr Southward.</p> <p>4 COMMISSIONER HANSFORD: Yes. Okay. Thank you.</p> <p>5 MR CHOW: Mr Southward, can I refer you to page 21 of your</p> <p>6 slide, where you talk about dowel action resistance.</p> <p>7 If I may then refer you back to yesterday's</p> <p>8 transcript at page 120, starting from line 3, where you</p> <p>9 talked about the dowel action and the slide showing the</p> <p>10 yellow block. Do you recall that?</p> <p>11 A. Yes.</p> <p>12 Q. You said:</p> <p>13 "Looking at a close-up detail of the yellow slice,</p> <p>14 we can see there are two layers of T50 vertical bars and</p> <p>15 two layers of T40 bars that cross this interface. So</p> <p>16 these are the vertical bars drawn in black. Two of</p> <p>17 those bars are T40 bars and two of those bars are T50</p> <p>18 bars.</p> <p>19 There is so much reinforcement, in fact, that the</p> <p>20 basic shear capacity of the steel bars in dowel action</p> <p>21 alone is enough to resist the tension load developed in</p> <p>22 the horizontal T40 bars at the top of the slab. So you</p> <p>23 can see the red arrow which is -- that's the tension</p> <p>24 force in the T40 bars, and that is pulling the yellow</p> <p>25 slice to the left. That pulling is basically resisted</p>	<p>1 apart. If we can see that slide, that would be the</p> <p>2 easiest.</p> <p>3 So this top -- the slide on -- the image on the top</p> <p>4 right-hand corner, you will see there's two plates, and</p> <p>5 there's a bolt that goes through the middle of those two</p> <p>6 plates.</p> <p>7 Q. Yes.</p> <p>8 A. Now, that bolt has got a rounded stud on the top and</p> <p>9 a rounded stud on the bottom. That is drawn</p> <p>10 diagrammatically, I guess, as the nut and the head of</p> <p>11 the bolt.</p> <p>12 Now, if you took the nut and the head of the bolt</p> <p>13 off, if you removed the nut and the head of the bolt,</p> <p>14 there's no anchorage to the bit of bolt that's in</p> <p>15 between the two plates.</p> <p>16 Q. Yes.</p> <p>17 A. So there's no anchorage. But I'm sure you would agree,</p> <p>18 that bolt is still working, it's still there, working in</p> <p>19 dowel action.</p> <p>20 Q. Right.</p> <p>21 A. So that's why I say that you don't need the bolt to go</p> <p>22 400 millimetres up, above the top plate. You don't need</p> <p>23 it to be anchored, because dowel action is just the</p> <p>24 action of (demonstrating with a pen) this pencil</p> <p>25 breaking, being sheared sideways.</p>
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<p>1 by the steel bars. The steel bars would have to be</p> <p>2 sheared. The steel bars would have to break in order</p> <p>3 for the yellow slice to move."</p> <p>4 Can you see that?</p> <p>5 A. Yes, I can.</p> <p>6 Q. My question is this. The T50 bars that you are talking</p> <p>7 about are the vertical bar on your slide; is that</p> <p>8 correct?</p> <p>9 A. Yes. I recall that the two bars closest -- the two</p> <p>10 vertical bars closest to the right are the T50 bars, and</p> <p>11 inside, the third bar is the T40, and then on the other</p> <p>12 face, on the left side, it's a T40 bar.</p> <p>13 Q. So the dowel bars that you refer to are the vertical</p> <p>14 black bars?</p> <p>15 A. Those are the main steel reinforcement in the diaphragm</p> <p>16 wall.</p> <p>17 Q. Do you agree that to be able to mobilise the dowel</p> <p>18 action, one has to ensure that we have adequate</p> <p>19 anchorage length, that is the portion of the vertical</p> <p>20 bar inside the yellow block?</p> <p>21 A. Not -- no. No. I don't agree with that. Would you</p> <p>22 like me to explain or --</p> <p>23 Q. Yes, please.</p> <p>24 A. Let's take Prof Yeung's slide yesterday. The very last</p> <p>25 slide was an example of a bolt with two plates moving</p>	<p>1 Q. Thank you.</p> <p>2 Then if I may go to your expert report.</p> <p>3 Mr Southward, do you know Mr John Blackwood of Atkins?</p> <p>4 CHAIRMAN: Sorry, could I just ask one question there, to go</p> <p>5 back. I appreciate the point you're making, that you've</p> <p>6 got the bolt -- it may not have the top and the bottom</p> <p>7 but it's still there, and so on a straight shear force</p> <p>8 basis it's still operating, even though it's not</p> <p>9 anchored.</p> <p>10 But would shear force operate together with some</p> <p>11 form of other dynamic, such as vertical force, which</p> <p>12 might then, because that bolt is not anchored, lift the</p> <p>13 bolt in some way or drop the bolt in some way, and then</p> <p>14 allow the shear force to operate?</p> <p>15 A. Well, okay. In the example on the screen, if you took</p> <p>16 the head of the bolt and the nut of the bolt off,</p> <p>17 there's a chance that the bolt might fall through</p> <p>18 because there's nothing below it. But in this case,</p> <p>19 there's a concrete diaphragm wall, so the bars aren't</p> <p>20 going anywhere.</p> <p>21 CHAIRMAN: Yes.</p> <p>22 A. What other complementary actions there are -- I mean,</p> <p>23 Prof McQuillan showed us in his sketch a vertical load</p> <p>24 that was clamping down on that interface. Okay, that's</p> <p>25 a representation, but there was that vertical load.</p>

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<p>1 The purposes of that sketch was to provide 2 a response or to say that that free body diagram does 3 work, and in that free body diagram there are no other 4 forces acting. 5 CHAIRMAN: Of course. I suppose my question then is, using 6 the words that you use so much better: when you are 7 looking at shear force and on a day-to-day design basis, 8 you presumably don't look at that in isolation, you look 9 at complementary forces? 10 A. That's right, so there's axial load, there's bending 11 moments and there's shear. So outside of the diaphragm 12 wall, at the junction of the wall and the slab, there 13 are bending moments, shears, axial loads. So those are 14 complementary. 15 In this particular case, in this horizontal slice, 16 we are just talking about shear, and that's the concern 17 of Prof Au, the shear stresses across that joint. 18 CHAIRMAN: Thank you. 19 MR CHOW: Mr Southward, can I just quickly clarify one more 20 thing regarding the dowel action. Am I right in 21 thinking that the dowel action actually is comprising of 22 two elements? The first element is because of the dowel 23 bar, if there is sufficient anchorage, then it will 24 generate a compressive force between the concrete 25 surface, and that compressive force will mobilise the</p>	<p>1 Q. But that is your assumption. Your assumption is that -- 2 A. Well, it's reality, that's what happens. 3 Q. -- the construction joint was properly prepared, the 4 surface of the construction joint was properly prepared 5 before casting of the new concrete. This is your 6 assumption. 7 A. Well, okay -- I was not on site at the time of the 8 preparation of the construction joint, so yes, I did not 9 see with my own eyes that the construction joint was 10 prepared in accordance with the specs. No, I didn't. 11 But I am told that it was prepared so I can only rely on 12 that. 13 Q. Later on I will take you to some of the photos, but for 14 the present purpose, so you agree -- do you agree with 15 me that this is one of the components of -- 16 A. Sorry, you will have to go back to "this is one". What 17 is "this"? You said "this is one of the components" -- 18 can you just remind me what "this" is? 19 Q. The dowel bar will mobilise the friction between the two 20 concrete surfaces to resist the shear force? 21 A. The dowel bar will mobilise the friction between the 22 two -- no, I don't understand that. 23 Q. Fine. The second component is the one you have just 24 mentioned, make use of the dowel bar and that will 25 generate bearing stress on the concrete surrounding the</p>
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<p>1 shear resistance, the friction between the concrete 2 surface. This is one element of the dowel action. Do 3 you agree or -- 4 A. Sorry, that -- 5 Q. That would be one component of the dowel action? 6 A. I don't -- can you repeat again clearly? I can't -- 7 Q. Because of the dowel bar, when it is subjected to shear 8 motion, then it will mobilise tension within the dowel 9 bar, and the reaction will be resisted by -- will exist 10 between the concrete surface that the dowel bar tries to 11 connect together? 12 A. There will be some -- are you talking about the bearing 13 stresses in the steel bar against the concrete? Is that 14 what you are referring to? 15 Q. That is the second component that I am going to. But do 16 you agree with me that the reason why dowels can help to 17 resist lateral movement, part of the action actually 18 goes to the fact that it will mobilise the friction 19 between the two concrete surfaces? 20 A. Well, there aren't two concrete surfaces. Here, it's 21 one monolithic piece of concrete. There is only this 22 artificial construction joint that has been properly 23 prepared and made ready so that, in the eyes of design, 24 it's no longer a construction joint because it's become 25 a monolithic piece of concrete.</p>	<p>1 dowel bar. 2 A. Yes. 3 Q. Have you checked whether -- you mentioned about there 4 are lots of reinforcement, T50, T40, to be able to work 5 as a dowel bar -- have you checked the stress generated 6 on the surrounding concrete, to make sure that the 7 concrete can withstand the stress? 8 A. No, I have not. 9 Q. Thank you. 10 CHAIRMAN: Do you think you should have done? That's 11 I suppose the natural question. 12 A. Well, I mean, I've had limited time. I think if one 13 really needs to do that calculation in Prof Au's way, 14 you actually need to look at a much bigger picture, 15 because looking at this little yellow slice, it's 16 physically impossible for it to move, and that is 17 actually evidenced by reality because it's not moved. 18 So if you were to do this kind of check, you would 19 look at the whole element. Maybe perhaps -- can I draw 20 and show you? 21 CHAIRMAN: Of course. 22 A. (Drawing on the whiteboard) I think, from recollection, 23 it's something like that, isn't it? The D-wall comes up 24 and then it goes like that, and there's all that 25 reinforcement there and then there's reinforcement here,</p>

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<p>1 and then we've got reinforcement that comes down there</p> <p>2 and we've got reinforcement that comes here and across</p> <p>3 here, I think.</p> <p>4 I've run out of colours, but Prof Au is saying we</p> <p>5 need to be looking at the stresses across that interface</p> <p>6 there (indicating red dotted line) in isolation, by</p> <p>7 itself, and really, that slide, it can't move. Well, it</p> <p>8 hasn't moved and it can't move. But if you did want to</p> <p>9 look at things moving, you would look at that section</p> <p>10 (drawing blue dotted line) all the way.</p> <p>11 Maybe, actually, if you could look at the slide on</p> <p>12 the screen, you see the way the structure -- in fact,</p> <p>13 I think there were two -- this slide and also the slide</p> <p>14 before shows how -- that when things are struck</p> <p>15 together, they bend, but when things aren't stuck</p> <p>16 together they bend independently.</p> <p>17 COMMISSIONER HANSFORD: That's it.</p> <p>18 A. Yes.</p> <p>19 So if when looking at this slab (indicating) and</p> <p>20 this slab is being bent downwards, then we could imagine</p> <p>21 that there was a slice all the way along here (extending</p> <p>22 the dotted red line). So imagine that line is one of</p> <p>23 the lines on the slide.</p> <p>24 So you would have to check that the whole plane</p> <p>25 didn't slide, not just one small plane.</p>	<p>1 interface, and after that there may be other cracks</p> <p>2 develop vertically on the two sides of the diaphragm</p> <p>3 wall. This is how Prof Au explains to the Commission.</p> <p>4 So Prof Au is not anticipating that the whole</p> <p>5 horizontal slice of the whole EWL slab would slide, and</p> <p>6 he considers cracks developing in that way, the concrete</p> <p>7 is considered to have failed. What is your response?</p> <p>8 A. But he sat here and said that this bit up here is going</p> <p>9 to slide and we need to check to make sure it's not</p> <p>10 sliding. That's what he said.</p> <p>11 I believe there was talk about -- well, okay,</p> <p>12 I mean, it was three days ago now -- but I think he was</p> <p>13 talking about the subsequent signs of distress, what</p> <p>14 might happen afterwards and the cracking, but that's</p> <p>15 just a guess. I can't remember.</p> <p>16 Q. All right. Let's move on then.</p> <p>17 A. Okay.</p> <p>18 Q. Mr Southward, just now I've asked whether you know</p> <p>19 Mr John Blackwood of Atkins.</p> <p>20 A. I have met him maybe once or twice. I think maybe five</p> <p>21 or six years ago I was on the Association of Consulting</p> <p>22 Engineers council and I can't remember whether</p> <p>23 Mr Blackwood was a member there or not. But I met him</p> <p>24 a couple of times, but not more than that.</p> <p>25 Q. All right. Don't worry about it.</p>
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<p>1 Does that make sense?</p> <p>2 CHAIRMAN: Yes, it does.</p> <p>3 COMMISSIONER HANSFORD: Two supplementary questions,</p> <p>4 Mr Southward.</p> <p>5 Firstly, is that something that could be done with</p> <p>6 finite element analysis?</p> <p>7 A. Yes, I'm sure. Yes. I mean, if you did a finite</p> <p>8 element analysis of this thing, you would see exactly</p> <p>9 where all the stresses went and the flow of shears and</p> <p>10 everything.</p> <p>11 COMMISSIONER HANSFORD: The second question is: do you think</p> <p>12 that's necessary?</p> <p>13 A. Not really, no.</p> <p>14 COMMISSIONER HANSFORD: Thank you.</p> <p>15 MR CHOW: Mr Southward, in fact this very point has been</p> <p>16 raised by Mr Shieh with Prof Au, and Prof Au has</p> <p>17 explained how the concrete failed under --</p> <p>18 A. Sorry, which point?</p> <p>19 Q. About the whole slice has to move.</p> <p>20 A. Yes, he --</p> <p>21 Q. Can I finish my question first, then you will have</p> <p>22 a chance to respond.</p> <p>23 And Prof Au explained to the Commission that when</p> <p>24 the concrete within the connection starts to fail</p> <p>25 because of the shear and cracks will develop at the new</p>	<p>1 The reason why I ask is because Mr Blackwood gave</p> <p>2 evidence to this Commission, and from Mr Blackwood's</p> <p>3 witness statement, I understand he is also a very</p> <p>4 experienced engineer. He is a director of Atkins.</p> <p>5 Now, when it comes to the question of whether the</p> <p>6 second change needs to get prior consultation with BD,</p> <p>7 he said in paragraph 98 of his statement at bundle J,</p> <p>8 page 75:</p> <p>9 "This question refers to procedures regarding BD</p> <p>10 submissions and is not my personal area of expertise.</p> <p>11 However, having consulted RSEs ..."</p> <p>12 "RSE", as far as I know, stands for registered</p> <p>13 structural engineer under the Buildings Ordinance.</p> <p>14 "... of Atkins with relevant experience, I am able</p> <p>15 to make the following observations ..."</p> <p>16 Now, you explained to this Commission yesterday your</p> <p>17 past experience. The past 25 years you have worked in</p> <p>18 Hong Kong on many infrastructure projects; do you recall</p> <p>19 that?</p> <p>20 A. Yes.</p> <p>21 Q. Am I right in thinking that those infrastructure</p> <p>22 projects mostly were not governed by the Buildings</p> <p>23 Ordinance in Hong Kong?</p> <p>24 A. A decent percentage have been highway infrastructure</p> <p>25 projects.</p>

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1 Q. And they are not governed by the Buildings Ordinance?
 2 A. Yes, highway infrastructure projects are exempt. They
 3 are not governed, yes.
 4 Q. Without disrespect, my instructions are that you are not
 5 an authorised person in Hong Kong.
 6 A. That is correct, I'm not an AP and I'm not --
 7 Q. You are not a registered structural engineer in
 8 Hong Kong either?
 9 A. That is correct.
 10 Q. So you may not claim any expertise in dealing with
 11 design submission with the Buildings Department, getting
 12 approval or the operation of the practice notes issued
 13 to the AP and RSE; am I right?
 14 A. Certainly, we have done work on Buildings Department
 15 projects. So we have done that -- over the past so many
 16 years, we've certainly done work on Buildings Department
 17 projects.
 18 But yes, I'm not a RSE, so, you know, you are
 19 correct there.
 20 Q. When you say "we" you mean your company?
 21 A. Yes.
 22 Q. But I'm talking about you yourself. Do you claim any
 23 expertise in this area?
 24 A. I'm a project director of all our projects and I see
 25 everything that goes on. So, for example, we are

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1 working on a project at the moment which will be
 2 submitted to BD at some point and, you know, I'm
 3 involved in the review of those documents.
 4 Q. So you said you have the expertise, right; is that your
 5 answer?
 6 A. No, I'm just saying that I have experience of working on
 7 BD projects, but I am not a registered structural
 8 engineer.
 9 Q. There is a registered structural engineer from Atkins,
 10 a Mr Sung, S-U-N-G, informing the Commission that as far
 11 as he was concerned, as an RSE, the diaphragm wall in
 12 question was a foundation, and therefore he made it very
 13 clear PNAP ADM-19 does not apply. Do you agree with
 14 him?
 15 A. Well, we are getting into -- what do you call it? We
 16 are getting into areas of process.
 17 I was asked to look at whether the structure --
 18 whether the joint that the connection -- at the top
 19 would classify as a foundation. So, in my report,
 20 I gave my engineering response to that, and then
 21 I looked at the documents to see whether that
 22 engineering response could in any way be backed up by
 23 what was written.
 24 I mean -- okay, carry on.
 25 CHAIRMAN: I think that's one of the reasons, if I may step

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1 in, why we are not going to involve ourselves in a legal
 2 determination of what constitutes a foundation in
 3 Hong Kong, according to the various documents that
 4 relate to Hong Kong but may not relate to other
 5 jurisdictions.
 6 So as I understand, Mr Southward, you are saying
 7 your approach was an engineer's approach to it?
 8 A. Yes.
 9 CHAIRMAN: Not a quasi-legal or legal approach?
 10 A. That's why I quoted from an engineering textbook, to
 11 give some weight to my statement.
 12 CHAIRMAN: All right. Yes. And your expertise that you've
 13 put forward today, and in terms of which you are giving
 14 evidence, is as a design consultant?
 15 A. Yes.
 16 CHAIRMAN: Looking at the overall safety of the structures,
 17 because that's the type of work you've been doing --
 18 A. Yes.
 19 CHAIRMAN: -- on complex structures over an extended period
 20 of time?
 21 A. Yes.
 22 CHAIRMAN: So not purely as a structural engineer? So you
 23 are not giving evidence purely as -- you are giving
 24 evidence on a broader basis of design and safety, which
 25 takes in all these various issues?

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1 A. Yes, but the structural engineering aspect is key to the
 2 safety.
 3 CHAIRMAN: Okay.
 4 A. So that's the main bit.
 5 CHAIRMAN: And that's what you do all the time?
 6 A. That's what I do every day, yes.
 7 COMMISSIONER HANSFORD: Can I just ask a question here,
 8 Mr Southward, because I fear there may be a confusion.
 9 You are a structural engineer and a qualified structural
 10 engineer, it's just that you are not an RSE,
 11 a registered structural engineer?
 12 A. I'm not a registered structural engineer in the
 13 Hong Kong BD Buildings Ordinance parlance.
 14 CHAIRMAN: That I didn't understand. Thank you very much.
 15 A. I'm a civil engineer.
 16 COMMISSIONER HANSFORD: This is a very important
 17 distinction.
 18 A. Yes. I understand.
 19 COMMISSIONER HANSFORD: That's why I wanted to be clear
 20 about that. Thank you.
 21 MR CHOW: Just to make sure, you are not a qualified
 22 structural engineer?
 23 A. I'm a qualified civil engineer, so I work on civil
 24 engineering infrastructure projects. So I'm a qualified
 25 civil engineer.

Page 21	1 Q. So not a structural engineer? 2 A. I'm not a member of the Institution of Structural 3 Engineers in the UK. So it depends how you say that. 4 I practise civil engineering -- sorry, strike that. 5 I practise structural engineering and I am qualified in 6 that because I am a member of the Institution of Civil 7 Engineers and the Hong Kong -- 8 COMMISSIONER HANSFORD: We may be getting into quite 9 an interesting area here -- interesting for you and I, 10 Mr Southward, because of course civil engineering 11 embraces structural engineering -- 12 A. Absolutely. 13 COMMISSIONER HANSFORD: -- but the Institution of Structural 14 Engineers -- and we will be hearing from Dr Glover and 15 from Prof McQuillan later in these proceedings -- is 16 a specialist branch that focuses on structural 17 engineering. Am I correct? 18 A. Yes. So -- I mean, in my very basic -- a basic way of 19 putting -- I don't design high-rise buildings, you know, 20 the Nina Tower -- that kind of structure, that is 21 structural engineering, whereas this kind of structure 22 here that we're talking about here is civil engineering. 23 COMMISSIONER HANSFORD: But nevertheless, as I read from 24 your CV, you were a director of Benaim and other 25 reputable structural engineering companies?	Page 23
Page 22	1 A. Indeed, yes. I mean, Tony Gee is a civil and structural 2 and geotechnical consultant. 3 COMMISSIONER HANSFORD: Thank you. 4 MR CHOW: Mr Southward, on the issue of whether prior 5 consultation with BD for the second change is required 6 prior to the implementation, I have read your report, in 7 fact the majority part of your report goes to that 8 issue. Am I right to summarise as follows: your 9 position is, first of all, PNAP-19 does not apply, but 10 if it applies then your view is, first of all, the 11 connection that is in question is part of the 12 superstructure and therefore, under PNAP ADM-19, it is 13 exempted because the changes is minor? Is that a fair 14 summary of your view? 15 A. More or less, yes. 16 Q. Thank you. 17 Just now you mentioned -- we had an exchange on the 18 question of whether the construction joint, the 19 interface between the new concrete and the old concrete 20 of the diaphragm wall has been properly prepared. Your 21 assumption is in terms of quality, there's no problem, 22 so it is a monolithic -- after the new concrete is cast, 23 it is a monolithic part of the whole structure; right? 24 A. If the construction joint is properly prepared, then 25 yes, that's correct.	Page 24
	1 Q. We've had some factual evidence from Mr Jason Poon, 2 telling the Commission that first of all the interface 3 was not horizontal, so it's different from what people 4 assume today, and we have some photos I would like you 5 to look at to see whether you agree or not. Bundle B19, 6 page 25581, please. 7 You see the part which is clouded in red? 8 A. Yes. It's not a very good photo. Maybe if you could 9 zoom in a bit. 10 Q. I think that can be done, yes. Actually, Mr Jason Poon 11 described something like an A shape. Accidentally, 12 I found this photo, so -- obviously it is not 13 horizontal; do you agree? 14 A. Yes. If that's the construction joint, then yes, it's 15 not horizontal. It looks -- but then is this actually 16 what it was before they -- I mean, there's no slab here; 17 right? In fact, which side of this is the slab and 18 which side of this is the OTE? 19 MR PENNICOTT: What's the date of the photo? 20 MR CHOW: Honestly, I can't help you, because this is 21 a photo produced by the MTR and the annotation is by MTR 22 as well, "Breaking out top of diaphragm wall and top 23 couplers removed". 24 COMMISSIONER HANSFORD: Mr Chow, this is one of the issues 25 with photographs, isn't it? They are snapshots in time.	

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1 A. So who knows what --

2 MR CHOW: I hear what you say. I show you the photo.

3 There's some factual evidence saying that the interface

4 was prepared in an A shape, and I found this among the

5 photos produced by MTRC, to be fair to you --

6 COMMISSIONER HANSFORD: I think this shows us that at some

7 point in time, it was an A shape.

8 MR CHOW: Yes, that is a possibility.

9 CHAIRMAN: I don't even see that, I'm afraid.

10 MR CHOW: Perhaps for the benefit of the Chairman, we can

11 blow up the central part of the photo which is clouded.

12 CHAIRMAN: Oh, you mean the bit in the middle? Thank you.

13 MR CHOW: Yes.

14 A. You can't actually see it though. The quality is not

15 very good.

16 Q. If I may ask you to look at another photo in the same

17 bundle, 25587.

18 CHAIRMAN: Again, I don't wish to belabour matters, but as

19 Prof Hansford has said it's a shot of a moment in time.

20 How do we know that the work on that particular piece of

21 structure was complete?

22 MR CHOW: Mr Chairman, the next photo that I would invite

23 Mr Southward to look at will not have this problem.

24 CHAIRMAN: All right.

25 MR CHOW: Because the next photo shows that the

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1 reinforcement is almost completed, and we can see,

2 again, in the area which is clouded, it seems to suggest

3 that it is part of the top of the diaphragm wall. We

4 see horizontal reinforcement had been fixed, and

5 honestly, I'm not an expert, but my question for

6 Mr Southward is: the bit in between the two lines of

7 vertical blue reinforcement, would it be the concrete

8 surface, after hacking off?

9 A. That looks to be the concrete, yes.

10 Q. Would this appear to you not to have been roughened,

11 aggregate had not been exposed?

12 A. Well, it looks quite rough to me. Clearly, you can't

13 measure from the photograph -- I don't know whether the

14 quality of the photograph is good enough to zoom in --

15 is it? You can't really see anything there.

16 Q. Thank you. So I will move on.

17 CHAIRMAN: Sorry, is what's being suggested here -- and this

18 is a new matter to me -- I'm well aware of Mr Jason

19 Poon's observations, and there was some time spent on

20 it, that it was sort of A-shaped, in a way, when it was

21 cut down.

22 But I think what concerns me now is the broader

23 issue, which Prof Hansford has just raised, which is

24 that if this cutting down was not properly prepared, so

25 that it would be structurally safe, then what on earth

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1 is anybody doing pouring concrete on it? I mean, that

2 strikes me as another issue entirely.

3 But we will come to that.

4 MR CHOW: I'm afraid I am not able to assist on that.

5 If I may then move on. Mr Southward --

6 CHAIRMAN: Sorry, if I can -- I put this out as a statement,

7 I don't make it as a question, but it seems to me that

8 by and large, unless you've got compelling evidence

9 otherwise, fairly obvious structural matters like that,

10 which are being put into preparation so that they are

11 part of a larger structure with concrete pours, one must

12 assume regularity, unless there's good reason not to,

13 because otherwise we are going to be looking at every

14 last little tiny bit of this structure.

15 COMMISSIONER HANSFORD: I think we are also assisted by the

16 hold point and the inspections, the pre-pour

17 inspections, or we should be. So they are designed to

18 ensure, as I understand it, that concrete pours are

19 ready before the concrete is poured.

20 Now, I don't recall evidence to say that such hold

21 points had been missed.

22 CHAIRMAN: And also, with respect, and in support of

23 Mr Jason Poon, Mr Jason Poon, to my understanding -- and

24 I'm open to correction -- merely said that he observed

25 that some of the work being done resulted not in

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1 an entirely horizontal cut but left a sort of A shape.

2 And he didn't say that was how it remained and that was

3 how it was poured upon. He merely spoke about the

4 quality of work that he saw in passing, so to speak.

5 Do you see the point I make? Because, of course, if

6 he had have said, "And that was what I was faced with

7 when I had to pour the concrete", then, as

8 a professional man, no doubt, running his own operation

9 and with responsibility to ensure that it operated

10 properly, he would have been obliged, because he was now

11 the one responsible, to say, "This is not a properly

12 prepared surface", and I don't recall him ever saying

13 anything like that.

14 MR CHOW: Not that I'm aware of either, sir.

15 CHAIRMAN: No.

16 MR CHOW: The reason why I need to show or bring to the

17 attention of the Commission these photos is because

18 other experts make the point that it is important to

19 ensure that the interface is properly prepared,

20 aggregate are exposed, to ensure that after the casting

21 it will become a monolithic part of the whole structure.

22 And when I noticed this photo, given the duty of the

23 Commission, I am duty-bound to at least bring to the

24 attention of the Commission.

25 CHAIRMAN: No, it's not a criticism. This type of debate or

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1 interchange between the counsel and the Commission is
 2 quite proper and assists. But what we are saying,
 3 I think, is that Mr Jason Poon did not say, "I poured
 4 concrete in accordance with my contract on top of
 5 an ill-prepared surface." He did not say that. He
 6 spoke about -- to use French, which I'm not supposed to
 7 do, I suppose, in courts today -- he spoke about what he
 8 saw en passant. That's all he did.
 9 I think there's been no other suggestion that this
 10 was wrong. I'm happy for a hypothetical question to be
 11 put, that "What would be the case if it wasn't
 12 prepared?" but I'm not happy to now have another
 13 factual issue, which nobody has touched upon in several
 14 weeks of this Inquiry, now falling for determination,
 15 because I think so far everybody accepts that whatever
 16 the work may have been in passing, at the end of the day
 17 nobody suggests that it wasn't properly prepared.
 18 COMMISSIONER HANSFORD: But it would be interesting to know
 19 what would be the case if it were not properly prepared,
 20 so we might proceed on that basis, if it suits you.
 21 MR CHOW: Yes. Thank you.
 22 Mr Southward, may I ask, if the interface between
 23 the new and old concrete had not been properly prepared,
 24 would it have any effect on your view?
 25 A. Can you define what you mean by "properly prepared"?

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1 Q. The aggregate was not properly exposed, surface was not
 2 clean, for example.
 3 A. There is a specification requirement for preparing
 4 a construction joint, which means removing the latent,
 5 which is the stuff that floats to the surface of
 6 a construction joint, and then ensuring that the
 7 amplitude of the exposed stones above the grout part of
 8 the concrete is at least whatever the number is.
 9 I can't remember. 6 millimetres, maybe? I can't
 10 remember.
 11 So there is that specification, the requirement for
 12 preparing a construction joint.
 13 But this photograph does raise one point. Yes, we
 14 don't know what it is, but another part that you
 15 mentioned about construction joints is it being
 16 horizontal, and really whether it's horizontal or not,
 17 that doesn't really matter.
 18 If I could draw, I could explain -- can I draw?
 19 Q. Yes. That would be of assistance to the Commission.
 20 A. So a concrete wall (drawing red vertical lines) and
 21 rebar (drawing blue vertical lines), and if the
 22 construction joint had been prepared in an A shape,
 23 then, you know, you would get -- you would see that
 24 (drawing a squiggly red line); right?
 25 COMMISSIONER HANSFORD: That's right.

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1 A. The question about properly preparing a construction
 2 joint -- this concrete was originally up here (drawing
 3 red line at the top), way above the top of the final
 4 level, and then it was broken down.
 5 So in the breaking down, you use a big machine to do
 6 the top bit and then you go into small, hand-held
 7 breakers, and in doing that, that is going to guarantee
 8 that the finish of the concrete is going to be properly
 9 prepared, because you are basically hammering out the
 10 bits of the concrete. So you are going to get a rough
 11 finish.
 12 So I don't have any doubt, because they were up here
 13 and they went down here (indicating), I don't have any
 14 doubt that the surface would have been properly
 15 prepared.
 16 The question about the profile -- we talked about
 17 dowel action earlier, but if we got this slab (drawing
 18 a horizontal red line), and we got Prof Au's free body
 19 slice, which was this slice here (drawing a red box),
 20 and he doesn't want that slice to move sideways -- well,
 21 now we've got a shear key there (indicating), inside,
 22 that is actually stopping the body from moving
 23 regardless of the reinforcement.
 24 So, okay, we don't know whether it was done that
 25 way, but if it had been done that way, that would

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1 actually be better than it being a flat surface.
 2 COMMISSIONER HANSFORD: Right. But it would be the case
 3 that it would complicate the analysis of the free slice?
 4 A. It wouldn't make any difference to the analysis --
 5 COMMISSIONER HANSFORD: Would it not?
 6 A. -- really, because from the perspective of design, once
 7 the construction joint is prepared properly and the
 8 concrete is poured, it becomes a solid, monolithic piece
 9 of concrete.
 10 COMMISSIONER HANSFORD: Sorry, I meant -- what's it
 11 called -- the free position analysis that Prof Au was
 12 referring to, the free block.
 13 A. The free body?
 14 COMMISSIONER HANSFORD: The free body.
 15 A. You no longer have a free body that shape (drawing
 16 a blue square), you have a free body that shape (drawing
 17 a square with an A shape at the bottom).
 18 COMMISSIONER HANSFORD: That's why I was wondering whether
 19 it would complicate the analysis.
 20 A. There would be a resisting force here (drawing blue
 21 arrows), so that when you are pushing this way you've
 22 got to shear off the A, as well as the reinforcement.
 23 COMMISSIONER HANSFORD: So it would improve the situation?
 24 A. So it would improve the situation.
 25 COMMISSIONER HANSFORD: I'm sure nobody is advocating

Page 33	1 A-shaped construction joints. 2 A. I don't know. I don't know. 3 MR CHOW: Mr Southward, I would like to move on to the next 4 topic. Earlier, you mentioned about the textbook that 5 you referred to, the foundation analysis. Do you recall 6 that, Foundation Analysis and Design? 7 A. Yes. 8 Q. In support of your view that the connection in question 9 should be treated as part of the superstructure. Do you 10 recall that? 11 A. Yes. 12 Q. But you have not -- if I am correct, you have not 13 provided copies of that textbook, have you? 14 A. No, I didn't realise I was supposed to, I'm sorry. They 15 are expensive! Ignore me. 16 Q. I have managed to get somebody providing support to me 17 to download the relevant part of that textbook, 18 apparently free of charge, from the internet. If I may 19 perhaps distribute. (Handed). 20 COMMISSIONER HANSFORD: Which textbook is this? 21 MR CHOW: This is Foundation Analysis and Design referred to 22 by Mr Southward in paragraph -- 23 A. Joseph Bowles? 24 Q. -- 14.2, page 40 of Mr Southward's report. 25 COMMISSIONER HANSFORD: Thank you.
Page 35	1 The term superstructure is commonly used to describe 2 the engineered part of the system bringing load to the 3 foundation, or substructure." 4 So these are the two sentences that you quote in 5 your report to support your view. However, the book 6 does not stop here. If you turn over the page to 7 page 3, basically, in section 1-3, it is where this book 8 tells us how to classify and what kind of structures 9 should be considered as foundation. Section 1-3: 10 "Foundations may be classified based on where the 11 load is carried by the ground, producing: 12 Shallow foundations -- termed bases, footings, 13 spread footings, or mats. The depth is generally D/B 14 less than 1 ..." 15 Meaning the depth against the width of the 16 foundation. If it is less than or close to 1, it is 17 considered to be a shallow foundation. Then: 18 "Deep foundations -- piles, drilled piers, or 19 drilled caissons. Lp/B is greater or equal to 4 ..." 20 Then the next paragraph: 21 "Figure 1-1 illustrates general cases of the three 22 basic foundation types considered in this text and 23 provides some definition commonly used in this type of 24 work. Because all the definitions and symbols shown 25 will be used throughout the text, the reader should give
Page 34	1 MR CHOW: You relied on this textbook in support of your 2 argument that the connection we are looking at should be 3 treated as superstructure. 4 If I may refer you to the relevant part. The part 5 that you have quoted actually can be found right in the 6 first paragraph of the book, chapter 1, the first 7 paragraph of chapter 1 of the book, where it says: 8 "All engineered construction resting on the earth 9 must be carried by some kind of interfacing element 10 called a foundation." 11 And under footnote 1 it makes a point that: 12 "This is also sometimes called the substructure." 13 So according to this book, "foundation"/"structure" 14 are interchangeable. 15 Then is the statement that you relied on and quoted 16 in your report: 17 "The foundation is the part of an engineered system 18 that transmits to, and into, the underlying soil or rock 19 the loads supported by the foundation and its 20 self-weight." 21 And it goes on to say: 22 "The resulting soil stresses -- except at the ground 23 surface -- are in addition to those presently existing 24 in the earth mass from its self-weight and geological 25 history.
Page 36	1 this figure careful study." 2 Figure 1-1 is on the next page. You see on the next 3 page we have three types of structures, all considered 4 to be foundation: (a) is the spread foundation that we 5 have just looked at, (b) is the pile foundation, and (c) 6 is the retaining structure. 7 Now, do you agree with me that the part of the 8 diaphragm wall between the EWL slab and NSL slab is 9 a retaining structure? 10 A. It is a retaining structure, yes. 11 Q. If I may just complete the relevant part that I intended 12 to show to you. Page 5, the third paragraph from the 13 top, starting with "Any structure"; do you see that? 14 A. Yes, I see it. 15 Q. "Any structure used to retain soil or other material 16 (see figure 1-1(c) [the one we have just looked at]) in 17 a geometric shape other than that naturally occurring 18 under the influence of gravity is a retaining structure. 19 Retaining structures may be constructed of a large 20 number of materials including geotextiles, wood and 21 metal sheeting, plain or reinforced concrete, reinforced 22 earth, precast concrete elements, closely spaced 23 pilings ..." 24 Do you agree with me that the diaphragm wall that we 25 have with interlocking can be considered -- if we want

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1 to refer to this paragraph, actually it's akin to
 2 a closely spaced piling to resist -- to retain the soil
 3 on one side?
 4 A. Well, closely spaced piling refers to things like
 5 contiguous bored pile walls, which is not the diaphragm
 6 wall.
 7 Q. Of course, but what I'm saying is how it works, the
 8 diaphragm wall that we use in this project is akin to if
 9 we want to somehow relate to the closely spaced piling
 10 or any one type of structure here, the closely spaced
 11 piling would be the appropriate reference; right?
 12 A. Well, I mean, you are just looking at the words. The
 13 words say "closely spaced piling", they don't say
 14 "diaphragm wall". And on the issue of retaining walls
 15 and diaphragm walls -- retaining walls and foundations,
 16 in Hong Kong they are two very distinct elements.
 17 There is a code of practice for design of
 18 foundations, and there is also a separate document which
 19 is a code of practice for design of retaining walls. So
 20 they are separate.
 21 Q. All right. Looking at -- we have now looked at the
 22 relevant part of the textbook that you relied on. Do
 23 you agree with me that the connection we are interested
 24 in between the EWL slab and the diaphragm wall should
 25 not be treated, according to the textbook, as part of

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1 the superstructure?
 2 A. Well, I think it is part of the superstructure because
 3 it is -- looking at the first page, a superstructure "is
 4 commonly used to describe the engineered part of the
 5 system bringing load to the foundation". So the station
 6 box structure, that is an engineered structural system
 7 that is supported on diaphragm walls below.
 8 But I say this just from an engineering perspective.
 9 Please understand me.
 10 CHAIRMAN: All right. Could I ask you this then, because
 11 I've already made clear that we're not going to come to
 12 a decision legally whether in Hong Kong these
 13 constituted whatever they constituted, and if we were
 14 going to I would demand a good deal of authority, legal
 15 authority, before I was going to make that decision.
 16 But perhaps more important is the issue of -- if you're
 17 working towards a common goal, namely the building of
 18 a structure, and you know that that process involves
 19 oversight by a building department, are there occasions
 20 when, even though you may be of one view, you feel
 21 nevertheless you should consult with that oversight
 22 body, namely a building department?
 23 I mean, do you do that in your daily work? Do you
 24 say, "Well, I don't think we need to, but I think we
 25 should"?

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1 A. No. I mean, it doesn't work like that. You can't just
 2 ring up and say, "Can you help me here?" You know,
 3 you've got to make formal submissions.
 4 CHAIRMAN: Okay. Good.
 5 A. You do the work, you read the documents first to make
 6 sure you're fulfilling the criteria. You do the work,
 7 you prepare the submissions, and then they are
 8 submitted, and then there's a review period, which takes
 9 a while. So you don't have -- as far as I know, there's
 10 no facility for, "Can I have some advice here, please"
 11 on this.
 12 CHAIRMAN: I'm not talking about a helpline, as such --
 13 I don't mean that facetiously -- but I'm wondering if
 14 you can write in, formally, to the Buildings Department
 15 and say, "We intend to do this, we see it not as
 16 a design change, but before proceeding can you give us
 17 the okay", or will you then get a request to formalise
 18 it?
 19 A. I don't know because I've not been in that situation,
 20 sir.
 21 CHAIRMAN: All right. So for you, if ever there's going to
 22 be a change, because of the formalities of the process,
 23 you and those who work with you will make a decision as
 24 to what it is, whether you need to consult with the
 25 Buildings Department or not, and then you will proceed,

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1 if you feel you should consult, with a formal
 2 application?
 3 A. Yes, but this is to do with a change on site.
 4 CHAIRMAN: Yes.
 5 A. In this instance, it's a change on site. I'm working in
 6 a design office, so my day-to-day working -- in the
 7 design office, we are not really in the same situation
 8 as the change on site.
 9 CHAIRMAN: Okay. I'm with you. Okay. Thank you.
 10 MR CHOW: Mr Southward, there is evidence from Atkins --
 11 well, actually, you recall you have looked at the design
 12 report prepared by Atkins, 4B3, TWD-4B3, the
 13 temporary --
 14 A. I've seen so many reports. I haven't memorised their
 15 numbers.
 16 Q. Perhaps I will cut it short then. In one of those
 17 reports prepared by Atkins, Atkins put down clearly that
 18 the diaphragm wall was designed as a foundation system;
 19 right?
 20 A. I really can't remember --
 21 Q. Perhaps I can take you to that particular part.
 22 B12/9012.
 23 CHAIRMAN: I'm going to let you proceed here, but I think
 24 I've thrown enough red flags up now to distract a herd
 25 of bulls.

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<p>1 MR CHOW: I'm going to move on pretty quickly. Sorry.</p> <p>2 I just want to ask you one last question on this</p> <p>3 subject. If you look at the bottom of the page --</p> <p>4 A. Can I just see the front page of this report, just so</p> <p>5 I can get it in context?</p> <p>6 Q. Yes. The front page --</p> <p>7 COMMISSIONER HANSFORD: I think we are finding you a hard</p> <p>8 copy.</p> <p>9 MR CHOW: Yes. 8984.</p> <p>10 A. I think I've got that somewhere, yes.</p> <p>11 Q. If I can refer you to page 9012. Under</p> <p>12 paragraph 3.2.2.1, Atkins confirm that:</p> <p>13 "Diaphragm walls and barrettes are employed as the</p> <p>14 foundation system."</p> <p>15 But I only have one question for you: would that</p> <p>16 make you change your view as to whether that part of the</p> <p>17 diaphragm wall should be considered as superstructure?</p> <p>18 A. Well, I think I would say that statement written is not</p> <p>19 true.</p> <p>20 Q. All right.</p> <p>21 A. Because it says -- the second sentence says:</p> <p>22 "Both will have a nominal embedment</p> <p>23 (300 millimetres) into acceptable rock."</p> <p>24 Now, as I understand it, the diaphragm walls are</p> <p>25 constructed on a hit-and-miss basis, so every third</p>	<p>1 nominal threaded length of 44 millimetres is 26.4mm."</p> <p>2 A. Sorry, I'm just waiting for the words to come up, just</p> <p>3 so -- it would be easier for me to read them.</p> <p>4 Q. Page 49, the fourth paragraph from the top.</p> <p>5 A. Okay. I could have written, "In my opinion, this</p> <p>6 therefore could become the acceptable standard for</p> <p>7 a pass and fail", but, I mean, the whole report is</p> <p>8 prefaced on the basis that it's my opinion.</p> <p>9 Q. Understood. Yes. I just wanted to clarify, because</p> <p>10 I thought that is what you actually mean. Right. Thank</p> <p>11 you.</p> <p>12 In section 15.6, here you refer to the fact that the</p> <p>13 yield strength of the reinforcement used on site was</p> <p>14 higher than the assumed 460 megapascals, and you</p> <p>15 therefore suggest that we may perhaps have a further</p> <p>16 8 per cent reserve in the capacity of the section. Do</p> <p>17 you recall that?</p> <p>18 A. Yes.</p> <p>19 Q. In the various steel reinforcement testing reports, we</p> <p>20 notice that there are some reports that show actually</p> <p>21 the reinforcing bars used did not have 500MPa. I just</p> <p>22 want you to take a look to see whether you have the same</p> <p>23 interpretation.</p> <p>24 Bundle B5, TS35254, please.</p> <p>25 Yes. First of all, on top of the page, right-hand</p>
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<p>1 panel goes into the rock but the other two panels are</p> <p>2 founded at a level much higher, so therefore that</p> <p>3 statement is not actually right.</p> <p>4 Q. All right. I will move on to the next subject, the</p> <p>5 CASTCO -- the testing done by BOSA.</p> <p>6 In your report you said because of the test result,</p> <p>7 "This therefore becomes the acceptable standard for</p> <p>8 a pass or fail of thread engagement."</p> <p>9 Am I right in understanding that what you actually</p> <p>10 intended to say is that these new -- the 60 per cent</p> <p>11 partially engaged thread length ought to become a new</p> <p>12 acceptable standard? Is that what you really intended</p> <p>13 to say?</p> <p>14 COMMISSIONER HANSFORD: Which paragraph is this?</p> <p>15 MR CHOW: That is section 15.5.</p> <p>16 COMMISSIONER HANSFORD: 15.5. Thank you.</p> <p>17 MR CHOW: Page 49.</p> <p>18 MR PENNICOTT: It starts at 47.</p> <p>19 MR CHOW: The fourth paragraph, starting with "At</p> <p>20 60 per cent":</p> <p>21 "At 60 per cent thread engagement the test showed</p> <p>22 that the failure load was 886 kilonewtons and the</p> <p>23 failure occurred in the parent bar. This therefore</p> <p>24 becomes the acceptable standard for a pass or fail of</p> <p>25 thread engagement. 60 per cent thread engagement of the</p>	<p>1 side, it's stated, the fourth item, you see that on the</p> <p>2 right-hand side, "Grade of steel" is indicated to be</p> <p>3 460?</p> <p>4 A. That's what's written there, yes.</p> <p>5 Q. If we move down to the lower part of the table, where it</p> <p>6 sets out all the test results, you see there is</p> <p>7 an entry, an item called "Yield stress"; right?</p> <p>8 A. Yes, I can see that.</p> <p>9 Q. And three samples have been tested. Two of them show</p> <p>10 a yield stress of less than 500, and the mean yield</p> <p>11 stress is 499, close to 500 --</p> <p>12 A. Yes.</p> <p>13 Q. -- but not 500.</p> <p>14 If we now move on to another test report --</p> <p>15 A. Before we do, while we've got this one here --</p> <p>16 Q. Yes.</p> <p>17 A. -- at the top of the page it says "Results of tensile</p> <p>18 tests", "Bar identification marking", "Mass per metre</p> <p>19 run", "Effective sectional area", and it goes 112.4,</p> <p>20 109.9, 110.1. That's a T12 bar, so that's very</p> <p>21 different from the T40 bars. This is a test for a T12</p> <p>22 bar which is not the T40 bar, and up in the slab they</p> <p>23 used T40s and T50s.</p> <p>24 So do you have the same for a T50 bar?</p> <p>25 Q. I don't know. We just noticed there are some test</p>

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<p>1 reports, so that's why I wanted to show it to you, to 2 see whether you have any further input on that. 3 Another test report, at page TS35375 -- we may have 4 the same problem here because honestly I haven't noticed 5 this but I just want to make sure -- these are again -- 6 A. These are T16 bars. 7 Q. So that would not affect your opinion; right? So we can 8 still safely allow for another -- 9 A. Not on the basis of this. 10 Q. Okay. 11 A. Clearly the person to ask is the stockist and the 12 manufacturer. 13 But, I mean, I asked Leighton -- it was a question 14 that I asked them -- "Can you tell me what grade of 15 steel?", and they responded to me, "We used grade 500." 16 Grade 500 was used. But, I mean, I don't have any 17 certificates or evidence of that. I just took that at 18 their words. So -- 19 COMMISSIONER HANSFORD: I'm sorry, I don't wish to 20 interrupt. 21 A. No, it's okay, please. 22 COMMISSIONER HANSFORD: This is an interesting area for me 23 and this has come up earlier in these proceedings, that 24 we don't know whether we are dealing with 460 or 500, 25 and my understanding is there was a point in time when</p>	<p>1 MR SHIEH: Before we rise, perhaps some references for the 2 Commission to consider in its spare time. It's as good 3 as any for me to raise it. 4 CHAIRMAN: Yes. 5 MR SHIEH: Just now, there was a reference to earlier 6 references in the evidence to A shape or tapered. Can 7 I just give the Commission the evidential reference to 8 when it was raised previously in the course of evidence? 9 CHAIRMAN: Thank you. 10 MR SHIEH: The first time it was raised, not surprisingly 11 not in the witness statement, is in Mr Poon's testimony 12 on Day 7, page 142. 13 MR PENNICOTT: To 144. 14 MR SHIEH: Mr Pennicott has found it. 15 MR PENNICOTT: I just checked. 16 MR SHIEH: Page 142, line 19 to page 144, all the way to the 17 end of 144. 18 MR PENNICOTT: Yes. 19 MR SHIEH: Then it was picked up by the government in 20 cross-examination: Day 11, page 94, line 15, all the way 21 down to page 102, line 25. Those are the areas I could 22 locate -- 23 CHAIRMAN: Thank you. 24 MR SHIEH: -- where the issue about A shape or tapered 25 diaphragm wall was mentioned. Maybe Mr Pennicott has</p>
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<p>1 the market changed from 460 to 500. But what I had not 2 appreciated, and perhaps I'm still not sure, is as to 3 whether it changed for all diameters at the same time or 4 whether T12s and T16 were still at one grade and T40s 5 T50s at another. Do you have any knowledge of that? 6 A. I don't, no. 7 COMMISSIONER HANSFORD: It will remain as a puzzle. 8 A. I must clarify, I'm not relying on that 8 per cent -- 9 the numbers I said yesterday, about 40 per cent reserve 10 and stuff, that 8 per cent isn't there. That's just 11 sorted added bumph, if it turns out to be the case that 12 it is grade 500. 13 COMMISSIONER HANSFORD: So the point you have made about 14 redundant capacity, I'm not going to get tied up into 15 definitions here -- 16 A. Spare capacity. 17 COMMISSIONER HANSFORD: -- spare capacity, let me use that 18 term, spare capacity -- is on the assumption of 460? 19 A. 460, and just from a design perspective. 20 COMMISSIONER HANSFORD: From a design perspective. Thank 21 you. That's helpful. 22 MR CHOW: Sir, I only have one more topic to cover but 23 I note the time. Perhaps it's a convenient moment that 24 we have -- 25 CHAIRMAN: Good. Thank you.</p>	<p>1 located -- 2 MR PENNICOTT: I have one further one. On Day 24, page 39, 3 when Mr Chow was cross-examining Mr Buckland of Leighton 4 regarding the A shape, evidence given by Mr Poon. 5 MR CHOW: Thank you. 6 CHAIRMAN: Thank you very much. That assists us. Thank 7 you. 8 Good. 15 minutes. Thank you. 9 (11.40 am) 10 (A short adjournment) 11 (12.02 pm) 12 CHAIRMAN: Yes. 13 MR CHOW: Mr Southward, there is only one last matter 14 I would like you to help me with, and for this I would 15 need to borrow the bending moment diagram prepared by 16 Prof McQuillan, if I may. Page 39 of tab 3, please. Do 17 you see that? 18 The way I understand it is -- here, Prof McQuillan 19 drew the bending moment showing the variation of bending 20 moment along the EWL slab; do you see that? 21 A. Yes, it looks like it. 22 Q. Then on the two sides we see the blue line, the curved 23 line, also shows the bending moment inside but along the 24 diaphragm wall on each side, under the usual loading 25 that we usually see acting on that structure.</p>

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1 In terms of the general shape of this variation of
 2 bending moment, is that what you expected as well?
 3 A. Yes. For the top slab -- I mean, in the D-wall, it very
 4 much depends on the moments that are built up in the
 5 D-wall during construction. So I can't recall exactly.
 6 But there are reports that have all the D-wall bending
 7 moment diagrams in them quite clearly. But this looks
 8 about right, yes.
 9 Q. For the benefit of a layperson, what we see the blue
 10 line here represents is -- for the blue line above the
 11 EWL slab, it shows that there is a hogging bending
 12 moment; is that right?
 13 A. Correct, yes.
 14 Q. The blue line -- for the region where the blue line is
 15 under the EWL slab, it represents that the moment there
 16 is a sagging moment, in other words in another
 17 direction?
 18 A. Correct.
 19 Q. What I am interested in is the location where we have
 20 the bending moment equal to zero, that is the location
 21 where bending moment inside the EWL slab starts to
 22 change direction.
 23 I myself just tried to scale it off. The location
 24 is about one-fifth of the span of the EWL slab. Does it
 25 appear to you to be roughly proper, in order?

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1 A. I couldn't say. You're talking about the point of
 2 contraflexure.
 3 Q. Yes.
 4 A. And this is a schematic diagram. I'm sure it's not
 5 plotted based on real values. We'd have to go and look
 6 in the Atkins report to see exactly where the point of
 7 contraflexure was. But perhaps in a typical beam,
 8 one-fifth in or whatever might be a point of
 9 contraflexure.
 10 Q. Of course I know the exact location would depend on the
 11 loading, depend on the structure and the size of member.
 12 A. Yes.
 13 Q. I fully accept that. But as a general phenomenon, the
 14 location, although it varies, would be within a certain
 15 range; would you accept?
 16 A. It can vary. The point of contraflexure, it can vary
 17 widely depending on the loading applied to the frame.
 18 It really can. And also how the structure was built.
 19 So the manner in which the structure was put
 20 together, because the manner in which it was put
 21 together affects the shape of the bending moment
 22 diagram.
 23 COMMISSIONER HANSFORD: When you say "manner put together",
 24 you're referring to -- in this instance, we have
 25 a top-down method; is that the sort of thing you're

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1 referring to?
 2 A. Yes.
 3 COMMISSIONER HANSFORD: So we've got a method where the top
 4 slab is constructed and then excavation takes place
 5 underneath it?
 6 A. Yes.
 7 COMMISSIONER HANSFORD: In fact Prof McQuillan shows that
 8 sequence and I'm sure we will come to that when we
 9 ultimately get to him, probably tomorrow.
 10 A. It may be the manner in which it's put together is most
 11 easily explained by a bridge, a simply supported span
 12 bridge. When that bridge is built, it's a simply
 13 supported span, but sometimes bridges are then made
 14 continuous with the next-door span.
 15 COMMISSIONER HANSFORD: Yes.
 16 A. In that case, the bending moment diagram is very
 17 different compared to if you built two spans together at
 18 the same time.
 19 COMMISSIONER HANSFORD: Yes. Thank you. That's helpful.
 20 MR CHOW: The matter that I would like you to help me with
 21 is to understand the answer that we received from COWI
 22 last night. I'm not sure you've had a chance to read
 23 it.
 24 A. I've not seen it, no.
 25 Q. It has been inserted into the bundle. I believe it's

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1 tab 4.1 or 4.2.
 2 MR PENNICOTT: 4.5.
 3 MR CHOW: 4.5, sorry. Thank you.
 4 This is the answer that we received last night.
 5 I would like you to look at question 2. Perhaps if you
 6 would like to take some time to read question 2 and the
 7 answer provided by COWI.
 8 A. Okay. Move up.
 9 Q. Thank you.
 10 A. Sorry, "move down" I suppose.
 11 Can you just move up -- can I read the question
 12 again, please?
 13 Okay. I've think I've understood that.
 14 Q. Mr Southward, perhaps I will give you some background
 15 information first. The reason why we asked question 2
 16 is because it is agreed between all the experts that at
 17 the connection between the EWL slab and the diaphragm
 18 wall actually experienced hogging moment, and that's the
 19 reason why the experts agree that the bottom steel is
 20 subject to compression.
 21 A. Yes.
 22 Q. This is also part of your view. So we would expect
 23 hogging moment to appear along the top of the east
 24 diaphragm wall. But when we look at the details of
 25 COWI's calculation, there is one loading case which the

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1 result shows all along the east diaphragm wall, the top
 2 of the east diaphragm wall, there is a sagging moment,
 3 and that's why it appears to the government as something
 4 that needs to be explained, and that's why we raised the
 5 question.
 6 Now, we received the answer from COWI last night.
 7 The way I understand it is what COWI tells us is, yes,
 8 at the centre line of the diaphragm wall, the moment was
 9 a hogging moment, but as soon as we move outside, up to
 10 the interface, we are talking about 600 millimetres of
 11 distance away from the centre line, theoretical support.
 12 The hogging moment becomes sagging moment.
 13 So we are talking about the change of bending moment
 14 within a very short distance.
 15 The reason why I need to borrow Prof McQuillan's
 16 bending moment diagram is to try to understand whether
 17 it is reasonable. Now, according to Prof McQuillan's
 18 bending moment diagram, the point of zero moment
 19 should -- I take your point that it may vary -- but
 20 generally would be at 20 per cent or 15 per cent away --
 21 20 per cent or 15 per cent of the span away from the
 22 support.
 23 But in this particular case, according to COWI's
 24 analysis, we are talking about 600 millimetres away from
 25 the support, for a span of 25 metres. In other words,

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1 the point where the moment starts to change, it's even
 2 closer than 600mm.
 3 Now, I am not an expert but I am instructed by those
 4 who know this matter that there must be something wrong
 5 with the analysis, and I want to hear what is your
 6 reaction to that.
 7 A. Okay. So you said a loading case, so that would mean --
 8 that would indicate that it's a loading case.
 9 Q. Yes.
 10 A. You have loading cases and then you go to load
 11 combinations, and the load combination is the one that
 12 we designed for.
 13 So I don't know which loading case it is, but if you
 14 put load onto a structure in isolation from any other
 15 load, then you might have a case that the sagging moment
 16 goes all the way to the end of -- all the way to the
 17 walls. Like what? What example would that be? Maybe
 18 the live load or -- one discrete case might have
 19 a bending moment diagram that goes all the way to the
 20 end, but these diaphragm walls are -- the analysis, so
 21 far as I've understood everyone's done, everyone's done
 22 a Plaxis analysis, which is a geotechnical software, and
 23 that gives you the bending moments in the diaphragm
 24 wall. And the bending moment at the top of the
 25 diaphragm wall is a very large hogging moment, which is

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1 much, much larger than any of the other loads that are
 2 applied to the slab itself. So that hogging moment
 3 dominates.
 4 Now, onto that hogging moment, you have to add the
 5 bending moment diagrams from all the other different
 6 load case situations. So maybe one of those load case
 7 situations creates a sagging moment. Maybe temperature
 8 or -- I don't know, because I haven't studied it in
 9 depth. But I can see a scenario in which case a single
 10 loading case exhibits what you said, but that's not the
 11 same as the final design moment.
 12 COMMISSIONER HANSFORD: So are you saying that with one
 13 particular loading case there may be a sagging moment,
 14 but that's counteracted by the hogging moments from
 15 other load cases?
 16 A. Yes. Maybe -- can I draw?
 17 COMMISSIONER HANSFORD: Yes, please. That would be quite
 18 useful.
 19 A. If you don't mind. A new page.
 20 (Drawing with a black marker) The Plaxis run models
 21 the slab at the two joints, the two slabs, and there are
 22 some struts; I think there's a diagonal strut in there
 23 as well. So it models the whole building --
 24 COMMISSIONER HANSFORD: There's a diagonal strut during the
 25 temporary work?

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1 A. During construction, yes. I think there's a strut.
 2 COMMISSIONER HANSFORD: Again, I think Prof McQuillan shows
 3 that in his sort of sequence of construction which we
 4 will come to tomorrow.
 5 A. So the Plaxis run models the whole life of the structure
 6 during the construction stage and it ends up with
 7 a bending moment diagram, and I have to say, where it
 8 goes down here (indicating), I'm not sure. Maybe it
 9 does that (drawing a curving line), that kind of shape.
 10 But the big thing is that up at the top of the wall,
 11 there's a significant hogging moment, which means that
 12 in the slab there's a significant hogging moment like
 13 that (drawing with a black marker). So that's very
 14 large.
 15 And maybe the order of magnitude of that bending
 16 moment from the Plaxis run is maybe 70 per cent, I'm
 17 guessing, 80 per cent, that kind of number, maybe. But
 18 it's large.
 19 Then you might have another loading case that you
 20 have to consider, and because of the way the load is,
 21 maybe a particular train over here (indicating) causes
 22 that kind of shape (drawing with a red marker) with
 23 a very small transfer of moment around the corner.
 24 But for design, we have to add these two together.
 25 So you add that to that (indicating), multiplied by

Page 57	1 various factors and things. But in this point here, 2 it's that, and actually that's a minus, because it's 3 a different side. 4 COMMISSIONER HANSFORD: That's what I meant by one 5 countering another; am I correct? 6 A. Yes. 7 I don't know whether that is the case, but that 8 would be an explanation for that case. 9 MR CHOW: My last question, probably not a good question, in 10 that particular load case, where the bending moment 11 generated within the diaphragm wall manifests such 12 a sharp or quick change in bending moment within a very 13 short distance, does this mean that the mid-span moment 14 would be very large, in such circumstances? 15 A. Yes. In that case, it means the mid-span moment might 16 be larger, but it depends on the magnitude of the load 17 applied in the beginning. 18 Q. Of course, yes. Would you recommend, in those 19 circumstances, someone has to check whether the mid-span 20 is strong enough to resist that sort of a large bending 21 moment? 22 A. Sorry, can you say -- 23 Q. The load case that we have looked at resulted in a very 24 sharp change in bending moment, close to the support. 25 A. Yes.	Page 59
Page 58	1 Q. And you agree with me, in such circumstances, the 2 mid-span moment tends to be very large as well? 3 A. No. 4 Q. Not necessarily? 5 A. No, because the gradient changes, it's a very sharp 6 peak, and then as you go further away from the wall, the 7 gradient becomes less and less and less and it flattens 8 out. So just because that's very steep (indicating) 9 doesn't mean that this (indicating) is going to be very 10 big, because it doesn't continue at this angle all the 11 way down. It sort of comes here (indicating) and then 12 the gradient gets less and less and less and then the 13 gradient becomes flat (indicating the whiteboard). 14 Do you understand? 15 Q. I understand what you say, yes. I thought the bending 16 moment diagram is a kind of parabola. 17 A. Yes, a parabola is one that is very steep at its 18 steepest bit and then as you go away it becomes more and 19 more flat (demonstrating with hands). 20 MR CHOW: Thank you very much. I have no more questions for 21 you. Thank you. 22 Cross-examination by MR SO 23 MR SO: There are some questions from China Technology. 24 Mr Southward, I am Simon So; I represent China 25 Technology.	Page 60

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<p>1 A. What I'm saying is that some testing has been done, and 2 that testing demonstrates that the strength of the bar 3 coupler assembly is strong enough to meet the criteria 4 of strength for the performance of the station 5 structure. 6 So that is a real -- it's a real thing. It's 7 something that we've actually seen. We've seen a test 8 and it's been tested and we know it's strong enough. So 9 that's what I mean. If we have 60 per cent engagement, 10 that's what happens, so we know the structure is then 11 safe. 12 Q. And when you say "some tests", I understand that you are 13 referring to the CASTCO test that you have referred to 14 in page 48 of your expert report; correct? 15 A. Correct. 16 Q. Just so I don't misunderstand, that is also the only 17 test, one and only one test, that you are now basing 18 this hypothesis on; correct? 19 A. I believe there were five or six tests, but yes. The 20 results of those tests. 21 Q. All right. Just to make myself clear, when I say "one 22 test", I mean just the static tension test; correct? 23 That is five different tests based on the static tension 24 test, one type of test? 25 A. Yes.</p>	<p>1 not go to structural integrity and just go to compliance 2 with specification; is that your evidence? 3 A. No. All those tests are all part of demonstrating that 4 the coupler is satisfactory for use in any situation, in 5 any civil engineering application. 6 Q. All right. Just to move on slightly -- it is at 7 page 132 -- then Prof Hansford asked you, in line 20: 8 "Sorry, Mr Southward -- so are you saying you don't 9 believe elongation to be relevant to this project?" 10 Your answer -- to be fair to you, you say: 11 "... no. If you are looking at it from the point of 12 view that I was, 'Is the structure safe?', then that's 13 where I came from." 14 That is the part which troubles me, Mr Southward. 15 So are you saying that the permanent elongation test and 16 the cyclic tension test has no contribution to 17 structural safety? 18 A. Those tests are all part of a process of ensuring the 19 quality of the product so that product can be used 20 anywhere. 21 Q. And the quality of the product certainly goes to 22 structural safety; correct? 23 A. The quality of -- yes. I mean, structural safety is -- 24 when you have a functioning coupler, you then have 25 structural safety, yes.</p>
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<p>1 Q. Right. I don't need to trouble you to go to the QSP, 2 but you certainly will understand that under the QSP, 3 they stipulate more tests, not just one type of test; 4 correct? 5 A. Correct. 6 Q. Those are the permanent elongation test and cyclic 7 tension tests; correct? 8 A. Correct. 9 Q. I wish to invite you to go to a discussion that you had 10 with my learned friend Mr Pennicott yesterday. It is in 11 transcript Day 42, page 131, line 24. 12 There, when you were answering queries from 13 Mr Pennicott, you were trying to say that: 14 "The testing of couplers to compliance to BD rules 15 is a kind of -- is a different thing. It's testing them 16 with respect to the specification requirements, so that 17 those couplers can be used in any situation anywhere." 18 Now, when you are talking about the testing of 19 couplers to compliance with the BD rules, you are 20 mentioning those permanent elongation tests and cyclic 21 tension tests, were you? 22 A. Yes. 23 Q. Insofar as -- so that I don't misunderstand your 24 evidence, you are saying that the static tension test 25 goes to the structural integrity, and those two tests do</p>	<p>1 Q. Good. So in order to have a full picture of whether the 2 coupler assembly is safe, you need all the three tests; 3 correct? 4 A. Well, some tests have been done and they have -- 5 Q. Don't tell me some tests have been done. There is just 6 one test done. Just the static tension test was done, 7 is it not? 8 A. Yes, and that is what is happening in real life out 9 there. The station structure is there in a static 10 arrangement, with a large load in the bars, now, as we 11 speak. So that coupler assembly is under a static load. 12 I think I also said that the future loading on this 13 coupler assembly is due to the trains, as the trains 14 move over the platform, and the stress in those bars is 15 quite small. 16 So when you do the cyclic tension tests and you do 17 the elongation tests, you are pulling the bar up to 18 0.6fy, which is a large load; 0.6 times 460 is, off the 19 top of my head, 300. 20 Q. I don't think we need to go to the rocket science of 21 those tests. 22 A. Whereas the actual stress in the rebar due to the 23 loading is maybe 15MPa, somewhere around that, of that 24 low double-digit figure. 25 So really, if we look at the coupler, it's under</p>

Page 65	1 a static load. So we've got to test it statically to 2 make sure it can resist the applied static load, and 3 that's what those tests show. 4 Q. Let me try it another way. The station is now not yet 5 in use; correct? 6 A. Correct. 7 Q. Your evidence, insofar as I understand, now the station 8 is static, the permanent elongation test and the cyclic 9 tension test, at this stage, at this moment, does not 10 concern about structural safety; correct? 11 A. I don't think I'm saying that, no -- 12 Q. So what's your evidence? 13 A. What's my evidence? What do you mean? 14 Q. Let me put it another way. In the current state, which 15 is static, is it your evidence that the permanent 16 elongation test and the cyclic tension test can shed no 17 light whatsoever to structural safety of the station? 18 A. I think all testing gives confidence in performance of 19 things. That's why people do tests. So I'm not saying 20 that you shouldn't do testing. Testing is good. 21 When I'm looking at the station, in this particular 22 instance, with it being built, I know it's not open but 23 apparently trains have run across the slab, so it's 24 experienced its design loading. There has been no sign 25 of reported distress. All the calculations indicate	Page 67	1 just trains. And yes, trains are big and heavy but 2 they're nothing compared to the weight of the slab, the 3 3 metre thick slab, the span of the wall between the 4 slabs. So everything is on a massive scale. So the 5 loading on the bars is much larger now than any future 6 train loading. Does that make sense? 7 COMMISSIONER HANSFORD: It does. To me it does. Thank you. 8 MR SO: So you are saying that as long as it passes the 9 static tension test at this point in time -- 10 A. Please don't get me wrong. I'm not saying: don't do the 11 cyclic test. I'm not saying that. I'm saying from my 12 perspective, and what I was engaged at, was to look at 13 the safety aspects, and I'm satisfied if the static 14 tension test can be met -- and that wouldn't be the case 15 for every structure. I mean, I said yesterday about 16 a coupler at the base of the Nina Tower. I mean, 17 there -- the loading situation there is completely 18 different, and there that coupler would experience large 19 reversals of force, and so other tests may be relevant, 20 or will be relevant, for that coupler. But that's 21 a different situation to where we are now. 22 Q. All right. Can I bring you to the letter which BOSA 23 writes to the Buildings Department. That is in 24 bundle H25, page H45858. 25 COMMISSIONER HANSFORD: Sorry, Mr So, the date of that
Page 66	1 that there is a massive reserve of strength there, so 2 we've got to look at what is the most relevant test that 3 we can do that proves that the bar/coupler assembly will 4 not break. So what is that test? That test is a static 5 load tension test, to replicate the condition that the 6 bar/coupler assembly is in at this moment. 7 Q. In other words you are saying that if the station passed 8 the static tension test, then because of this nature the 9 permanent elongation test and cyclic tension test would 10 be subordinate, in a sense, to the static tension test; 11 is that your evidence? 12 A. I'm not quite sure what you mean by is that my evidence, 13 but what I'm saying -- what concerns me, as a structural 14 engineer, in this instance, is the ability of the bar to 15 not break, because I know that the loadings placed on 16 this bar are of a static nature and not a cyclic nature. 17 COMMISSIONER HANSFORD: Sorry, when you say the "loadings 18 placed on this bar", do you mean the loadings placed on 19 this bar now, or do you mean the loadings placed on this 20 bar now and in the future? 21 A. Now and in the future, yes, because the loading placed 22 on this bar is pretty much -- is close to the maximum 23 load that this bar will experience, because it's in its 24 final state and it's buried, it's encapsulated in the 25 ground, and what happens -- what comes onto it now are	Page 68	1 letter? 2 MR SO: 7 January 2019. 3 CHAIRMAN: You heard what I said about that? 4 MR SO: Yes, I heard that. I took that into account. 5 I think it would be of benefit if this expert can give 6 evidence or give his expert opinion as to what he sees 7 in terms of the response given by BOSA. 8 CHAIRMAN: That's fine, as long as you are aware of my 9 concern as to weight. When you've got a letter written 10 in the middle of a controversy where you may well be 11 held to account, that letter is going to look to 12 absolutes and on a defensive basis. 13 MR SO: Of course. 14 A. Can I point out, I'm not -- I think someone had this 15 letter on the screen the other day, but I've not 16 actually seen this letter. It was written -- dated 17 after the submission of my report. 18 Q. Indeed, we do appreciate that. 19 A. I've not read or studied it or -- 20 Q. Do you want to have a chance to read it now? 21 A. It depends on what you are going to ask me. 22 Q. Sure. Of course. Perhaps I will draw you to specific 23 paragraphs which I wish you may give us some insight 24 upon. It is in page H45859. I want to draw your 25 attention to the second paragraph. Ill just read it

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1 into the record. There it writes:
 2 "Regarding your question on how a partially engaged
 3 coupler would perform in permanent elongation test,
 4 static compression and tension tests and cyclic
 5 tension-and-compression tests, it is our opinion as
 6 explained in paragraph 4 above, that it is unlikely that
 7 such couplers, without being spliced butt-to-butt and
 8 are therefore loose, will survive permanent elongation,
 9 and cyclic tension-and-compression tests."
 10 Mr Southward, correct me if I am wrong, my
 11 understanding is insofar as you are aware, there were no
 12 static compression and tension -- permanent elongation
 13 test and cyclic tension-and-compression test being
 14 performed?
 15 A. I've not been made aware of those.
 16 Q. Are you able to give us expert opinion as to whether you
 17 think BOSA is justified to say that it would be unlikely
 18 that it would survive those tests?
 19 A. I don't think I am, and actually I note that these guys
 20 can't give their opinion because they just say
 21 "unlikely". But, I don't know, I've not seen or
 22 witnessed a partially engaged test, so I can't tell you
 23 whether or not it will fail or pass.
 24 Q. All right.
 25 COMMISSIONER HANSFORD: Sorry, Mr Southward, aren't you

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1 telling us that this situation of cyclic tension and
 2 compression, this reversal of load on this coupler, is
 3 not something that's going to occur in this situation?
 4 A. Yes.
 5 COMMISSIONER HANSFORD: So whilst what BOSA says here may be
 6 perfectly fair, it's relevant to the particular couplers
 7 installed at Hung Hom Station; is that your view?
 8 A. Yes, and also a cyclic tension-and-compression test is
 9 done outside the concrete. So it's just in free air,
 10 and you put the bars in and you pull them, you
 11 measure -- you've got marks on the bars and you measure
 12 the distance, between them, to measure the permanent
 13 elongation. That's all done in free air.
 14 At the moment, these couplers are encased and
 15 embedded in concrete.
 16 COMMISSIONER HANSFORD: Yes.
 17 A. So that movement -- the movement won't occur because the
 18 bars can't move because they are all encased and
 19 surrounded by concrete.
 20 COMMISSIONER HANSFORD: But your expert evidence that you
 21 have given us doesn't contradict this paragraph, does
 22 it?
 23 A. No, I don't think so, no.
 24 COMMISSIONER HANSFORD: Okay. Thank you.
 25 MR SO: Thank you, Professor.

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1 Then I would wish to draw your attention to the
 2 first paragraph, then, of this page, the first line:
 3 "In response to paragraph 2(b)(i) and (ii), please
 4 note we do not have any test data on correlating partial
 5 thread engagement of coupler to its structural
 6 performance. We have no intention in conducting such
 7 tests as it should serve no useful purpose for our
 8 products."
 9 Just to confirm, insofar as you are aware, before
 10 the tests conducted by CASTCO on 21 November 2018, were
 11 there any tests, either by BD or by Leighton or by MTR
 12 or by any sub-contractors, that have done tests as
 13 regards to partial engagement of threads?
 14 A. I'm not aware of any such tests.
 15 Q. We know that you are an expert in this field. Have you
 16 come across any situation where you would test partial
 17 engagement of threads into a coupler?
 18 A. No, I mean, I've not had the need to test this situation
 19 before.
 20 Q. Have you engaged in testing the strength of a coupler by
 21 fully engaging the threads into it, in your past
 22 experience?
 23 A. I've not personally seen any testing of these couplers.
 24 Q. In your past experience, not confined to this?
 25 A. Yes, in my past experience, I've not seen or witnessed

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1 a coupler test.
 2 Q. All right.
 3 CHAIRMAN: But surely, are you -- this is why I'm concerned
 4 about this letter coming as it does -- "We have no
 5 intention in conducting such tests as it should serve no
 6 useful purpose for our products."
 7 That any normal person who is not an engineer would
 8 view with horror. Are you suggesting that because
 9 a particular item must be placed in a particular way,
 10 that you do no tests to see what would happen if it
 11 wasn't placed in a particular way? So you are basically
 12 saying to the client, "Absolutely, buy it, but if you
 13 don't put it in right, we can't guarantee what's going
 14 to happen. The roof could fall down." That is
 15 ridiculous and that can't be the case, and I don't
 16 accept for one moment that is what's meant. What is
 17 meant here is, "We are not now going to do some extra
 18 special tests for you because that's not our function."
 19 That's what's being said, in effect.
 20 MR SO: Of course, then I would wish to add one more point
 21 to Mr Chairman's observation, that there are certainly
 22 no such tests by anybody before this saga all blew up.
 23 There was no test on partial engagement.
 24 CHAIRMAN: We don't know.
 25 MR SO: That was confirmed by the expert now.

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<p>1 CHAIRMAN: He hasn't. No, he doesn't work for BOSA, but if 2 he does, he should have told us. 3 Are you employed by BOSA? 4 A. I can confirm, I do not work for BOSA. I have no 5 relationship with them. 6 CHAIRMAN: So effectively we are in a position where 7 internationally recognised manufacturers of artefacts 8 for engineering will test them as is necessary to ensure 9 not only that they stand up under correct application 10 but that they have tolerance levels outside of correct 11 application. That must be the case, and I think that we 12 as a Commission can take it that that is what will have 13 happened with BOSA couplers. 14 Now, was it done in this particular instance? Are 15 they willing to now do it? Clearly not, not in terms of 16 that letter. 17 MR SO: Of course, sir. 18 CHAIRMAN: All right? I don't mean to sound overly 19 aggressive but there are certain areas -- and that's why 20 I'm concerned about this letter -- we have to be very 21 careful when it's written and in that context it's 22 written. 23 MR SO: Of course, sir. 24 Mr Southward, then, as a matter of common sense, 25 would you agree with me, and as a matter of practical</p>	<p>1 with partial engagement and the test results are shown 2 in the photo enclosed." 3 Now, Mr Southward, I just want to confirm, save and 4 except the set of data that you have received from 5 CASTCO, did you receive another set of data from MTR? 6 A. No. I'm just reading the paragraph above. Here it 7 says: 8 "Nevertheless, in view of the issue of insufficient 9 engagement of threads ... wish to find out the tensile 10 strength of couplers with various degrees of partial 11 engagement and accordingly, we have provided such 12 samples and conducted tensile strength tests on them and 13 representatives from BD were invited to ... [witness] 14 such tests." 15 So that implies that that sentence is about the 16 CASTCO tests. Then it says: 17 "We also understand MTR has conducted various 18 similar tests." 19 I'm not aware of those various similar tests. 20 Q. Thank you very much. I just want to confirm that point, 21 that you didn't receive other test results from MTR, 22 just the CASTCO? 23 A. Yes. 24 Q. Thank you. 25 Now I want to move to another topic. Can I bring</p>
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<p>1 science, experiments and experimental results would 2 vary? 3 A. Experimental results will vary? Yes, of course, they 4 do, yes. 5 Q. And although conducting in -- all the control factors 6 being at hand, there would still be differentiations 7 between experimental results; would you agree with that? 8 A. I would agree with that, yes. 9 Q. Of course, therefore, that's the reason why we have to 10 have more than one test being tested for each control 11 set of variables; correct? 12 A. Yes. Yes. 13 Q. Because it would be not reliable in that case, just to 14 rely on one of the experimental results that we have 15 obtained? 16 A. Yes. As I said, I'm not an expert in statistics, so, 17 you know, as to the number of tests, I can't comment. 18 Q. Thank you. I bring you back to the same paragraph. I'm 19 not labouring the point that the Chairman has just 20 indicated. I just want to confirm one fact with you. 21 It was five lines counting from the bottom of this 22 paragraph. There it writes: 23 "We also understand MTR has conducted various 24 similar tests. So far as we are aware this is the 25 single type of test that has been conducted on couplers</p>	<p>1 you to OU352. 2 Sorry, I understand there is a new addition this 3 morning. OU368. 4 I'm happy to use an old edition, if OU368 is not yet 5 up. I'm happy to proceed with OU352. Let's move on. 6 Let's take a look at OU352. 7 Mr Southward, I'm sure that you are of course aware 8 of the results of the opening-up? 9 A. I've been receiving these documents, yes. 10 Q. Thank you. I want to draw your attention to a few of 11 the test results. The first one I want to draw to your 12 attention would be test 21. Can that be blown up a bit? 13 Thank you. 14 A. Test 21, where is that? 15 (Hand indicating on the screen) 16 Q. Before we start, just to let us have a backdrop of what 17 is happening. I understand that it is BOSA's 18 specification that the threaded length is 44 millimetres 19 long; correct? 20 A. The threaded length is -- 21 Q. 44 millimetres long. 22 A. Plus up to 4mm extra. 23 Q. Correct. That 44 millimetres is what we call a positive 24 tolerance, so it is always about 44; it could not be 40. 25 A. I understand, yes.</p>

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<p>1 Q. So the length must be 44 to 48 millimetres? 2 A. Correct. 3 Q. Let us have a look at test 21. We can see the 4 engagement length is 35.34 millimetres; correct? 5 A. 21, 35.34, yes, I see that. 6 Q. If we give the benefit of doubt of that 3 millimetres, 7 plus or minus 3 millimetres, that would give us 8 38.34 millimetres; correct? 9 A. Yes. 10 Q. And there are no exposed threads, so the maximum 11 possible total threaded length would be 12 38.34 millimetres? 13 A. I really don't know, because that's a measurement that's 14 come out of this test, this phased array ultrasonic 15 testing thing. I don't know how that system really 16 works, so whether that's the right number or not, 17 I don't know. 18 Q. All right. Fair enough. But at least on the face of 19 the results? 20 A. On the face of it -- so it says zero threads exposed, 21 but where -- you know, what does that mean? Does that 22 mean that there is absolutely nothing and the bar is 23 completely screwed on, or does it mean that the bar -- 24 there's a little bit of thread exposed or the start of 25 a thread?</p>	<p>1 plus or minus 3 millimetres of that test. So that would 2 not be just 4 millimetres, in my respectful submission. 3 COMMISSIONER HANSFORD: Forgive me, Mr So. I think I was 4 just thinking out loud. 5 MR SO: Thank you, Professor. 6 Let me just give another example. I wish to labour 7 this point. Can I go to test 48. This is another 8 example. The engagement letter is 33.98 this time; 9 right? 10 A. 48, 33.98, yes. 11 Q. Giving the benefit of doubt again, the 3 millimetres, 12 that's 36.98, and again with no threads being exposed. 13 A. (Nodded head). 14 Q. You are of course aware of these results. 15 I would then wish you to go to Prof McQuillan's 16 report, page 117. That's the agreed expert memorandum 17 signed on 18 December 2018. 18 A. Yes. 19 Q. I understand this is also one of the memoranda you have 20 signed your name onto, which indicates that you agreed 21 with the content of this agreement; correct? 22 A. Yes. 23 Q. Of course, being an expert to this Commission, you are 24 aware that you are allowed to change your evidence or 25 change your opinion if you find it justified to do so;</p>
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<p>1 Q. Of course. That's a fair comment. 2 Let me give the benefit of doubt to that too. All 3 right. There is a 2 millimetre thread there, as you 4 said, one extra thread; that would give us 5 40.34 millimetres. That is still short of 6 44 millimetres, you would agree with that; correct? 7 A. Well, 40 is less than 44, yes. 8 Q. Right. Would you accept that there is such 9 a possibility at the very least that the thread is being 10 cut? 11 A. I have absolutely no idea. You could equally well say 12 that the bar has been supplied to site with not enough 13 thread. 14 Q. All right. 15 COMMISSIONER HANSFORD: Actually, wouldn't it be rather 16 difficult to cut 4 millimetres? 17 A. I don't know. 18 COMMISSIONER HANSFORD: Sorry, that's not really a question 19 for you. 20 A. I haven't done it. 21 COMMISSIONER HANSFORD: That's me puzzling. 22 MR SO: Professor, that 4 millimetres has to bear in mind 23 that first I give the benefit of doubt of 2 millimetres 24 for the extra thread that Mr Southward just said, and 25 the benefit of another 3 millimetres of the possible</p>	<p>1 correct? You understand that is -- you are of course 2 advised about that? 3 A. Yes. 4 Q. Can I draw your attention to paragraph 6 of that 5 memorandum, the second sentence, second chunk of it -- 6 it reads "further opening-up was unnecessary" -- or 7 I will read the whole sentence: 8 "In terms of the current opening-up regime all 9 agreed, based on the 'redundancy' of the couplers in the 10 bottom of the EWL slab, that further opening-up was 11 unnecessary." 12 My question is: is that still your opinion? 13 A. This is in the bottom of the EWL slab and it's based on 14 the redundancy, so yes, that would still be my opinion. 15 MR SO: Thank you. No further questions. 16 MR SHIEH: No re-examination. 17 COMMISSIONER HANSFORD: No, nothing further. 18 CHAIRMAN: Mr Southward, thank you very much. You have 19 completed your evidence. It's been of very particular 20 help to us. 21 WITNESS: Thank you. 22 CHAIRMAN: We would like to thank you very much for your 23 assistance. 24 WITNESS: Okay. Thank you. 25 (The witness was released)</p>

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<p>1 CHAIRMAN: It's just before 1 o'clock. Mr Boulding? 2 MR BOULDING: I was just going to say that Dr Glover is 3 available but I do see the hour and you may well think 4 it's worthwhile rising a few minutes early and giving 5 him a clean start at 2.15. 6 CHAIRMAN: Yes. Good. So we will adjourn until 2.15, the 7 same time. Thank you. 8 (12.57 pm) 9 (The luncheon adjournment) 10 (2.19 pm) 11 MR BOULDING: Good afternoon, sir. Good afternoon, 12 Professor. 13 CHAIRMAN: I do apologise. One second only. Thank you. 14 Mr Chow, I'm not suggesting that we will have to go 15 through the exercise yet, but at the end of his evidence 16 Prof Au had spoken of a series of mathematical 17 calculations that may assist him to be more certain or 18 more satisfied, whatever the correct terminology is, as 19 to the safety issues. 20 COMMISSIONER HANSFORD: More confident. 21 CHAIRMAN: "More confident" would be the word. I'm not 22 saying we necessarily have to embark upon them, but we 23 would like to know what they would be; okay? 24 I understand that there are two different tranches: 25 firstly, a set of mathematical calculations that should</p>	<p>1 COMMISSIONER HANSFORD: Ah. Good. 2 MR CHOW: And I've just received instructions that actually 3 the list has been served right before lunch. 4 COMMISSIONER HANSFORD: The wonders of modern technology 5 Thank you. 6 CHAIRMAN: Thank you. So long as it's being dealt with, 7 because we appreciate Prof Au's concerns, and it may be, 8 it may not be, our decision, once we've heard all the 9 evidence, that perhaps, in the interests of caution, if 10 nothing else -- and we make no assessments of anything 11 at this stage -- 12 MR CHOW: Understood. 13 CHAIRMAN: -- that those tests or those calculations should 14 be conducted. 15 MR CHOW: Understood. 16 CHAIRMAN: Thank you very much, Mr Chow. 17 Mr Boulding. 18 MR BOULDING: Good afternoon, sir. Good afternoon, 19 Professor. As I promised, I am now going to call the 20 MTR's structural engineering expert, Dr Glover. 21 Dr Glover, good afternoon. Welcome to the 22 Commission. 23 WITNESS: Thank you. 24 25</p>
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<p>1 be reasonably easy to conduct in a short time span; and 2 secondly, as a fallback, in the case of real concern, 3 certain tests -- okay? 4 Let's leave the tests at the moment. What we are 5 more concerned with is an outline of those mathematical 6 calculations, put together in a way that people who 7 understand these things are able to deal with, so that 8 we can, if necessary, give directions as to those 9 mathematical calculations. 10 MR CHOW: Yes. Sir, I am actually in a position to inform 11 the Commission that as far as I know, over the past few 12 days, Prof Au has been working on this and we have got 13 to a stage where the document is almost ready to be 14 served. 15 I understand that originally there was a deadline 16 imposed by the Commission which was, I believe, 17 yesterday, and we have been working hard on this and 18 I understand that the document is almost ready to be 19 served. 20 COMMISSIONER HANSFORD: I'm slightly confused by that 21 answer, Mr Chow, because all we were expecting was 22 a list of those things that needed to be done. Are you 23 saying not only do we get the list but he's actually 24 done them? 25 MR CHOW: No, just the preparation of a list.</p>	<p>1 DR MIKE GLOVER (sworn) 2 Examination-in-chief by MR BOULDING 3 MR BOULDING: So you have given your name to the learned 4 Commissioners. Please give them your professional 5 address. 6 A. Ove Arup & Partners, Hong Kong. 7 Q. You have prepared, have you not, a report for the 8 Commissioners' assistance, and perhaps we can get that 9 up -- ER1, tab 6 -- and look at the cover page. 10 A. That's correct. 11 Q. That's the first page of your report, 17 January. 12 Please go on to page 16. Do we there see your 13 signature above the date of 7 January 2019? 14 A. That's correct. 15 Q. Insofar as that report contains facts, are they facts 16 which you honestly believe to be true, Dr Glover? 17 A. Most certainly. 18 Q. Insofar as they contain opinions, are they opinions 19 which you honestly hold? 20 A. Yes. 21 Q. You signed a joint memorandum. I wonder if we can look 22 at that. ER1, tab 3, page 120. If we could scroll down 23 a little bit -- that's the manuscript version -- is that 24 an agreement which you signed on 18 December 2018? 25 A. It is.</p>

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<p>1 Q. Do you still hold the views and agreed propositions 2 which are signed off therein? 3 A. I do. 4 Q. So far as you are concerned, were all experts content to 5 sign that joint memorandum? 6 A. Yes. 7 Q. Right, Dr Glover. I understand you have prepared 8 a little presentation for us, and that first of all you 9 are going to tell us a little bit about yourself, and 10 then, as I understand it, you are going to give all 11 present a summary of your views. Is that the situation? 12 A. That is correct. 13 Q. Over to you, Dr Glover. 14 A. Good afternoon. My name is Mike Glover, I'm a fellow of 15 the Institution of Structural Engineers and a fellow of 16 the Royal Academy of Engineering. I was made an Arup 17 fellow in 2016, in recognition of the highest design and 18 technical achievements of an Arup person. It's a great 19 honour to have that. I was awarded the 2007 Sir Frank 20 Whittle Medal by the Royal Academy of Engineering, the 21 first civil engineer ever to receive it, and the gold 22 medal of the Institution of Structural Engineers in 2008 23 for outstanding contributions to the design and 24 construction of major multi-disciplinary projects. 25 In 2009 I was awarded an OBE in the New Year's</p>	<p>1 attending Prof Au's lectures on the same subject. I'm 2 sorry for that little brief interlude but I think the 3 exchange earlier in the sessions deserved that. 4 So from the outset of my career, I've had a strong 5 insight into the drafting of guidelines for codes and 6 standards, and most of all the fundamental importance in 7 my career of two things: one is research and the other 8 one is development. You will find that in practically 9 every project I've done. There's always a degree of 10 research and development and experimentation in them. 11 So, after research and development, I was thrust 12 into the world of high-tech architecture, which 13 culminated in the design and construction of the 14 Hongkong and Shanghai Bank here in Hong Kong, and some 15 of the research that we carried out on that was really 16 quite ground-breaking. Interestingly enough, that's 17 where I first initiated tests on -- not couplers but the 18 hangers that hold the whole building up. Some of them 19 have solid ingots and others are tubes, but they are all 20 screwed, they are all threaded. So one of the big 21 threats we had was: what if they aren't secured? 22 So we carried out a very, very extensive, full-scale 23 research in the UK to test various levels of engagement. 24 My mechanical engineering friends told me that this was 25 obvious, you know, all bolts, all screwed threads are</p>
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<p>1 Honours list for services to engineering. I emphasise 2 "to engineering" because of my wide involvements which 3 are much wider than just structural engineering, 4 although structural engineering is my key skill. 5 As to the detail of my career -- well, you can do 6 a lot in 50 years -- I had the good fortune of -- yes, 7 I am that old -- I had the good fortune of starting in 8 Arup, who I had the relationship of my career, and 9 I started in Arup research and development. At the 10 time, we were assisting the C&CA, that's the Cement and 11 Concrete Association, in drafting the first limit state 12 code; we used to call it the unified code. That was 13 published in 1972 as CP110, which interestingly enough 14 the existing Hong Kong Code is a direct descendant. 15 My period in R&D, as I refer to it, coincided with 16 the aftermath of the Ronan Point disaster which Prof Au 17 referred to in his expert report, and I was involved in 18 producing the initial guidance on how we should 19 introduce robustness into our designs. And subsequently 20 CP110 became the first international code to overtly 21 specify requirements for robustness, and those same 22 guidelines are found in the Hong Kong Code today, 23 40 years on. 24 I hope, therefore, everyone present can understand 25 why I would like to politely excuse myself from</p>	<p>1 designed to have a level of percentage which is less 2 than 100 per cent, and I haven't got the records in 3 front of me but I think we came to the view after these 4 tests that we wouldn't be happy with 50 per cent but if 5 by accident it happened to be 50 per cent, we could 6 sleep well in our beds. 7 So this idea of lack of 100 per cent engagement is 8 not a new issue, and indeed our experiments weren't new. 9 I mean, they were just really following in the paths of 10 all those wonderful people who have made screws in the 11 past. So I just wanted to put that into context. 12 That's the sort of theme of my life. It's really, 13 if there is an uncertainty, if there is an unknown 14 dimension to something, one clicks into a process, and 15 what is that process? That process is, first of all, 16 doing some initial concepts/calculations. The next 17 thing is you do a mock-up or a prototype. Do excuse the 18 people around me, it might just be one. But that one is 19 important because it gives you an indication of which 20 direction you go next. And the next stage is you do 21 formal tests. 22 So at each stage of the process you are going 23 through, you are actually testing the hypothesis. You 24 don't go immediately to testing things, because that 25 wastes energy, so you walk up to it. The parallel that</p>

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<p>1 you've got before you now is BOSA have done some 2 calculations, there's an indication that it could be 3 successful, there have been some limited tests carried 4 out, but they are not detracting from the course of 5 direction. And as I will give in my presentation later, 6 MTR are about to embark upon a full-scale test which 7 will satisfy the criteria of the specifications which 8 are set down by various organisations, and I think that 9 will bring a full stop to that issue.</p> <p>10 For those doubting Thomases in the audience, yes, it 11 will involve what I think is being called elongation or 12 something -- yes, elongation -- and I will go into that 13 a little bit more in my presentation.</p> <p>14 So I make those statements at the outset because 15 they seem to be recurring concerns, so I just wanted to 16 pick up on those as we went.</p> <p>17 After the Hongkong Bank, I decided I wanted a change 18 from buildings, particularly working with high-signature 19 architects in that sense, so I did some prime agency 20 work in the oil and gas industry, and we came up with 21 prototype concrete gravity platforms for the North Sea 22 and we built quite a number of them around the world, 23 and I enjoyed that very much, and I enjoyed the prime 24 agency issue, really, the design and taking it through 25 to construction. In other words, having the actual idea</p>	<p>1 way, at 230 kilometres per hour, so that can burst the 2 ears if you are not watching out, so we've got lots of 3 vent shafts.</p> <p>4 All I'm trying to get across to you is that this is 5 sheer excitement of engineering; that's what matters to 6 me.</p> <p>7 Then as soon as I finished that, I found myself 8 being the technical director for the client for let's 9 call it the third Forth Bridge in Scotland, which -- I'm 10 very proud of it, and I'll come on to why I'm very proud 11 of it a little bit later. Again I took that right 12 through from inception, took it through the 13 parliamentary process, in select committees, and right 14 the way through to it getting opened, and that is 15 substantially under budget.</p> <p>16 With projects like that, I think you will get 17 a feeling for the emotion and passion I show for what it 18 is, that the things I do are hands-on. I'm a doer, not 19 a watcher. I think that's a very important property 20 to have in an individual.</p> <p>21 As to my remit today, to be clear, I've been 22 appointed by MTR to present expert evidence to the 23 Commission on structural engineering matters, and on 24 such evidence I am completely independent, and my sole 25 objective is to assist you, the Commission, in its</p>
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<p>1 and then actually making it. I always find the design 2 process, it's only a means to an end, and people who 3 spend their whole life just thinking about design, they 4 have missed something. That's what it is, it is that 5 continuous thinking process which is important in what 6 you do.</p> <p>7 But then I got whisked away to be the technical 8 director and the deputy project director for HS1, the 9 first high-speed railway in the UK. I was effectively 10 the chief engineer.</p> <p>11 The project, how do you did describe it? 7 billion 12 pounds, and I took it through the approvals process, the 13 design process, procurement, construction, 14 commissioning, and the final handover, to cost and 15 programme. I think that's a theme of practically 16 everything I have ever done in my life. That matters to 17 me. It's that balance between achieving the objective 18 that the client wants both in terms of the artefact but 19 also that it cost him what he thought it should do and 20 he gets it when he wants it.</p> <p>21 That project, just to give you a feeling for the 22 scale, 150 bridges, 50 kilometres of very large diameter 23 tunnel under London, the largest tunnels that had ever 24 been -- in fact probably still are the largest, at 25 8 metre diameter. Our trains go through there, by the</p>	<p>1 deliberations.</p> <p>2 I think that's enough about me, so I'd like to start 3 the presentation, really, in that sense.</p> <p>4 CHAIRMAN: Yes, of course.</p> <p>5 A. Before I actually start the presentation proper, I would 6 like to share with you some lessons or some particular 7 lessons I've learnt from my experience, and I think they 8 are poignant. They might be at slightly left-field but 9 I feel I want to say them, because I do have 10 a longstanding relationship with Hong Kong and I like 11 mankind to move forward, but I like Hong Kong and I want 12 to see it prosper.</p> <p>13 I'm a strong believer that a career should be 14 a constant learning experience, but the only reason you 15 learn for yourself is because you can share it with 16 others, and that's why I want to say just a few words, 17 really.</p> <p>18 I'm very proud of the new Forth Bridge. It's 19 world-beating, it's novel in so many ways, and you would 20 think that would be enough. But no, the real 21 achievement, the real success there, was taking 22 a project, when we started, which was estimated to cost 23 4 billion pounds, but we delivered it for 24 1.35 billion pounds.</p> <p>25 You ask yourself: how do you do that? Is it magic?</p>

<p style="text-align: right;">Page 93</p> <p>1 Is it the same bridge? Well, no, it can't be the same 2 bridge, it's just more beautiful. But there are things 3 you do right at the outset which become so important. 4 Some of them might be a little too near the bone for 5 this audience so I will just pick on some of them. Some 6 of them were very innovative engineering. Maybe you 7 would expect that from Arup, but actually it comes from 8 a freedom of thought, not crushing things. It's 9 fundamentally creating a single focus on delivering the 10 project for whoever is involved in the project. 11 COMMISSIONER HANSFORD: Sorry, did you say not crushing 12 things? 13 A. I'll just elaborate on that. 14 COMMISSIONER HANSFORD: Okay. 15 A. It is crushing, yes. 16 COMMISSIONER HANSFORD: That's fine. Thank you. 17 A. You've got to get people -- I call it the flag on the 18 hill -- you've got to get every member of the team -- 19 and the team is not just the people who are the 20 designers or the specifiers. They are the approvers, 21 they are the third parties, they are the community; 22 you've got to get everybody -- it's hard work, but when 23 you do that, you've got everybody aligned. Everybody 24 can see the flag on the hill. There's no them and us. 25 It's them and us that costs you money in projects, but</p>	<p style="text-align: right;">Page 95</p> <p>1 My report and this presentation are looking at the 2 design and construction on a strictly 3 fitness-for-purpose basis. I'm not seeking to 4 demonstrate compliance. I'm just trying to demonstrate 5 safety, on the basis of fundamental physics and 6 experience. 7 The first thing I would say, that ho hum -- sorry, 8 Hung Hom. I'm sorry, I nearly broke into song there. 9 I didn't mean to. It could be a good one, couldn't it? 10 CHAIRMAN: That's a very interesting malapropism. 11 A. It's a very unusual structure and I've not heard people 12 referring to it as being unusual. People just look at 13 problems and things but I look at it as a structure. 14 It's quite unusual for a number of characteristics and 15 I'll try to pick out a few of those as we go through. 16 But I think some of the issues you've been 17 confronted with are a direct product of that. There's 18 a danger of always looking at construction and saying 19 there's this in construction, but it's not. It has its 20 roots right the way back in its concept, right the way 21 through its design, and all you're seeing is the end, 22 the result of that process. 23 With that as the backcloth, maybe I could go to the 24 slides. 25 MR PENNICOTT: On the screen.</p>
<p style="text-align: right;">Page 94</p> <p>1 if everybody is rooting for that objective, it's quite 2 remarkable how the pounds, or in this case the Hong Kong 3 dollars, fall away. 4 So that's fundamentally important, but one of the 5 subsets of that is that you must challenge compliance 6 rules right from the outset, because those are the 7 things that crush ideas at the beginning, and if you 8 don't have the ideas and the enthusiasm at the outset, 9 you will never get them as you go through. 10 So all I'm saying is the best projects in the world, 11 the projects that create great engineering, are ones 12 where everybody is pulling in the same direction, and if 13 you find any situation where someone's pulling in the 14 opposite direction, if you're a client, you sort it out, 15 because it's going to destroy the project. 16 So I'm sorry about those thoughts. Some people 17 might think they are completely left-field. But I feel 18 very passionately about them and they are the hallmark 19 of what I do with my life. 20 COMMISSIONER HANSFORD: I think they are very helpful. 21 A. Thank you. 22 Now to my presentation. I'd like to make it clear 23 that in my opinion, the structure is safe, and I will 24 try to explain the reasons why I formed that opinion in 25 this short presentation.</p>	<p style="text-align: right;">Page 96</p> <p>1 A. Do I just say "next slide"? 2 Next slide, please. I haven't done this for ages, 3 saying "next slide". It's quite refreshing; I'll have 4 to try to think about this. 5 I'll deal with the project by going through a whole 6 series of headings, and these are headings that I can 7 speak to, but they are at the heart of what the project 8 is about. 9 Prof Au says in his report, in paragraph 6.1.1, that 10 ductility is a desirable quality in structures. I would 11 go further than that. I would say, firstly, the 12 Hong Kong Code is misleading in the sense that it has 13 a section called "Ductility". In other words it's 14 implying that if you don't do this, you don't get it. 15 Well, that's absolute nonsense, because all reinforced 16 concrete is ductile, provided the tension, the 17 reinforcement, is what controls the design. In other 18 words, the steel components should be slightly weaker 19 than the concrete, and in that case, whenever you have 20 a bending moment or something, the first thing that 21 starts to yield is the steel. 22 So you don't need a special clause called 23 "Ductility". That's the first thing that I would say. 24 I don't really understand why that should be mandatory. 25 But I'll go on to why I think it's there. It's because</p>

Page 97	<p>1 the sort of detailing that you are seeing in that</p> <p>2 particular clause, 9.9.1.1, is the sort of detail we</p> <p>3 would use in real seismic areas, and Hong Kong is not</p> <p>4 a high seismic area. And the reason why you have those</p> <p>5 particular details is because you get what we call</p> <p>6 stress reversals. In heavy ground shaking, things move</p> <p>7 backwards and forwards, so something that was in tension</p> <p>8 becomes compression so you get that action</p> <p>9 (demonstrating with hands).</p> <p>10 Well, that won't happen in Hong Kong and it most</p> <p>11 certainly won't happen with a rigid box sitting in the</p> <p>12 ground. So I think there seems to be a slight</p> <p>13 misapprehension as to how to apply that particular</p> <p>14 clause to this type of construction. That's my opinion.</p> <p>15 Could we go to the next slide, please. I just</p> <p>16 wanted to explain to people what ductility is, and this</p> <p>17 is going to be difficult without a pointer but I'll try</p> <p>18 my best.</p> <p>19 COMMISSIONER HANSFORD: You can get a pointer because the</p> <p>20 operator can put a little hand on.</p> <p>21 A. Could you take it up to where the 560 is and where it</p> <p>22 links across to the yellow. That's it. That's what we</p> <p>23 would call the notional yield point. If you loaded</p> <p>24 something from zero, it would go up to about the 560 and</p> <p>25 then it would follow the line back again when you took</p>	Page 99	<p>1 trouble with so I try to keep the scale.</p> <p>2 So that's appropriate. Under normal loading, you</p> <p>3 would want there to be no permanent deformation.</p> <p>4 Take the case where you have a very strong ground</p> <p>5 motion from an earthquake. There you want survivability</p> <p>6 of the occupants, so therefore you can accept permanent</p> <p>7 deformation. Some of it, if it's a small amount, it</p> <p>8 could be recovered and you can use the building again,</p> <p>9 but normally it would be demolition.</p> <p>10 On the next slide, hopefully -- yes, here we are --</p> <p>11 the codes talk about critical zones, plastic zones, and</p> <p>12 these are shaded on the top diagram, and these are where</p> <p>13 these plastic hinges occur, which allows the structure</p> <p>14 to sway, as shown as the bottom.</p> <p>15 If you go to the next slide, you will see that's not</p> <p>16 what we've got. We've got a really substantial stiff</p> <p>17 box, which actually, if there is -- and the earthquakes</p> <p>18 you get in Hong Kong will tend not to be of long</p> <p>19 duration or -- they will be high energy but they tend to</p> <p>20 be in the high frequency areas -- so the box is really</p> <p>21 held very steady, and the ground would dampen any large</p> <p>22 movements.</p> <p>23 This is the experience around the world. Box</p> <p>24 structures have survived very, very heavy ground</p> <p>25 movement, remaining effectively in their elastic zone.</p>
Page 98	<p>1 the load off. That's what we call elastic. So you load</p> <p>2 it on and it comes back.</p> <p>3 We say that's recoverable shortening or deflection.</p> <p>4 So that's the elastic zone.</p> <p>5 If you then take the pointer from that point and</p> <p>6 move it to the right -- there it goes; keep going, right</p> <p>7 to the end -- where the pointer is going is the plastic</p> <p>8 portion of the curve, and ductility really is the ratio</p> <p>9 between the elastic portion and the ductile portion, and</p> <p>10 this one, looking here, it's probably a ductility ratio</p> <p>11 of five. In other words, you can get five times the</p> <p>12 energy absorption out of a plastic zone than you do out</p> <p>13 of the elastic.</p> <p>14 And why the plasticity is so important is because</p> <p>15 it's absorbing energy. Normally, if you want this</p> <p>16 building -- if this building was, I don't know, you took</p> <p>17 your pet hippopotamus walk across the floor, it would</p> <p>18 deflect, but you wouldn't want it to stay there, you</p> <p>19 would want it to come back, so it stays in the elastic</p> <p>20 range.</p> <p>21 COMMISSIONER HANSFORD: Sorry, if you took what for a walk</p> <p>22 across --</p> <p>23 A. A hippopotamus. I chose a hippopotamus rather than</p> <p>24 an elephant, because a hippopotamus, you could get it</p> <p>25 through the door, but an elephant you would have some</p>	Page 100	<p>1 It's because --</p> <p>2 COMMISSIONER HANSFORD: Where, for example?</p> <p>3 A. California, for example. I don't have experience of</p> <p>4 Japan so I'm not going to go that far. Japan is very,</p> <p>5 very seismic, much more seismic than California, for</p> <p>6 example.</p> <p>7 So assuming a box like that is seismically sensitive</p> <p>8 in an environment like Hong Kong is not correct.</p> <p>9 But I'll use that particular slide to explain some</p> <p>10 of the reasons why I say this construction is a little</p> <p>11 bit different. It is because if you see the arrow that</p> <p>12 says "EWL slab" -- well, that slab is 3 metres thick,</p> <p>13 and that's very, very exceptional for a suspended</p> <p>14 construction. We wouldn't maliciously do something like</p> <p>15 that. There has to be a reason for it, and that's what</p> <p>16 makes it exceptional. The reason in this case is we</p> <p>17 need to get as much deadweight, vertical weight, as we</p> <p>18 can to stop uplift, because -- there are no dimensions</p> <p>19 on this but the underside of the lower slab, called the</p> <p>20 NSL slab, is 15 metres below ground, and groundwater is</p> <p>21 potentially near ground level, so you've got 15 metres</p> <p>22 of water trying to push this structure out of the</p> <p>23 ground, and so the only way you can fight against that</p> <p>24 is by using mass. The Hong Kong codes don't allow us to</p> <p>25 use what we call adhesion on the side of things; we have</p>

<p style="text-align: right;">Page 101</p> <p>1 to use mass. And so therefore we have to find something 2 equivalent to 5 metres of mass in the construction to 3 keep the water down. The way that is done is a 3 metre 4 slab at EWL level and a 2 metre slab at NSL level. 5 COMMISSIONER HANSFORD: Why that way around? 6 A. This was a design decision, as I understand it, and it 7 was that there was sufficient headroom between the NSL 8 level trains and the EWL that they could use that depth. 9 If they had done it the other way around, we would 10 have had to go deeper, because -- a lot of people don't 11 realise this but trains don't just go up and down hills, 12 they have very controlled gradients and so the line the 13 trains come in on the NSL, that's the level it has to 14 be, within a few metres. 15 COMMISSIONER HANSFORD: I see. 16 A. So really the decision to put the 3 metre slab there, 17 although it is extremely unusual, the engineering 18 justification for it is very, very sound and very solid, 19 and interestingly enough, even -- although I had shock 20 horror of seeing it in the first place -- I can 21 understand the logic of it and I wouldn't contest that 22 idea. 23 But it does generate its own issues, and some of 24 them very positive, actually. 25 So that's what makes this one particularly special,</p>	<p style="text-align: right;">Page 103</p> <p>1 COMMISSIONER HANSFORD: Albeit quite a thin one. 2 A. That one looks thin but there are some more substantial. 3 COMMISSIONER HANSFORD: Okay. 4 A. You've got to remember, when you build something into 5 something that's already there, there are locked-in 6 stresses and locked-in deflection. I wouldn't want to 7 alarm you. I mean, a 3 metre slab spanning something 8 less than 24 metres is more like an arch -- it's going 9 to turn into a lecture, I've got to watch out -- but 10 that's one of the other issues about robustness. People 11 normally -- and I think Prof Au used the term 12 a catenary, you know, you -- with a thin slab, it 13 certainly would go into a catenary and -- that's what it 14 is. But a structure like this, the fire -- the 15 structure expands and really it tends to arch. You 16 know, it can -- 17 COMMISSIONER HANSFORD: Perhaps colleagues will excuse my 18 enthusiasm for this but I'm rather interested. 19 A. Well, that's the way the structure works. And believe 20 me, this structure's got plenty of -- I use the 21 definition very appropriately here it's got plenty of 22 robustness; it's not going anywhere. 23 So I thought, to give some context to some of the 24 issues, it would be worth just explaining some of that 25 to you.</p>
<p style="text-align: right;">Page 102</p> <p>1 the geometry. 2 The second thing that makes it very interesting -- 3 and this is why a lot of people are saying they don't 4 believe the utilisation values that are being talked 5 about -- is it's a structure which has two lives. The 6 first life is when it's being constructed, and that is 7 where the EWL slab that you can see on the slide has no 8 other supports, other than the two diaphragm walls on 9 either side. So it's free-spanning. And during that 10 condition, it's subjected to the most onerous 11 construction loads, not just because it's spanning circa 12 24 metres but because it's got all the soil coming out, 13 the heavy plant dragging the materials out from 14 underneath. 15 So, as a consequence, the slab to a very large 16 extent experiences its worst loading case. 17 COMMISSIONER HANSFORD: During construction? 18 A. During construction. Once they have dug down and they 19 have formed the NSL slab, you notice that there's 20 a couple of green lines sticking up. 21 COMMISSIONER HANSFORD: Yes. 22 A. Well, they become secondary columns and supports. So 23 the second life of the EWL slab is one where it is in 24 a much more benign environment, where it's undergone its 25 worst conditions and it's got vertical supports.</p>	<p style="text-align: right;">Page 104</p> <p>1 If I could move on to the next slide now and talk 2 about seismicity. I just want to -- I won't spend so 3 much time on this one, because nobody is contesting the 4 fact it's a low to moderate seismicity. The Hong Kong 5 Code doesn't even have a chapter on it. MTR in their 6 wisdom have got a nominal load of 7 per cent G. 7 7 per cent G on a world scale is very, very nominal 8 load; it's not -- it's a prudent measure. Interestingly 9 enough, something like that would be much more important 10 on an elevated bridge or something, but something in the 11 ground, I wouldn't say it's token; I think "nominal" 12 would be a better word. But as I've said earlier, 13 sub-ground structures, like the box, perform extremely 14 well in earthquakes, if you can perform very well in 15 an earthquake. 16 The other thing I draw -- I did do, and I do 17 apologise for the quality of my calculations, I'm 18 getting a bit older now, but I did include a calculation 19 in appendix C to explain why the EWL slab never becomes 20 ductile; it remains elastic, no matter -- even if you 21 did have a California-type earthquake, it's just not 22 physically possible to become a ductile structure. So 23 the idea of using ductile couplers is clearly just not 24 appropriate. I mean, by all means use ductile couplers, 25 because they are very robust and they don't seem to cost</p>

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<p>1 a lot more than the other, but they are not serving</p> <p>2 a function of ductility.</p> <p>3 The other important thing is because of its sheer</p> <p>4 mass and because of the fact that it sits in this box,</p> <p>5 it means that it doesn't undergo stress reversals, as</p> <p>6 I was saying about the things (demonstrating with</p> <p>7 hands); it only knows about either direct tension or</p> <p>8 direct compression.</p> <p>9 The other thing to emphasise is that the base, the</p> <p>10 bottom of the slab, as it joins the wall, is permanently</p> <p>11 in compression. With all due respect to Mr Chow</p> <p>12 earlier, the idea of there being a sagging moment to the</p> <p>13 support, I hope that you understood what we were saying</p> <p>14 about load combinations. That particular -- I think</p> <p>15 it's called PERM 5 -- it never exists as an individual</p> <p>16 situation. It's only a component. And if necessary, if</p> <p>17 you wanted me to, in discussion, I could explain</p> <p>18 a little bit more, but it never goes into sagging and</p> <p>19 indeed Prof McQuillan's diagram, you should stay with</p> <p>20 that as your knowledge base, I think.</p> <p>21 So if I have the next slide, I think, please. Oh,</p> <p>22 that's the calculation which I apologise for, so we can</p> <p>23 skate over that.</p> <p>24 COMMISSIONER HANSFORD: You are only apologising for your</p> <p>25 handwriting, are you?</p>	<p>1 them are distressingly high. I'm a great believer in</p> <p>2 not having exception solution designs, in other words</p> <p>3 don't design for the maximum. You've got to design for</p> <p>4 something lower than that and deal with the maximums.</p> <p>5 But there are no maximums that I've found or that Atkins</p> <p>6 have drawn to our attention that would cause alarm in</p> <p>7 this structure.</p> <p>8 COMMISSIONER HANSFORD: The reason you say you are a great</p> <p>9 believer in not designing for the maximums, Dr Glover,</p> <p>10 is because presumably, if you design for the maximum,</p> <p>11 you are always overdesigning and it costs a lot more?</p> <p>12 A. It costs a lot more. It costs a lot more time. There</p> <p>13 is a lot more that can go wrong. I've always tried to</p> <p>14 bring my team up with the attitude of do the simple</p> <p>15 things simply to buy time for those things that we know</p> <p>16 we're going to deal with, otherwise you are just caught</p> <p>17 out, you know. The other thing -- you really are</p> <p>18 starting me off now -- you've got to do at the outset of</p> <p>19 any project, you've got to be very honest about what you</p> <p>20 don't know. If I was to think about what the most</p> <p>21 important thing about starting a project is you sit down</p> <p>22 with your key team and say, "What don't we know?",</p> <p>23 because those are the things you've got to embark upon</p> <p>24 your research programme then.</p> <p>25 So often you see with projects people bump into</p>
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<p>1 A. No. I'm not trying to hide any errors on that. I'll</p> <p>2 take you through it if you want me to. Are you sure?</p> <p>3 I'm quite happy to.</p> <p>4 COMMISSIONER HANSFORD: I made the point yesterday that</p> <p>5 I think it's unwise for lawyers to get into structural</p> <p>6 calculations.</p> <p>7 A. I don't know, you may want to change career.</p> <p>8 Could you go to the next slide.</p> <p>9 You've heard a lot of strength utilisation and</p> <p>10 basically it's the ratio between two numbers. One is:</p> <p>11 what is the maximum strength of this component on the</p> <p>12 bottom, and on the top is, what is it actually being</p> <p>13 stressed to at the moment? It's just a simple ratio.</p> <p>14 And it's a measure, obviously, of how hard the structure</p> <p>15 is working. A high percentage means it's working very</p> <p>16 high and obviously a low one means it's not working very</p> <p>17 hard at all. I'll illustrate that a bit later.</p> <p>18 If I could go to the next slide, please. This is</p> <p>19 just to emphasise why I have the confidence in the</p> <p>20 utilisation values. Atkins, the designer, have covered</p> <p>21 every single element in the structure, as you would</p> <p>22 expect, and they have come forward with generally --</p> <p>23 I say generally low -- less than 50 per cent, let's call</p> <p>24 50 per cent of the benchmark. There are a few areas</p> <p>25 where there are hotspots, what I could call, but none of</p>	<p>1 something later on and it's too late. You know? I'm</p> <p>2 not going to say I'm infallible, please don't take it as</p> <p>3 that, because that's the quality of the team, no</p> <p>4 individual is strong enough to know everything. But if</p> <p>5 you've got the right team, and I don't just mean those</p> <p>6 people around you, but those people who positively think</p> <p>7 about the flag on the hill, then you rarely go wrong.</p> <p>8 Both ourselves have carried out spot-checks, as</p> <p>9 Arups, and COWI's report I thought was -- condescending</p> <p>10 slightly -- a good effort, but I thought it was</p> <p>11 well-conceived. They drew attention to 161 stress, as</p> <p>12 a good engineer would do, just innocently saying it's</p> <p>13 a boundary condition and suddenly a bonfire is lit.</p> <p>14 But, no, I fully understand the way it was modelled</p> <p>15 and you've got to cut a model somewhere and there's</p> <p>16 a discontinuity in it. I get that.</p> <p>17 We all find that we arrive at about that sort of</p> <p>18 50 per cent level, and some areas are actually lower.</p> <p>19 The next thing which reinforces my belief about</p> <p>20 these low levels is when you build a diaphragm wall, you</p> <p>21 put, let's call it, tubes. You cast a tube in the</p> <p>22 diaphragm wall.</p> <p>23 COMMISSIONER HANSFORD: We've been referred to tremie pipes.</p> <p>24 A. No, that's --</p> <p>25 COMMISSIONER HANSFORD: That's different.</p>

<p style="text-align: right;">Page 109</p> <p>1 A. That's for pouring the concrete. 2 COMMISSIONER HANSFORD: Okay. 3 A. You put -- interestingly enough, when you look at 4 a modern diaphragm wall, you think it's a piece of 5 scientific investigation. It is, in fact, because we 6 put tubes in for inclinometers, let's call it 7 a gyroscope, and the gyroscope measures the shape of the 8 tube, and so by integrating the rotations, basically, 9 you get deflection. 10 And so through the life of the construction, if you 11 drop the gyroscope down at weekly intervals, you get 12 a record of how the wall is moving. Some of the other 13 holes are for acoustics and other holes are for grouting 14 the base. 15 And so we've taken a number of those inclinometer 16 readings and they are all remarkably consistent that 17 there's hardly any movement in the wall. When I looked 18 at them I thought have they been out there measuring 19 them, but we've looked at about -- please don't hold me 20 to this, but well in excess of a dozen, and they are all 21 showing very low movements, and in fact, in some cases, 22 you reckon, on the depth of the walls we've got, 23 a tolerance of probably in excess of 5 millimetres, plus 24 or minus, thereabouts, and we are recording movements of 25 about 15, I think, that sort of number.</p>	<p style="text-align: right;">Page 111</p> <p>1 prudence. The other reason is that they have had some 2 bad experiences in the past, but I think those bad 3 experiences are not to do with the soil parameters, they 4 are to do with contractors not putting props in at the 5 right time. But there we are. But don't start me on 6 that issue. I will move on. 7 So there are all sorts -- basically what it's saying 8 is the soil is a lot stiffer than was expected. And 9 I've already said to you that there's a large reserve 10 capacity in the bottom of the slab, really, based on, 11 really, purely structural considerations. But having 12 said that, we would make sure there was enough steel in 13 there for robustness. There we are. 14 Could I have the next slide, please. I just wanted 15 to really touch on what that 50 per cent meant. I think 16 I've described to you this curve just now, but if you 17 look at the "460 characteristic strength", that's what 18 the discussion has been about, what is the bar that's 19 been used on the construction, and it's interesting on 20 this curve, this must have been a 500 bar, because you 21 can see it goes above the 460. 22 But we only design to 400, so although if a bar is 23 460, we reduce that by using material factors to 400. 24 So when we talk about ultimate limit state, we are 25 designing at 400MPa. But because of our load factors</p>
<p style="text-align: right;">Page 110</p> <p>1 So what does that mean? It's good news. It's 2 lovely. It really means, if you're not getting 3 movement, you are not getting bending moments. If 4 you're not getting bending moments, you're not 5 gaunching things, you're not applying load. 6 So the utilisations that I mentioned to you earlier 7 are all to do with calculated analyses. They are 8 predictions. But on the diaphragm wall, what I'm saying 9 to you is we can reduce those predictions I think with 10 a great degree of confidence. 11 COMMISSIONER HANSFORD: In your view, in your experience, is 12 that due to design or is that due to construction? 13 A. No, it's due to the assumptions. You could call it 14 design. In Hong Kong, they take an extremely 15 conservative view on the ground parameters. 16 COMMISSIONER HANSFORD: Right. 17 A. Because a site investigation is carried out, doing 18 boreholes and taking measurements called SPTs and CPTs, 19 and from that you can derive a model of the stiffness of 20 the soil. Then you have to make a decision where you 21 draw a line, because there's scatter on those results. 22 So do you draw the line down the middle, do you draw it 23 optimistically or do you draw it pessimistically? 24 Hong Kong being prudent, the BD and GEO, would tend it 25 to the lower line. One of the reasons for that is</p>	<p style="text-align: right;">Page 112</p> <p>1 the maximum the structure would be working at is the 2 260. That's the working stress. That's if you've got 3 the full load and the minimum amount of steel required. 4 COMMISSIONER HANSFORD: This is irrespective of the grade of 5 steel used? 6 A. No, it would be proportional. So if it was 500, then it 7 would be a ratio of -- 10 per cent higher, probably 300. 8 And I've taken a 460 bar because that's what it is. 9 But if you take 50 per cent utilisation, the stress 10 levels in the bars, they are down at 130, and throughout 11 our structure -- I say "our", I seem to be possessing it 12 now -- the levels are even lower than that, and if 13 I take into account the results from -- the inclinometer 14 results, you are probably down in the 60s and whatever. 15 So these issues that you keep hearing about, is it 16 going to crack or whatever -- well, I just can't see 17 how, to be honest, under loading conditions. There are 18 reasons you get cracks and they're not necessarily to do 19 with loading. They are to do with shrinkage. They are 20 due to all sorts of little features. But there's 21 nothing -- I've seen nothing alarming in the 22 superstructure or the diaphragm walls in my walk around 23 the site at all. 24 Could I have the next slide, please. This just 25 gives you the scale -- sorry, the yellow line is the</p>

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1 predicted deflection, and I call it the "Arup modified
 2 model" because we took the Atkins model and we made
 3 a few little adjustments for ourselves, you know,
 4 carrying out checks.
 5 So we were predicting -- let's call it 45, I don't
 6 want to be alarmist at 50, but the green and blue lines
 7 are us trying to work out what the actual stiffness of
 8 the soil is based on the inclinometers. You can see
 9 there's quite a dramatic difference, in fact more than
 10 I would have thought. We are about a third. Normally
 11 in Hong Kong, other experiences are that it's about
 12 40 per cent, but this is a bit -- it's in the bounds of
 13 expectation but it's lower than even I would have
 14 thought.
 15 Moving on, please, to the next slide.
 16 Basically, the discussion, while I've been here
 17 anyway, has always been about the coupler connections,
 18 and they are really -- they are in the top and the
 19 bottom of the construction, as we all know.
 20 As far as the EWL slab is concerned, there's only
 21 a few areas of couplers in the top. I say "a few
 22 areas", there are ten individual panels or parts of
 23 panels. And why are they there? They are there because
 24 of the sequence of construction. There was a whole
 25 series of underpinning works that had to be done early.

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1 So when the contractor started his alternative design,
 2 those temporary works were already in place and he
 3 couldn't replace them.
 4 So generally the top of the EWL slab is the
 5 contractor's alternative design, and I make no apology
 6 for saying that in my opinion it is a superior detail.
 7 I'm not going to say anything more about construction
 8 joint. I think everybody has trampled over that enough
 9 and we will see, as the Chairman says, what the
 10 calculations show.
 11 It's because of the geometry in the slab and its
 12 massive weight that the bottom is always in compression.
 13 You just can't avoid that. It doesn't matter how you
 14 look at it. If this had been a 300 millimetre slab,
 15 a tenth less, then there's every opportunity for
 16 a loading over here (demonstrating) causing the slab to
 17 bow upwards, in other words to have tension in the
 18 bottom. That's why in thinner slabs we do put
 19 reinforcement in the bottom, just against that. Take my
 20 pet hippopotamus going for a walk on one span; that
 21 would definitely make the other one want to come up
 22 a little bit. But those loading cases don't apply here.
 23 This is a massive piece of construction.
 24 The other thing I want to emphasise, in the last
 25 bullet point, there's no cyclic loading on those

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1 connections. There's a slight variation in tension, as
 2 Mr Southward pointed out. When a train, in a normal
 3 situation, would go by there's a slight increase in
 4 stress, but it's just a little bit. It's not cyclic in
 5 the sense you're going backwards and forwards.
 6 And the point that I've got to emphasise again and
 7 I don't want to bring up the earlier slide I showed
 8 you -- the trains on the EWL slab effectively sit on the
 9 D-wall, because the slab extends across it --
 10 COMMISSIONER HANSFORD: In some cases slightly off.
 11 A. Yes, it is. On one side you've got one wheel firmly on
 12 it and the other one slightly off, and on the other side
 13 it's right parallel to it. So it's not going to give
 14 you large vibration. It's going to give you -- because
 15 to get vibration, you've got to excite something, and to
 16 excite something you've got to be in a position where
 17 you can bounce it.
 18 So I've got no concerns about cyclic loading. In
 19 fact, it would be criminal to consider things like
 20 cyclic testings on things like that. I mean, you can go
 21 all sorts of things --
 22 COMMISSIONER HANSFORD: Criminal?
 23 A. It's criminal because it would mean that you would be
 24 rejecting an opportunity to use something. You are
 25 being malicious in your rejection of something which

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1 would otherwise be sound.
 2 COMMISSIONER HANSFORD: Interesting.
 3 A. I mean -- did I explain it well enough?
 4 COMMISSIONER HANSFORD: I understand. Yes.
 5 A. Could I have the next slide, please. This is to just to
 6 emphasise, really -- and I still don't understand why
 7 we've got the same amount of reinforcement in the bottom
 8 as you do in the top but I think that's -- it's not --
 9 I think it's best to pass over that really. Could we
 10 just stick with that one for a moment, because this
 11 diagram, I didn't realise it would show this quite so
 12 well -- you see the shear key, and you saw the
 13 photograph earlier, where there was this concern about
 14 was that A shape or whatever? Well, if you look at the
 15 four couplers at the top and you strike a line across
 16 under soffit of the four couplers, it coincides with the
 17 shear key. So what you were looking at in that
 18 photograph, on the right-hand side of the photograph,
 19 was the exposed reinforcement on the inside of the slab,
 20 where that blue line is on the inside, going through the
 21 shear key. So that's why it looked as if it was going
 22 like that (demonstrating); it was because actually it
 23 was a vertical cut to form for the shear key. That's my
 24 guess but I think it fits and I didn't realise this
 25 would do that quite so well.

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1 Does that make sense, sir?

2 COMMISSIONER HANSFORD: I think we might want to revisit

3 that point slightly.

4 A. I didn't mean to bring it in.

5 COMMISSIONER HANSFORD: No, no, no, I don't want to

6 interrupt your presentation, but there is a flip-chart

7 here, and maybe at a later stage, if appropriate, we

8 will see how that A shape might fit with this.

9 A. Okay. Look, believe me, I fully support Mr Southward in

10 terms -- I like As. As long as the surface is

11 prepared -- I mean, people think it's got to be like

12 that (demonstrating), but what about the construction

13 joint that there was going to be against the diaphragm

14 wall? That's vertical. You know, is that bad news?

15 No, it's all to do with the preparation of the surface

16 which is very, very important.

17 COMMISSIONER HANSFORD: That's fine.

18 A. And the other point that's come out in the discussion is

19 the doweling action that you get, you know, it controls

20 all sorts of things.

21 Anyway, next slide, please. And I think this one

22 probably does show what I was just saying quite well,

23 actually. If you see the blue area, it almost does

24 coincide with the shear key. But again I emphasise I'm

25 very happy with that detail.

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1 Next slide. Now the coupler characteristics.

2 I mean, there's a lot of talk that goes on about ductile

3 couplers. Well, type I couplers are ductile. The

4 stress/strain curve I've just shown you -- twice, I do

5 apologise for that -- that is the stress/strain curve

6 for a type I coupler. So type I couplers and type II

7 couplers are ductile.

8 The difference is that a type II coupler can take

9 the seismic loading, can take the stress reversals, and

10 that's really why, as Mr Southward said, if you are in

11 doubt about future environment, fatigue or whatever,

12 then you would put a type II in. It might not -- it

13 probably won't ever know any cyclic loading. So I'm

14 perfectly happy to see type II couplers in there, but

15 what I'm not so happy about is people suddenly putting

16 baggage on that decision and ascribing all sorts of

17 things to it which was never intended, like cyclic

18 loading: we've got to have this because it's got cyclic

19 loading. Well, it hasn't. It's perfectly happy sitting

20 there, taking direct tension or direct compression.

21 I think that really is -- for my fitness-for-purpose

22 basis, I'm quite happy for just direct tension and

23 direct compression and I don't wish to hear cyclic

24 testing mentioned again in terms of their fitness for

25 purpose, because it's not appropriate.

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1 COMMISSIONER HANSFORD: I fear you might.

2 A. Okay. I'm sure I might but I'm used to that. 50 years

3 makes you a bit impervious to some of these things.

4 Could I have the next slide, please. Now, the

5 strength characteristics -- I did say to you earlier

6 about some of the earlier research I did in my life, so

7 I wasn't surprised with 60 per cent. In fact, I think

8 if you were pushing it you would go to 50. That's why

9 I'm happy with 60, because I think it gives you

10 a prudent reserve.

11 But I'll come on to that later. It requires this

12 next stage in my three stages of arriving at the full

13 stop, which is proper testing. And indeed they are --

14 MTR are embarking upon the testing programme that

15 I would expect, which would be nine specimens of each

16 engagement, and statistically that is what you would use

17 in a production engineering situation. If you are

18 looking for whether a batch is strong enough, you would

19 tend to take nine samples from something in excess of --

20 I think the overall I used to use was -- anything in

21 excess of 500 as a batch, you would take nine and you

22 would test them, to demonstrate that the batch was good,

23 and that would hold for even larger numbers, 1,000,

24 2,000 or whatever.

25 COMMISSIONER HANSFORD: You have been appointed by MTR, but

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1 of course you are independent.

2 A. Yes.

3 COMMISSIONER HANSFORD: But I don't think we've heard about

4 these additional tests from MTR. Do you know when?

5 Have you been told when these are happening?

6 A. I think they are very imminent and I think these have

7 been discussed with BD. I don't think they've just gone

8 out on a limb.

9 COMMISSIONER HANSFORD: Perhaps Mr Boulding will tell us

10 about that at an appropriate stage.

11 A. Yes. I'm sorry if I --

12 COMMISSIONER HANSFORD: That's fine. This is very useful.

13 A. I'm quite excited about it, actually. It would be

14 lovely, pulling things apart, getting to the bottom of

15 things, that's what you want, stop talking about it and

16 do it.

17 Anyway, subject to the successful outcome of those

18 tests, I think 60 per cent engagement -- where do you go

19 after that? You've done everything you can.

20 Sorry, next slide, please. Oh, yes, I had to put

21 this one in. I do apologise. This is another example

22 of where following the rules will trip you up. The NSL

23 slab has been designed as a suspended slab -- I only

24 brought this up because it came out in discussion

25 I think yesterday. Mr Chow, you brought it up, I think.

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1 The slab is designed as a suspended slab, so
2 therefore it's a suspended slab as far as the world is
3 concerned. That's like me saying black is white,
4 because physics has a way and natural life has some
5 other ways of telling you that it doesn't matter how
6 you've designed it, it's how it will work, and if you
7 cast a slab on the ground which has been surcharged for
8 over 50 years by soil which is 15 metres deep, which is
9 probably approaching 3 tonnes a square foot, you are
10 going to assume that that's going to settle under the
11 slab? There's more likelihood it will swell.
12 So designing it as a suspended slab is effectively
13 putting an air gap under it. Now, you say, okay, that's
14 conservative, and the water is going to come along and
15 lift it up and that's all right. But the problem is
16 that slab is connected into the diaphragm walls on
17 either side, so the mathematical design assumes the slab
18 deflects or pulls the wall over in a hogging fashion,
19 and then when you put the water on, it pushes it up, but
20 the datum point for the pushing up is in this sag
21 position. I can do a sketch to explain. But what it
22 is: it's unsafe.
23 COMMISSIONER HANSFORD: A sketch would be helpful.
24 A. I'm not very good at drawing.
25 COMMISSIONER HANSFORD: The next page.

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1 A. I don't want to spoil that.
2 Of course, that's evidence of what was said.
3 COMMISSIONER HANSFORD: Do the drawing first.
4 A. Okay. Let me do the drawing.
5 (Drawing on the whiteboard) This is the diaphragm
6 wall. A shear key. Very important. A slab.
7 COMMISSIONER HANSFORD: This is the NSL?
8 A. This is the NSL, I'm sorry, yes. And ground.
9 Now, if you design it as if there's an air gap, and
10 believe me it's going to be fictitious, the slab will
11 tend to go like this (demonstrating with hands). At
12 that point, it's hogging, but it will sag down.
13 What that does is it pulls this wall, it puts
14 a bending moment in the wall (drawing an arrow).
15 Now the water comes along and we are talking about
16 15 metres of water, which is pretty considerable, and
17 the slab does this (drawing arcs), and it then pulls the
18 wall that way (indicating).
19 The problem with that is it started from a position
20 that was down here, so let's call that M1 and that's M2.
21 So the difference is M2 minus M1. But the reality is M1
22 is zero. So the fact that you assumed it was sagging,
23 put a bending moment which was fictitious into the wall,
24 so when the real pressure came on, you were found -- in
25 fact, this is really why, if you look at our Plaxis

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1 report that we did, the bending moment down here becomes
2 more critical than the bending moment up there.
3 So it was a near-run thing, mathematically, but
4 fortunately the wall never moved anyway. But it's
5 a warning, really, of where following rules is daft.
6 You've always got to ask whether the rule is
7 appropriate. That's all. That's all I ever ask. You
8 know, rather than, "You do it that way or you don't do
9 it at all" -- I mean, that doesn't make any sense.
10 COMMISSIONER HANSFORD: Are you saying following rules
11 blindly is daft?
12 A. No, I say "following questions unquestioningly". No,
13 the blind is not -- unquestioning is a much better way
14 of doing it, because I'm sure everybody wants --
15 COMMISSIONER HANSFORD: No, I was just trying to understand
16 You weren't saying following rules is daft?
17 A. No. I think rules are important in any society. But
18 you've got to understand whether the rule is
19 appropriate, and you can only do that by asking
20 questions, and if the other side turns around to you and
21 says, "That's the rule", then we've got a real problem,
22 haven't we, as a society? A society that doesn't
23 understand the fact that you don't always get it right
24 because it's written down. It doesn't always apply.
25 COMMISSIONER HANSFORD: We'll leave it there.

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1 A. That's all. I can only speak as I find, really.
2 Okay, so if we keep going with that, I think I've
3 covered -- oh, it was interesting that Prof Yeung
4 brought that up in his expert report, in fact at 135,
5 and I think he probably described it better in words
6 than I could have done. So it's not just it was our
7 observation through our analysis. He had the same
8 concern. I don't know whether he's here -- anyway,
9 I thank him for drawing attention to that.
10 Next slide. So "Conclusion". There's undoubtedly
11 issues of workmanship with the coupler connections, and
12 they've got to be addressed and put to bed. Whether
13 I think they are exceptionally high, I wouldn't go as
14 far as saying exceptionally high. I would say that
15 there are issues, and clearly couplers that are only
16 6 millimetres engaged or 9 millimetres was a bit of
17 a surprise, but if you look at them, it's not a question
18 of work being malicious. The bar is there; he's done
19 his best.
20 My experience through life is operatives generally
21 want to do a good job. They don't get up in the morning
22 and say, "You know what, I'm going to cut ten bars
23 today." You know, people want to do a good job. And
24 interestingly enough, good operatives -- and the
25 construction industry in Hong Kong still has good

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1 operatives -- they know that if they do the job right
 2 first time, it's the easiest thing in the world.
 3 Boding costs time and runs the risk of you being
 4 identified as an individual and having to do it again.
 5 COMMISSIONER HANSFORD: But it helps if they can see the
 6 flag on the hill.
 7 A. Absolutely. Toolbox talks, in the morning: "What did we
 8 do yesterday? What are we going to do today? Could we
 9 do it better?" That's the spirit. That's what you've
 10 got to do.
 11 Anyway, I don't want those issues to cloud this one
 12 of safety. The construction, really, of that station
 13 should be allowed to continue, because when you think
 14 about it, every day you are denying society an asset
 15 that it can use. Why? There's physically no reason
 16 from a technical point of view why you can't do that.
 17 I would go -- and I say why -- I mean, technically
 18 the structure has a very large reserve of strength.
 19 I look forward to seeing the calculations for the
 20 construction joint, and if necessary I will join in the
 21 debate -- I've stayed out of it at the moment because
 22 I think there are people who have enough knowledge to
 23 deal with that. But, as Mr Southward pointed out,
 24 there's no evidence to show any distress whatsoever.
 25 Anyway, to my very last slide -- you will be glad to

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1 hear that -- "Way forward". I seriously think we should
 2 review the scope of the opening-up. It doesn't involve
 3 me as an individual but I think we have something like
 4 80 areas opened up. I think that is more than enough.
 5 My earlier reports show that that's more than enough to
 6 establish a trend statistically, whether it's 37 you are
 7 interested in, 32, 26, there's enough there.
 8 Opening up more will not change that picture, to the
 9 extent that it is statistically important. You can't
 10 stop it today, and maybe you don't have the authority to
 11 stop it, but what I'm saying is I think it's increasing
 12 the nihilism of the whole process, really, to continue
 13 it, but that's for other people.
 14 COMMISSIONER HANSFORD: And is it damaging?
 15 A. Well, with that reserve of strength, I've got to say no,
 16 but you've got to repair things and the idea of even
 17 digging out the second layer or the third layer or the
 18 fourth layer -- you won't get any better data than
 19 you've got now, and the data is -- it shows you a range
 20 of responses. What do you expect by opening up more?
 21 Is it the "I told you so"? I mean, it's not going to
 22 happen. And the police have enough information now,
 23 I would imagine, to establish there is either a case or
 24 there isn't. Opening up -- if you found one or two or
 25 whatever number of, let's say, wrongdoings, for example,

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1 how does ten help you?
 2 So the continuing process, you've learnt what you've
 3 learnt. The reason why -- the other reason why I want
 4 to possibly hopefully make a plea for stopping the
 5 opening-up is because then we can get back to building
 6 the thing and finishing it and getting it operational.
 7 That's where I'm coming from. It isn't, "You are
 8 weakening the structure further."
 9 COMMISSIONER HANSFORD: I understand.
 10 A. Just think of how much value that is to society for
 11 every week that goes by. Why do it? There's no reason.
 12 Anyway, the last point is the stage 3 holistic
 13 proposal re-analysis that we are doing. We've actually
 14 started now.
 15 COMMISSIONER HANSFORD: Sorry, who?
 16 A. Sorry, I should explain. The holistic proposal had
 17 a stage 3 to it, which was the re-analysis of the
 18 structure --
 19 COMMISSIONER HANSFORD: Yes.
 20 A. -- using the as-built information and the best
 21 information we have available. Indeed we and Atkins
 22 and -- we've started that process now of compiling our
 23 basis of design and making sure we've got the right
 24 records to be able to do it. So we've started on that.
 25 MR BOULDING: Good.

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1 A. Is that -- that is it.
 2 Q. Thank you, Dr Glover. I just have a few questions by
 3 way of clarification. This proposed stage 3 of the
 4 holistic proposal, I want to be clear about the
 5 intention. Will that include direct force and
 6 elongation tests on the coupler assembly?
 7 A. Yes. I mean, the tests -- thank you very much for
 8 that -- the test we intend to or MTR intend to carry
 9 out, as I say, is nine samples, covering direct tension
 10 and compression, and the elongation -- I would like you
 11 to know that the elongation is the width of your hair,
 12 0.1 millimetre.
 13 COMMISSIONER HANSFORD: Yes.
 14 A. That's the level of concern we're having.
 15 COMMISSIONER HANSFORD: Not the width of mine.
 16 A. Interestingly enough, if you were in Texas, for example,
 17 you wouldn't have 0.1, you would have 0.25, and I think
 18 California is another number.
 19 What I'm saying is the 0.1 is a measurement of the
 20 product passing. It's not a structural integrity issue.
 21 It's an indicator of what that thing does, because when
 22 you imagine it, this test is done in the open air, but
 23 the thing performs inside concrete, where it's bonded in
 24 and it's bound.
 25 So this thing about elongation -- yes, elongation

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<p>1 will be included, but not cyclic. That would come under 2 the heading of malicious. 3 MR BOULDING: I've got one other matter, and the people who 4 put things up on the monitor are very clever -- I wonder 5 if we could have slide 19 up at the same time as we have 6 photograph B19/25587, because do you remember you were 7 asked about the photograph that I think Mr Chow was 8 discussing with one of the witnesses earlier? 9 Then if we could have your slide 19 up alongside 10 that. 11 A. Yes. In fact, could you show the cross -- is slide 19 12 the cross-section? 13 Q. The cross-section? 14 A. Yes, the one that shows the couplers, the green one. 15 That one will do, yes. 16 Q. Now, can you explain -- 17 A. What we are looking at? 18 Q. -- what we are looking at? 19 A. The photograph is taken -- this is a supposition on my 20 part, but looking at the two side by side, I think it 21 explains it quite well. 22 The photograph is taken standing slightly outside 23 the line of the diaphragm wall. The right-hand side of 24 the photograph is inside the diaphragm wall -- sorry, is 25 inside the excavation.</p>	<p>1 that you are looking on the right-hand side I think is 2 the shear key. It seems to match, doesn't it? 3 MR PENNICOTT: I see it. 4 A. And the concrete on the left-hand side is the prepared 5 concrete, and you can actually see the shape of that. 6 So that's what I was saying. 7 MR BOULDING: That's what you were saying. Okay. 8 Now, Dr Glover, the process will be that various of 9 the lawyers in the room have declared an intention to 10 ask you questions, and it starts with my learned friend 11 Mr Pennicott in the front row, and after that 12 questioning it might be that I ask you a few further 13 questions, and of course the Chairman and the professor 14 can ask you questions whenever it takes their fancy. 15 WITNESS: Okay. 16 CHAIRMAN: Good. I think it's 20 to 4. 15 minutes. 17 Dr Glover, you have heard other people being warned 18 that when they are giving evidence, they remain 19 an island unto themselves. 20 WITNESS: Okay. 21 CHAIRMAN: You are not permitted to discuss your evidence at 22 this stage. 23 WITNESS: Okay. Thank you. 24 (3.37 pm) 25 (A short adjournment)</p>
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<p>1 So when you look at the blue bars -- 2 COMMISSIONER HANSFORD: Sorry, is this therefore the reverse 3 of your green diagram? 4 A. Yes, that's right, it is. Thank you for that. That's 5 a good way of explaining it. 6 COMMISSIONER HANSFORD: A mirror image. 7 A. Yes, it's a reflected image. It's almost like it's a 8 book being opened up. 9 You'll see the blue bars on the right-hand side, and 10 you can see that they go down the hole, as it were, the 11 slot, and you can see the binders that I talked about, 12 the stirrups. 13 MR BOULDING: Does the colour blue signify anything? 14 A. No. This is a corrosion and bonding agent that they 15 apply to the exposed diaphragm wall steel when they cut 16 it down. 17 Q. Right. 18 A. So when they cut out the shear key, they would have 19 applied this coating, as I say, anti-corrosion and 20 bonding. 21 Q. Anyway, what, if anything, does the photograph show you? 22 A. So that line, if you drew a fictitious line on the 23 left-hand diagram, you would see that if you took the 24 top of the shear key and you extended it to the right, 25 that would explain where you get the slot. So that slot</p>	<p>1 (3.56 pm) 2 MR BOULDING: Dr Glover, just before Mr Pennicott starts, 3 there's probably one other matter that I ought to 4 clarify with you. Could you go to page 9 of your 5 report, in ER1, tab 6. Yes, that's exactly that page. 6 In paragraph 7.2, you refer in the first sentence to 7 various tests carried out by MTRCL. Can you tell us 8 what that's a reference to? 9 A. It's my misapprehension, really -- sorry, 10 misappreciation. I thought MTR had commissioned those 11 tests but it seems it was BOSA that carried them out. 12 So I'm afraid it was me got it wrong. 13 MR BOULDING: Thank you very much. 14 COMMISSIONER HANSFORD: Sorry, are these the CASTCO tests? 15 A. Yes, that's correct. 16 COMMISSIONER HANSFORD: Okay. 17 Examination by MR PENNICOTT 18 MR PENNICOTT: Dr Glover, good afternoon. My name is Ian 19 Pennicott, I'm one of the counsel to the Commission, as 20 I expect you have either worked out or been told. I did 21 have a few questions for you but those few have been 22 reduced even further as a consequence of your very 23 helpful presentation, for which thank you, and indeed 24 thank you very much for coming to give evidence to the 25 Commission.</p>

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1 However, could I just take up a couple of points
2 with you. First of all, right at the end of your
3 presentation, the very last slide, you had the "Way
4 forward".
5 A. Mm-hmm.
6 Q. You will have seen, I think, in Prof McQuillan's report
7 that one of the recommendations that he makes and is in
8 favour of, going forward, is a system of fairly
9 sophisticated monitoring at the station. Is that
10 something that you would go along with?
11 A. I would go along with it, because I think that's what is
12 expected. As a personal approach towards such things,
13 I never embark upon monitoring anything unless
14 I understand what I'm going to get is going to be
15 meaningful, because there's no point. So I understand
16 there's two perspectives to this. One is: is it needed?
17 And from a technical point of view, not. From a public
18 perception, then I think the answer to that must be
19 a resounding yes.
20 Q. Right.
21 A. But I think it's important that all parties involved,
22 including the public, understand that it's very likely
23 that what they'll get is noise, because it won't move,
24 and the trains, as I've explained, run on the diaphragm
25 wall. So I'm not sure what you would be measuring, and

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1 to be honest the degree of movements that you will be
2 getting, the particular equipment that you would need to
3 use has to be thought about very carefully, because it's
4 not like having a sight line and a classic measuring
5 device. The movements are that small and you always run
6 a risk when you start a programme such as this that
7 people will say the system is wrong, something must be
8 moving. So I would suggest that if you do do that, and
9 I think I can understand the reasons for it, you've got
10 to be very frank with the public at large not to expect
11 to get daily or weekly or monthly readings which show
12 anything at all.
13 COMMISSIONER HANSFORD: So it's an assurance?
14 A. It's an assurance.
15 COMMISSIONER HANSFORD: You said all you are going to get in
16 noise. In this context, what do you mean by "noise"?
17 A. Noise in the readings. Everything has got a plus and
18 minus about it. You get a fluctuation naturally. So,
19 therefore -- I could be proved wrong, life is like that,
20 but my appreciation of the issue before us -- you've got
21 something of the order of in excess of 90 per cent of
22 the weight, so --
23 MR PENNICOTT: It's already there.
24 A. It's already there. So what's going to disturb it to
25 the extent that you will get anything meaningful out of

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1 it?
2 COMMISSIONER HANSFORD: Are you saying any movement has
3 already happened?
4 A. Not any movement. You could get a crowd of people
5 sitting on the thing, but at the moment you've got
6 something like 90 units. If you put all the people on
7 the platforms and brought the trains in, you've got
8 another six. So that's the proportion. So you've got
9 something less than 10 per cent of the full loading to
10 go and probably less. With that as backcloth, a 3 metre
11 slab has a lot of inertia.
12 All I'm saying is by all means do that because
13 people will expect it, but please don't expect anything
14 from it, and expect people to query why you're not
15 getting anything from it. That's all. Does that help?
16 MR PENNICOTT: That's helpful, and you'll be pleased to hear
17 that broadly accords with what Prof McQuillan thinks as
18 well.
19 A. That's always a good thing.
20 Q. Can I just follow up by asking you this. You pointed
21 out again in the "Way forward" slide that Ove Arup and
22 Atkins, I think, are carrying out stage 3 of the
23 holistic study which I think is some sort of
24 retrospective analysis of the structure.
25 A. Yes.

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1 Q. Will that study, that stage 3 element, in any way inform
2 what future monitoring or similar needs to be done, or
3 are the two things completely unconnected?
4 A. I think the two things are separate. I'm just pondering
5 whether -- I think that analysis would give you, in fact
6 will give you, an indication of what those fluctuations
7 might be, and I think that could inform the mechanism or
8 the means by which you -- the sort of instrumentation
9 that you could install.
10 It certainly could give you an indication of that.
11 The models will be good enough to give you
12 an understanding of what the likely deflections could be
13 in the future.
14 Q. Right. That's helpful. Thank you very much.
15 Could I then ask you to be shown -- possibly easiest
16 on the screen -- a page in the opening-up file, that's
17 OU, and could we go to 338, please. And could we blow
18 that up.
19 I imagine this is something you've been looking
20 at --
21 A. Yes, it is.
22 Q. -- like the rest of us on an almost daily basis,
23 Dr Glover.
24 In terms of safety, which of these results, to your
25 way of thinking, are of relevance and importance?

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1 A. Well, they are all relevant, because they add to
 2 a statistical story, so every single one of them is
 3 important.
 4 But there are two rogue values, and what I mean --
 5 "rogue" could be taken in statistical terms incorrectly,
 6 meaning they are incorrect and tampered with -- but no,
 7 the 6.22, and there's one further on, 9.4 at 22, and
 8 6.22 at 5 -- they did surprise me slightly, but the rest
 9 are pretty tight, in terms of -- I know we argue about
 10 millimetres, and we see them -- the problem with
 11 millimetres is they end up with a large number when you
 12 record them. I mean, 40 sounds a big number, you know,
 13 and the difference between 40 and 38 seems to be huge,
 14 but actually these are minute measurements, and I do
 15 know how these are put together, because you use the
 16 electronics to measure the engagement, but the bit
 17 outside is measured by a tape, and tapes are notoriously
 18 inaccurate. In fact it's a straight tape.
 19 Because it is a crime scene, the operatives haven't
 20 been able to get back and -- because I want them to
 21 check that particular measurement using a steel gauge or
 22 something -- so although I'm very happy with the
 23 measurement that's been taken by the ultrasonics,
 24 I would put a bit of a health warning on some of the
 25 tape measurements because what you are seeing there is

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1 a combination of two things.
 2 I'm not saying the results would be vastly
 3 different, but it would just give that little bit of
 4 precision, and it might answer some of these questions
 5 about the odd millimetre here or there, because when you
 6 are measuring with a tape, to be able to measure
 7 a millimetre, good grief, you've got to take the hair
 8 out.
 9 That's why I'm just a bit sceptical about the tape
 10 part of it all.
 11 Q. I understand, and I have some difficulty understanding
 12 the logic of a 3 millimetre tolerance one way or another
 13 when you are going to 0.02 --
 14 A. Absolutely.
 15 Q. -- on the engagement length, but no doubt there's
 16 an explanation for that.
 17 What I had in mind with my question earlier is if
 18 you go down to 21, for example --
 19 A. Mm-hmm.
 20 Q. -- we can see that the purpose for which that opening-up
 21 has been done is purpose (ii), which is malpractice, if
 22 you like, just to give its label.
 23 A. Mm-hmm.
 24 Q. But it's an opening-up, as we can see in the bottom bar,
 25 the BB, of the EWL slab, which as I understand from your

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1 evidence, the bottom bar or bottom rebar or bottom mat
 2 is always in compression.
 3 A. Yes.
 4 Q. And indeed, taking an extreme position, forgetting about
 5 compliance with the codes, none of that rebar is
 6 actually necessary.
 7 A. Well, I would like to say some of it would be nice to
 8 have around, but no. You are probably looking at
 9 something less than a third.
 10 Q. So when I say in terms of safety, on one view it might
 11 be thought, well, it doesn't really matter what's there,
 12 in terms of absolute safety?
 13 A. Yes, absolutely.
 14 Q. That's something you would agree with?
 15 A. I would agree. The phrase "so what" comes to mind.
 16 Q. Okay. In your report, if we could just go to that,
 17 please, with the tests in the back of our minds, could
 18 I ask you, please, to go to paragraph 8.2 of your
 19 report. That's at page 10, ER, tab 6.
 20 A. Yes.
 21 Q. You say there:
 22 "The allegations of cutting of threaded bars had to
 23 be investigated to allay concerns about the extent of
 24 such malpractice, but that should not obscure the fact
 25 that such malpractice would have to have been on such

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1 an unimaginable industrial scale and, in addition,
 2 focused in specific areas, to have any effect whatsoever
 3 on the structural integrity of this construction,
 4 particularly in terms of making it unsafe -- which it is
 5 not."
 6 Pausing there before the question, if you go then to
 7 paragraph 10.5 of your report, at page 14 --
 8 A. Yes.
 9 Q. -- you say:
 10 "On the basis of the evidence supporting the
 11 structural adequacy and safety of the construction,
 12 there is little case for opening up the structure beyond
 13 obtaining sufficient samples to statistically gain
 14 confidence that such widespread/wholesale illegal
 15 cutting has not taken place."
 16 Do you think we have reached that point yet,
 17 Dr Glover?
 18 A. Yes, I think you most certainly have, because subject to
 19 going back and measuring -- the measurements which have
 20 been done by tape, getting those checked -- I think you
 21 have a very reliable database there, and if you look at
 22 them then you would have to ask questions about each of
 23 them. But from a personal point of view, I find it very
 24 difficult to understand why an operative would want to
 25 take 2 or 3 millimetres off the end of a bar. It

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<p>1 doesn't make sense, to cut the bar and then put it --</p> <p>2 there comes a time when it's not plausible.</p> <p>3 But I think the answer to your question is: is there</p> <p>4 a sufficient statistical base now? I would think most</p> <p>5 certainly.</p> <p>6 CHAIRMAN: I think your words were "I would think most</p> <p>7 certainly"; is that right?</p> <p>8 A. Yes.</p> <p>9 CHAIRMAN: I'm sorry, it's just that the transcriber who</p> <p>10 does a fantastic job day by day has put "almost</p> <p>11 certainly". Let me emphasise yet again I have worked</p> <p>12 with this transcriber before and she has proved her</p> <p>13 again and again to be superb, but it's just occasionally</p> <p>14 something pops up.</p> <p>15 MR PENNICOTT: I see she's writing that!</p> <p>16 Dr Glover, I did have a other questions for you but</p> <p>17 you've covered them already, particularly on the</p> <p>18 elongation test and static load test which I was going</p> <p>19 to ask you about, but you have dealt with that, and</p> <p>20 Mr Boulding took you to the photograph I was going to</p> <p>21 take you to arising out of earlier evidence.</p> <p>22 So thank you very much; I have no further questions.</p> <p>23 MR SHIEH: There's no questions from Leighton.</p> <p>24 CHAIRMAN: Atkins? Sorry.</p> <p>25 MR TO: Chairman and Commissioner, I just have a few</p>	<p>1 them, or are they to be argued or are they to be</p> <p>2 followed by Prof Yeung wishing to then give oral</p> <p>3 evidence to --</p> <p>4 MR TO: No, I think he just wants to make a statement</p> <p>5 relating to what was stated in the PowerPoint.</p> <p>6 (Commissioners conferring)</p> <p>7 CHAIRMAN: I think this is what concerns us -- please, I'm</p> <p>8 not trying to be pedantic or difficult, but then the</p> <p>9 comments come in in writing, and then is Dr Glover given</p> <p>10 an opportunity -- he may have finished his evidence this</p> <p>11 afternoon maybe; we don't know -- and then how does he</p> <p>12 answer? Does he answer in writing? Because if they are</p> <p>13 comments made, normally what would happen is that -- if,</p> <p>14 for example, Prof Yeung was here and he could give you</p> <p>15 verbal instructions, you would put the questions, there</p> <p>16 would be an answer, and then Mr Boulding at the very</p> <p>17 end, if he felt that some point needed to be clarified,</p> <p>18 could deal with it. So we have a well-trying system.</p> <p>19 But we are stepping into difficult territory.</p> <p>20 MR PENNICOTT: Sir, if I may add just the observation you</p> <p>21 made earlier, which is the PowerPoints don't go outside</p> <p>22 the report, and I'm pretty confident the PowerPoints do</p> <p>23 not go outside the report and I've looked at that</p> <p>24 carefully. If Mr To was able to say to you, "Look, go</p> <p>25 to a particular PowerPoint", and say, "Compare that</p>
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<p>1 questions.</p> <p>2 The first question is our Prof Albert Yeung would</p> <p>3 like to comment on Dr Glover's PowerPoint and he wants</p> <p>4 to submit some documents tomorrow before 10 o'clock.</p> <p>5 CHAIRMAN: To make certain written comments, you mean?</p> <p>6 MR TO: Yes, written comments.</p> <p>7 CHAIRMAN: Which would be handed in?</p> <p>8 MR TO: Yes.</p> <p>9 MR PENNICOTT: Sir, it's one of those situations where</p> <p>10 I guess either you have decided on a point of principle</p> <p>11 here and now or you say to yourself it's difficult to</p> <p>12 make any observations without seeing what's coming, and</p> <p>13 of course we have absolutely no idea what these</p> <p>14 observations may be.</p> <p>15 MR TO: Chairman, bearing in mind we just received the</p> <p>16 PowerPoint this afternoon.</p> <p>17 CHAIRMAN: Yes, I appreciate that. We've all received it</p> <p>18 reasonably early. But it was the PowerPoint which is</p> <p>19 an encapsulation of core matters arising in the report.</p> <p>20 That's my understanding.</p> <p>21 MR PENNICOTT: Yes.</p> <p>22 CHAIRMAN: So it's not as if it's something new.</p> <p>23 I'm not against that request in principle. I'm just</p> <p>24 concerned as to how it plays out in process, by which</p> <p>25 I mean we get -- do we simply take the comments and read</p>	<p>1 PowerPoint with the report, there's a brand-new point in</p> <p>2 the PowerPoint that's not in the report and we haven't</p> <p>3 had a proper opportunity of considering with</p> <p>4 Prof Yeung", then one could see that there might be the</p> <p>5 basis of an argument for coming back on a new point.</p> <p>6 But I'm bound to say I don't see any new points of</p> <p>7 that nature in any of the PowerPoints of Dr Glover, and</p> <p>8 it was my concern -- as I'm sure is yours and no doubt</p> <p>9 everybody else's -- where does this process end? We</p> <p>10 appreciate there are issues. We've got to bring the</p> <p>11 experts on in some order. Someone has got to go first</p> <p>12 and someone's got to go last. That's just the nature of</p> <p>13 the process.</p> <p>14 But as you rightly say, if there were any points</p> <p>15 that Prof Yeung had about Dr Glover's report, then they</p> <p>16 could have been made orally by Prof Yeung at an earlier</p> <p>17 juncture or, as you say, with instructions some</p> <p>18 cross-examination could take place.</p> <p>19 I am a bit reluctant of getting into this process of</p> <p>20 more commentary on experts further down the line.</p> <p>21 I just don't see where it's all going to end.</p> <p>22 MR BOULDING: Sir, could I associate myself with those</p> <p>23 remarks? My learned friend is absolutely right, and in</p> <p>24 accordance with convention what ought to happen is that</p> <p>25 Prof Yeung ought to give Mr To instructions and on the</p>

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<p>1 basis of those instructions he ought to cross-examine 2 Dr Glover on the matter. Then, as you have observed, 3 I would then pick up anything that was not clear by way 4 of re-examination. 5 I'm very concerned if we are going to get some sort 6 of written response which no doubt I would then have to 7 consider with my expert when he comes out of the box and 8 it might even be that I have to say, "Prof Yeung has to 9 be recalled because on the basis of what I've been 10 instructed I now need to cross-examine him again", and 11 this merry-go-round frankly has to stop, there must be 12 fair play, and Mr To must have fair play and it may well 13 be that, with others in the room who want to 14 cross-examine, Mr To could delay his cross-examination 15 until tomorrow morning and take instructions overnight. 16 CHAIRMAN: I think that's essentially the best answer. 17 Mr To, I don't want to change the process. It's 18 a process that's well tried in our English and Hong Kong 19 common law system. But I don't, on the other hand, wish 20 to deprive of you putting questions. 21 Now, it seems to me we are at 20 minutes past 4. We 22 can complete any necessary questions from other counsel 23 if they wish. You will then have an opportunity to take 24 instructions overnight from Prof Yeung, and if the 25 professor wishes any particular matters to be put</p>	<p>1 stimulating. Originally, I prepared four pages of 2 questions for you, but having heard your presentation 3 a lot of them actually are gone. 4 First of all, I also appreciate that you took the 5 trouble to address the government's concern in relation 6 to COWI's calculation. We do appreciate that -- this 7 morning, maybe, when I explored with Mr Southward 8 regarding that particular load case number 5, which 9 according to COWI's analysis result shows significant 10 sagging moment along the east side of the diaphragm 11 wall. 12 A. Understood. 13 Q. We also appreciate that the combined loading together 14 with the superimposed -- the rest of the loading, the 15 final -- the resultant moment is hogging. 16 A. Yes. 17 Q. The reason why we still ask the question and we still 18 explored it with Mr Southward is because we want to make 19 sure that there is no problem with the modelling, and we 20 need to understand why, for a particular load case, we 21 have this result, having a sagging moment all along. 22 A. Yes. 23 Q. Our concern is the gradient of the change of the moment 24 over a very short distance, less than 600 millimetres, 25 because we know that the overall thickness of the</p>
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<p>1 forward and you deem it appropriate to do so, as 2 an officer of this Commission -- because we are all 3 officers of the Commission -- then you can do so 4 tomorrow morning. That will give you an opportunity 5 overnight and you can put the questions and nobody is 6 prejudiced. 7 MR TO: Mr Chairman, I agree with you, and also the 8 Commissioner, and also agree with Mr Boulding, if I can 9 defer until tomorrow morning to question Dr Glover, that 10 will be much appreciated. 11 CHAIRMAN: All right. I think we will proceed on that basis 12 because I do appreciate we are talking about a very 13 important core issue here, which is one of safety, and 14 the general integrity of the structures under 15 consideration, and insofar as is reasonably possible you 16 must be given all opportunity to air matters. 17 MR TO: Thank you, Chairman. 18 MR CHOW: Mr Chairman, I have a few questions for Dr Glover 19 CHAIRMAN: Yes. 20 Cross-examination by MR CHOW 21 MR CHOW: Good afternoon, Dr Glover. 22 A. Good afternoon. 23 Q. My name is Anthony Chow and I represent the government. 24 First of all, I thank you for the presentation. To 25 me, it's very -- actually, it's intellectually</p>	<p>1 diaphragm wall is 1.2, according to COWI the moment at 2 the middle of the diaphragm wall is a hogging moment. 3 A. Yes. 4 Q. On the surface of the diaphragm wall, which is at the 5 maximum 600 millimetres away from the centre, it has 6 changed to a sagging moment, and to us the gradient of 7 the change is very substantial, and that poses 8 a question as to the propriety of the modelling used, 9 and this is the government's primary concern and that's 10 the reason why we raised the question earlier. 11 A. Yes. 12 Q. In relation to that particular concern, does it appear 13 to be strange to you as a result of the analysis? 14 A. I have not looked at the detail of the gradient that 15 you're looking at, so I don't feel as if I can give you 16 the answer, but the point I'd like to emphasise is the 17 understanding between us that basically that model that 18 they were presenting was a simply supported model. 19 Do you understand that? Shall I just draw it? 20 Q. A simply supported model? 21 A. Just for the -- I don't want to extend the conversation. 22 Q. Sure. 23 A. But I think a diagram is always so much stronger. 24 I think it also answers your earlier concern. 25 When we do the analysis of a structure such as the</p>

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1 station box, it's a composite of different models.
 2 There's not one model. We have to get different effects
 3 from different models. And the bending moment, the
 4 hogging at the supports, comes from the Plaxis analyses,
 5 the ones that model the soil and the wall.
 6 So a Plaxis model would look like this (drawing with
 7 red marker). That's the NSL slab and there's the EWL
 8 slab. But to get to that stage -- and there's the
 9 soil -- we do a stage-by-stage construction. So the
 10 first stage -- and Prof McQuillan will show this,
 11 I think; he's got a number of slides -- so that slab is
 12 cast on the ground, and then we excavate it, and this
 13 model is modelling each one of those stages.
 14 So the Plaxis model gives us the bending moment that
 15 we apply at that point (drawing an arrow), but it
 16 doesn't model the slab. All that it gives us is the
 17 input at the end.
 18 So what we do to model the slab is we do that
 19 (drawing a second diagram), and that's what we call
 20 simply supported. I think you know that; yes, of course
 21 you do.
 22 Q. So apply the bending moment, that's Plaxis?
 23 A. That's right. So what you do -- there's one load case,
 24 which I guess in this case is PERM 5, you've referred to
 25 it, and that ends up the bending that looks like that

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1 (drawing on the whiteboard), but then the other load,
 2 which is coming from Plaxis, has another bending moment,
 3 and it looks probably like that. You notice this is on
 4 the top of the line and this is underneath.
 5 Q. Yes.
 6 A. So if I then take another blue line and I hang this from
 7 the top (drawing with blue marker), I end up with
 8 a resultant moment which is that, that and that.
 9 So it's two models which create two different
 10 inputs, and we add them together, and that's the way we
 11 do the analysis. So that's really why, on this case,
 12 you get a very steep gradient there.
 13 Now, the steepness of the gradient depends on what
 14 the loading configuration is. For example, if you put
 15 a huge loading at that point (drawing blue arrow), you
 16 most certainly do get a sharp piece, and I think that's
 17 probably the way -- the model of the train loading, I'm
 18 guessing. I don't know if Mr Southward knows that. But
 19 I have not looked at the detail of the model but that is
 20 the principle by which they arrive at it, and I think
 21 the point you are making is the gradient on this model,
 22 which is the simply supported model, and a very large
 23 train loading put at that point (indicating blue arrow),
 24 would certainly steepen the gradient.
 25 Q. But to be able to explain the result that is shown on

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1 COWI's analysis, perm 5 has to be a combination of both
 2 loading that you have drawn; right? Because according
 3 to COWI, at the centre of the diaphragm wall, the moment
 4 there, the hogging moment --
 5 A. There's always a problem at the boundary conditions, and
 6 that's what we lop -- we call lopping it, like chopping
 7 a tree -- because this support here (indicating), if you
 8 look at it, if you magnify it, that is a plan -- you are
 9 looking at the top of the diaphragm wall, and this is
 10 the centre line, so although this is a wall, we model it
 11 as part of the slab, generally. So you end up with this
 12 area -- because you want to make sure you've got
 13 equilibrium so you've got to take them to the centre.
 14 But this bending moment here, so if you superimpose the
 15 bending moment down here, it's doing something like
 16 that, I should imagine (drawing with blue marker), and
 17 that's why you are getting this little bit of hogging,
 18 but actually, if you lop it, you are all right.
 19 I'm afraid in any modelling in life, there's always
 20 a little bit of correction, but we understand that, and
 21 equilibrium is maintained. So that's why you get --
 22 please, I haven't looked at the analysis in detail, but
 23 I can understand what you are describing.
 24 Q. Neither do I. I guess that's as far as I can go on --
 25 A. I'm sorry, that's about as far as I can go.

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1 Q. The next area I would like to discuss with you is --
 2 just now I heard you explaining to us, as a layperson,
 3 about the water pressure. You mentioned about 15 metres
 4 in water pressure acting upwards on the underside of the
 5 NSL slab.
 6 15 metres deep of water pressure is almost
 7 equivalent to maybe 5 metres thick of -- the weight of a
 8 5 metre thick slab?
 9 A. Absolutely.
 10 Q. Now, the thickness of NSL slab is only 2 metres.
 11 A. Yes.
 12 Q. Whereas the thickness of the EWL slab is 3 metres.
 13 A. Yes.
 14 Q. As a matter of common sense, to me, a layperson, the
 15 bending moment for the NSL slab is more critical than
 16 the bending moment at the support of the EWL slab,
 17 because we don't see 5 metres thick of concrete sitting
 18 on top of the EWL slab.
 19 A. No.
 20 Q. And the EWL slab is much thicker, at least 50 per cent
 21 thicker than the NSL slab.
 22 I remember somewhere in your report you also
 23 mentioned that the underside of the NSL slab, I mean the
 24 bottom steel in the NSL slab --
 25 A. Yes.

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<p>1 Q. -- is always in tension, because --</p> <p>2 A. Only at the supports.</p> <p>3 Q. At the support, yes.</p> <p>4 A. Yes.</p> <p>5 Q. And it's also at the support that we have these coupler</p> <p>6 connections.</p> <p>7 A. Correct.</p> <p>8 Q. At the moment, the experts -- I think my impression is</p> <p>9 there's not much coverage talking about the couplers,</p> <p>10 the criticality of the couplers at the bottom steel --</p> <p>11 at the interface between NSL and the diaphragm wall.</p> <p>12 A. Yes.</p> <p>13 Q. If what I have just described is correct, then the</p> <p>14 effectiveness of the connection by the couplers between</p> <p>15 the bottom steel of NSL slab and the diaphragm wall is</p> <p>16 an important matter that we need to look at.</p> <p>17 Now, I believe that it is indisputable that they are</p> <p>18 not accessible for us to look at the workmanship.</p> <p>19 A. Mm-hmm.</p> <p>20 Q. I also believe that that is one of the reasons why we</p> <p>21 have this opening-up exercise at various locations.</p> <p>22 The government engaged experts in statistics and the</p> <p>23 government was advised by those experts as to how the</p> <p>24 opening-up work should be carried out, so as to get</p> <p>25 representative data to reflect the quality of the</p>	<p>1 that something I've got to draw?</p> <p>2 COMMISSIONER HANSFORD: No, no, no.</p> <p>3 A. So therefore the NSL slab, although it's being subjected</p> <p>4 to this water pressure, it's being supported by the</p> <p>5 diaphragm walls on either side, the upthrust in the</p> <p>6 middle of the spans is being taken up to the EWL slab,</p> <p>7 so they are sharing the load together, so you are</p> <p>8 mobilising the 5 metres, and in addition to that there</p> <p>9 are secondary -- we call them barrettes in the middle of</p> <p>10 the span, and that's also anchoring it.</p> <p>11 So when you add all those effects up, the actual --</p> <p>12 let's call it the bending moment rather than getting</p> <p>13 into sagging and hogging -- you know, the upward bending</p> <p>14 moment at the support is quite modest, the utilisation</p> <p>15 levels there, and we've got to do the analysis to</p> <p>16 demonstrate this but they are not going to be high. So</p> <p>17 that's the first thing.</p> <p>18 I did take account of that in my statement, that</p> <p>19 I think the structure is safe, you know, with full</p> <p>20 recognition of the fact, the vulnerability of that.</p> <p>21 The second thing you've got to remember is</p> <p>22 underneath the NSL slab, there's a very substantial</p> <p>23 waterproof membrane sitting underneath. So it's not as</p> <p>24 if -- you know, water does leach through to some extent,</p> <p>25 but for those of you who understand metallurgy, you</p>
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<p>1 couplers.</p> <p>2 A. Mm-hmm.</p> <p>3 Q. If the quality of the couplers at the NSL slab is so</p> <p>4 important, which I believe that you agree with me, at</p> <p>5 least up to this point, and there is no way that we can</p> <p>6 open up any of the couplers at the bottom of the NSL</p> <p>7 slab, do you agree with me that to be able to have</p> <p>8 a more representative picture of the quality of the</p> <p>9 couplers in the NSL slab, we need to continue with our</p> <p>10 opening-up proposal or scheme or whatever?</p> <p>11 A. Is that your question?</p> <p>12 Q. Yes.</p> <p>13 A. So your question is --</p> <p>14 Q. Yes.</p> <p>15 A. I will try not to make the answer long. The slab is not</p> <p>16 resisting all the water. The water is pushing on the</p> <p>17 slab, but the slab is doing -- in fact, it's getting</p> <p>18 support from three different locations. That's why</p> <p>19 I said the structure has two lives. In the first case,</p> <p>20 the EWL slab is spanning on its own, and as you say the</p> <p>21 3 metre weight is only going through to the diaphragm</p> <p>22 walls.</p> <p>23 Q. Yes.</p> <p>24 A. When you've constructed the NSL slab, you build walls</p> <p>25 and columns up to the underside of the EWL slab. Is</p>	<p>1 think about rust, everybody gets concerned about rust,</p> <p>2 but the interesting thing about rust is it needs three</p> <p>3 components to take place. It needs iron, it needs</p> <p>4 water, and it also needs oxygen. And so if you don't</p> <p>5 have all three of those, you don't get rust. That's the</p> <p>6 first thing.</p> <p>7 So if you are in an environment where the level of</p> <p>8 oxygen is quite low, and I would think 15 metres down in</p> <p>9 the ground, without recharging of water, oxygen is quite</p> <p>10 low, so the risk of high corrosion from water is very</p> <p>11 low. The second thing is if you ever got a crack</p> <p>12 pattern, the crack pattern wouldn't run along the bars,</p> <p>13 it runs across the bars, and all the research shows that</p> <p>14 actually that is the least risk.</p> <p>15 So to answer your question, the utilisation levels</p> <p>16 of that structure are lower than you think because of</p> <p>17 the supports it has. It's got a waterproof membrane</p> <p>18 underneath it, and looking at the photographs, I didn't</p> <p>19 see it myself, but I can vouch from the photographs that</p> <p>20 it's there, and the risk of actual cracking and</p> <p>21 corrosion at the stress levels we are talking about is</p> <p>22 very, very low. That's my answer to you.</p> <p>23 Q. So I guess someone has to at least run the numbers to</p> <p>24 work out the --</p> <p>25 A. The utilisation level, yes.</p>

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1 Q. And unless, having done that calculation, and we are
 2 satisfied that the bottom steel of the NSL slab is
 3 always in compression, as in EWL slab, the effectiveness
 4 of the coupler --
 5 A. No, sorry. I didn't say that the bottom of the slab
 6 would be in compression. It will be in tension, but it
 7 will be at a lower level than you suspect.
 8 Q. Yes, I fully agree with what you mean.
 9 A. Sorry, I thought you said --
 10 Q. What I'm trying to say is unless having run those
 11 numbers and coming to a result which shows that the
 12 bottom steel is always in compression, otherwise the
 13 effectiveness of the couplers is still an issue that we
 14 need to ensure that at least it won't be too bad; is
 15 that right?
 16 A. I'll answer two ways. First, you did say compression
 17 again of the bottom couplers, and I'm saying to you they
 18 will be in tension on the bottom. They will be in
 19 tension, but the level of that tension is very low.
 20 Q. So long as it is in tension, do you agree that we need
 21 a proper connection --
 22 A. Of course you do.
 23 Q. -- to resist that tension?
 24 A. Right. So we are agreed now that it's in tension at the
 25 bottom.

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1 Q. Yes.
 2 A. And I'm saying to you that the utilisation level is very
 3 low, because of the reasons that I've explained, which
 4 it's got multiple supports. So we agree that it's in
 5 tension and that I believe the utilisation is low.
 6 So then let's move to what is -- what do we expect
 7 to get from the opening-up? I would say, with the
 8 samples as they are now, probably about 84, you will not
 9 find -- and you can speak to as many statisticians as
 10 you like; I am not an expert in statistics but I use
 11 them -- you will find the trend is already set from the
 12 figures we have, and the fluctuation -- let's say, you
 13 know, arbitrarily, that something is coming out with
 14 a projection of 10 per cent at the moment. Then I think
 15 if you take another 84 or whatever it is samples, you
 16 will find that will fluctuate between probably
 17 8 per cent and probably 12. It won't affect what we
 18 will do, because whatever we get from the results from
 19 the study, we will take a conservative view.
 20 Let's say our utilisation levels are 60 per cent,
 21 then we will not necessarily use 60 per cent in our
 22 analysis. We will use something much more conservative.
 23 So my answer to you is you've got -- you, we, the
 24 world has got -- sufficient statistics on the potential
 25 of something being 32 millimetres, 34, 37. It isn't

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1 going to get better. So if you do another 84, they are
 2 not going to change that percentage by very much. And
 3 clearly you will, I guess, speak to a statistician and
 4 see whether what I'm saying is correct.
 5 Q. Yes.
 6 A. There's always the possibility you are going to find
 7 this black hole somewhere, but no, not with something
 8 like this.
 9 Q. Just for your information, according to the latest
 10 opening-up result up to I believe yesterday, at the
 11 moment, if we apply the passing mark of 37mm --
 12 I appreciate that MTRC is going to carry out extensive
 13 tests and then perhaps at some point we need to review
 14 this passing mark -- but at the moment, on the basis of
 15 the information available to the government and to the
 16 public, we have recommendation from the supplier of the
 17 couplers, and at the moment the passing mark is 37mm
 18 engaged length.
 19 On the basis of this, at the moment the result is
 20 that almost 49 per cent of the couplers exposed failed.
 21 A. You mean in terms of the total sample?
 22 Q. Yes, that's right.
 23 A. In other words, 49 per cent of the planned number have
 24 been exposed.
 25 Q. Yes. This is the situation that the government is

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1 facing at the moment.
 2 A. Yes.
 3 Q. If at some later point in time we can adjust, if there
 4 is justification to adjust the passing mark, then
 5 of course people will review the situation, but on the
 6 basis of what we have today, with 49 per cent failing --
 7 A. No, no, no, I'm sorry. I misunderstood your earlier
 8 statement. I thought you were saying that of the
 9 planned opening-up, you were 49 per cent. That's not
 10 what you meant; is that --
 11 Q. 49 per cent --
 12 A. Or are you saying 49 per cent of the readings have
 13 failed?
 14 Q. Yes, 49 per cent of the samples with the reading that
 15 failed to pass the 37 millimetres passing mark. This is
 16 the situation at the moment.
 17 A. You see, we have a problem there, don't we, because
 18 I don't recognise your number so we are going to be
 19 talking about statistics from two different points.
 20 I see no reason whatsoever to accept the 37 and I'm not
 21 giving that statement in the absence of any knowledge.
 22 I fully expect a screwed fixing of any type to behave
 23 such that you would get its full strength at something
 24 much less than 100 per cent. So the idea you stick to
 25 these higher numbers, personally I can't support.

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1 Q. May I just make a correction, I do apologise. I have
2 just been informed that the 49 per cent is a total,
3 including samples from EWL slab and NSL slab. Sorry, 49
4 is only for EWL slab, but for the total, it's something
5 like 42/43 per cent.
6 A. Okay.
7 Q. If you only look at the sample taken from NSL, actually
8 the percentage is about 20 per cent.
9 A. Okay.
10 Q. At the moment, this is the position at the moment.
11 A. And are they better or worse?
12 Q. Well, 20 per cent of the sample exposed fails to pass
13 the 37mm requirement.
14 A. Yes.
15 Q. With that level of non-compliance -- I put it as
16 non-compliance --
17 A. I like that, yes.
18 Q. -- do you think this gives rise to any concern as to the
19 effectiveness or the safety in relation to NSL slab,
20 assuming that we have 20 per cent of the couplers?
21 A. No. When you look at a statistical issue, you ask
22 yourself the question: what are the parameters that will
23 make it vary? So if you are looking at workmanship of
24 a coupler, you would be looking at the workforce, the
25 materials they use and the conditions they are working

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1 under, and there is no distinct difference between the
2 EWL and NSL. So they are all part of the same family,
3 as far as I'm concerned. I don't differentiate between
4 the NSL family and the EWL family. They are all one
5 family.
6 Now, statisticians might disagree. They might say
7 the NSL represents a different family. But then I'd ask
8 them why, because I don't see it.
9 Q. I see. So according to you, you will take the overall
10 percentage --
11 A. Correct.
12 Q. -- as representing the level of -- representing the
13 overall condition in NSL as well?
14 A. Absolutely.
15 Q. So if the overall percentage is 30, for example, just
16 for example, if the overall percentage is 30,
17 30 per cent of the couplers fail, then you would infer
18 that 30 per cent of the couplers in the NSL also fail?
19 A. That would be a conservative view, but that's one
20 I would stand by because it gives you -- I believe it
21 would give you a conservative view, and the reason for
22 that is operatives get better as they do the same
23 operation time and time again, and so therefore I would
24 expect the readings to be better on the NSL than they
25 are on the EWL.

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1 But I would still stand by the same statement that
2 I think they are part of the one family.
3 Q. Dr Glover, just now -- I'm moving on to another topic --
4 I heard you mention you said you look forward to looking
5 at the calculation for the construction joints.
6 A. Mm-hmm.
7 Q. Can I take it you are also of the view that it is
8 appropriate to carry out checking of the internal
9 stresses inside the connection; right?
10 A. I think if a professional person raises a legitimate
11 issue, then it has to be considered, and so, you know,
12 with that as a context, then yes, I think it's the
13 proper process to go through. I think the anxiety
14 I have is that it takes so long to do it.
15 It is not -- it is a calculation which can be simply
16 justified as Mr Southward indicated, and you reach
17 a situation sometimes where if you can demonstrate
18 something at such a sort of in-principle level, then you
19 don't dig down constantly. You don't keep looking for
20 the black hole that's in there. You know, maths is
21 maths, and the calculation yesterday that Mr Southward
22 showed just took into account part of the system that
23 holds that together, and he demonstrated, I thought --
24 I haven't looked at the calculations but it seemed very
25 rational to me -- that that in itself dealt with the

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1 problem.
2 But if you think, "No, we don't want to include
3 that, we've got to do something else", then there's lots
4 of other mechanisms in that joint which give me the
5 assurance, without doing any more numbers.
6 But if that doesn't pacify everybody then you have
7 to go the extra mile. I would rather we didn't have to,
8 that's all. So be it.
9 COMMISSIONER HANSFORD: Is the reason you would rather we
10 didn't have to because you don't think it's necessary?
11 A. Yes. I abhor wasted effort, but sometimes you've got to
12 do it, you've got to go that extra bit, and if that is
13 what the Commission believe is the thing that puts it to
14 bed, then so be it and I would support that.
15 MR CHOW: I am happy to ask my last question now, but can
16 I refer you to paragraph 4.6 of your expert report, at
17 page 4, please.
18 The fourth bullet point.
19 A. Yes.
20 Q. Where you said:
21 "Due to the disproportionately stiffer and stronger
22 EWL slab ... relative to the diaphragm walls ..., it
23 would be impossible to develop ductile behaviour in the
24 slab or its connection to the walls since the wall would
25 have failed structurally under ultimate load conditions

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1 long before the rebar in the slab would have reached its
2 yield stress ..."
3 Do you see that?
4 A. Yes, I do.
5 Q. Am I right in thinking that for this statement to be
6 true, there is a prerequisite which is the connection
7 has to remain intact in order to transfer the load down
8 to the diaphragm wall?
9 A. Yes, I would accept that, basic physics.
10 Q. So for that purpose one has to check the stress inside
11 the connection to make sure that it works?
12 A. Yes. Mr Chow, I've accepted the principle that the
13 calculation has to be carried out to satisfy everybody.
14 MR CHOW: Thank you very much, Dr Glover.
15 I have no more questions.
16 CHAIRMAN: All right. Good. Thank you very much.
17 Mr Connor?
18 MR CONNOR: I have some questions, if I may, please. Given
19 the hour and the estimate of time which I have already
20 given Mr Pennicott, I will not finish today but I'm very
21 happy to start, if you would like me to do so.
22 COMMISSIONER HANSFORD: I think so, yes.
23 MR CONNOR: Or I can defer it entirely and start in the
24 morning.
25 CHAIRMAN: We might sit just a little bit later. What is

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1 our normal time? Sorry, I know I have interrupted the
2 normal time recently.
3 COMMISSIONER HANSFORD: We no longer have a normal time
4 MR PENNICOTT: Normally 5 o'clock, I think. I don't know
5 how long Mr Connor is going to be, but if we could make
6 some progress, and you are happy to sit a bit later,
7 unless anybody else has a problem.
8 CHAIRMAN: We do have to rise by 5.30 and I appreciate the
9 day is draining on a lot of people, intellectually as
10 well as physically. So let's go through to until 5.15,
11 shall we?
12 MR PENNICOTT: Yes, sir.
13 MR CONNOR: Thank you. I'm very happy to do so.
14 Cross-examination by MR CONNOR
15 Q. Good afternoon, Dr Glover. I'm Vincent Connor;
16 I represent Atkins China.
17 A. Okay.
18 Q. I have a few questions for you this afternoon, picking
19 up on I think a couple of points which have arisen this
20 afternoon and also dealing with some points in your
21 report which you have produced as of January 2019, but
22 also referring back to some earlier work which you've
23 done in relation to the holistic study.
24 A. Okay.
25 Q. Thank you. As you have gathered from the Chairman and

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1 the professor, I will get some way along the road this
2 afternoon, but perhaps, with approval, we might resume
3 in the morning if need be.
4 Perhaps just starting with your experience and
5 credentials that you shared with us earlier on. You
6 told us very helpfully about perhaps one of your
7 earliest experiences in Hong Kong and in particular in
8 relation to the HSBC headquarter building --
9 A. Yes.
10 Q. -- and that by a rough measure would have been sometime
11 in the 1980s.
12 A. Started in 1979.
13 Q. There we are. Thank you. But I take it that you have,
14 therefore, over the time since that particular project,
15 had a level of involvement in Hong Kong projects? It's
16 something which has been part of your professional life
17 since then?
18 A. No. When I finished the Hongkong Bank, I didn't have
19 any further involvement. I mean, clearly I come to
20 Hong Kong to speak to our people and give them lectures.
21 Q. Yes.
22 A. My only other involvement was with MTR from 2013 through
23 to about 2015, as part of the international expert panel
24 review, and there were three others. There was myself,
25 John Burland and Alastair Biggart -- Alastair was

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1 tunnelling, John was geotechnics and I was structures,
2 and we looked at -- we came for a week, on about
3 six-monthly intervals and we looked at about three
4 projects a day. We just were given a briefing and gave
5 our comments on a Friday afternoon and then we went back
6 again.
7 So there was no deep research in it, but we looked
8 at particular issues and problems.
9 Q. That's helpful, because I think that gives us a flavour
10 of, shall we say, the continuity of your involvement in
11 the thinking and consideration of projects in Hong Kong,
12 and, I think as you have said, arisen in the way that
13 you just described and no doubt in the activities that
14 you have within Arup that brought you to Hong Kong over
15 the time.
16 A. Yes.
17 Q. And you made a comment I think in response to questions
18 from Mr Boulding earlier, but it may have been part of
19 your presentation, where you talked about, in Hong Kong,
20 that there is taken an extremely conservative view, and
21 that I think you were applying to the question of ground
22 parameters at the time, but I think it's one that you
23 extended into a view of prudence on the part of certain
24 government authorities.
25 A. Mmm.

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<p>1 Q. Do you recall that?</p> <p>2 A. Yes. I mean, I don't recall your particular words, but</p> <p>3 let's see where you want me to go with that. I didn't</p> <p>4 use those particular words.</p> <p>5 Q. My apologies.</p> <p>6 A. It's okay.</p> <p>7 Q. It's a rough and ready --</p> <p>8 A. I speak fast.</p> <p>9 Q. -- 4.50 pm attempt to capture your theme.</p> <p>10 But we understand, or does one understand, from your</p> <p>11 comment that those who are designing permanent works in</p> <p>12 complex infrastructure projects in Hong Kong clearly</p> <p>13 have to interface with those who are empowered by</p> <p>14 statute to review and approve those submissions?</p> <p>15 A. Yes.</p> <p>16 Q. And is your reference to prudence and conservatism on</p> <p>17 the part of those who approve something which is part of</p> <p>18 your evidence to this Commission?</p> <p>19 A. Yes. Crumbs -- how much time have we got? No, this was</p> <p>20 not -- my words were general, observational. Remember,</p> <p>21 when I did my reviews with MTR -- and interestingly</p> <p>22 enough none of them were on this station, none of them</p> <p>23 at all -- but I found certain illogicalities in the</p> <p>24 thinking that had been applied to particular situations,</p> <p>25 and I just used the ground one here because I know that</p>	<p>1 That's all I'm saying. And more and more in the</p> <p>2 Hong Kong Code I see these rules coming in, like the one</p> <p>3 I talked about with ductility.</p> <p>4 For the life of me, why does someone have to write</p> <p>5 a clause like that, which is very precise in what it</p> <p>6 asks for, when actually, if you stand back, you think,</p> <p>7 well, all reinforced concrete, if it's designed in the</p> <p>8 way I said, where the tension/reinforcement governs, is</p> <p>9 naturally ductile. But you do need these special</p> <p>10 requirements, and they are special, when you've got</p> <p>11 particular situations where you need high ductility,</p> <p>12 like the ground movement I was talking about.</p> <p>13 But really, the way the rules are written, you don't</p> <p>14 have an option as a designer. That's what you've got to</p> <p>15 do. And I'm saying that doesn't make sense in my world.</p> <p>16 But I live in a different world.</p> <p>17 Does that help you?</p> <p>18 Q. It is very helpful indeed, thank you, because I think</p> <p>19 what -- again, if I may play back to you what</p> <p>20 I understand you to be telling us -- it's that given</p> <p>21 those rules, that rule book, and the way in which</p> <p>22 therefore, as a designer, one must approach matters,</p> <p>23 then there's an inevitable observance and understanding</p> <p>24 of what the content of the rule book is and what the</p> <p>25 likelihood is of, shall we say, those rules being flexed</p>
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<p>1 was how the station was designed, and I found that it</p> <p>2 wasn't the calibre of the designers that was the</p> <p>3 problem. They were under severe stress in terms of</p> <p>4 getting things done, getting designs out of the door.</p> <p>5 And so, in that context, they were following the rules,</p> <p>6 and it would have been a brave man to fight against</p> <p>7 those rules because I thought Prof Au's description of</p> <p>8 the particular process you would go through for change</p> <p>9 actually painted a very stark picture, for me anyway, of</p> <p>10 the fact that they might be guidelines but the reality</p> <p>11 is they are mandatory, and if you are a professional in</p> <p>12 Hong Kong, a designer, then I think you would learn that</p> <p>13 very quickly and you would stop asking the questions,</p> <p>14 and hence that's why in my statement I use the word</p> <p>15 "unquestioning", not because the individual isn't</p> <p>16 capable of doing it, it's because the process would have</p> <p>17 resulted in him not being able to deliver what he has to</p> <p>18 within the time scales that are set by certain</p> <p>19 programmes.</p> <p>20 So it was not an assault on any particular</p> <p>21 individual or firm. It was a general statement, and</p> <p>22 a fear, because an environment that doesn't recognise --</p> <p>23 an environment that relies upon rules kills innovation.</p> <p>24 It kills off questioning. It kills off the very life</p> <p>25 blood of what engineering progression is all about.</p>	<p>1 or otherwise relaxed.</p> <p>2 A. Well, Galbraith would have called it the conventional</p> <p>3 wisdom. You know, after a little bit of experience,</p> <p>4 society gets a conventional wisdom, and they are the</p> <p>5 rules by which you live. And if those are the rules</p> <p>6 that you live in, then I'm coming from a different</p> <p>7 world, a different environment, and if I see differences</p> <p>8 then I feel that professionally I should identify them,</p> <p>9 because I do think they have bearing on issues. I don't</p> <p>10 think they are isolated from the particular issues we</p> <p>11 have on this project.</p> <p>12 Q. Thank you.</p> <p>13 Against that background then, and as you will gather</p> <p>14 and I think as I've shared with you, I will come to look</p> <p>15 at some parts of your report, and also the report which</p> <p>16 you did in November last year.</p> <p>17 A. Oh, I see, the actual reports themselves, the Arup</p> <p>18 reports, yes.</p> <p>19 Q. Indeed. That may be tomorrow, subject to the Chairman</p> <p>20 and the professor.</p> <p>21 A. Okay.</p> <p>22 Q. But just again to flesh out one's understanding of the</p> <p>23 approach then of the designer in Hong Kong to the way in</p> <p>24 which design needs to be put together to, shall we say,</p> <p>25 have the prospect of acceptability and progress, I have</p>

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1 a few areas which I want to ask you about, and I don't
 2 intend that they are exhaustive, but they might be
 3 instructive.
 4 The areas are really this, that when the designer is
 5 going through his process, putting together the
 6 permanent works design, on a project rather like this
 7 one, let's say the Hung Hom Station box design, he's
 8 going to have regard to the particular circumstances and
 9 nature of the project itself, the complexity of the
 10 project; safety --
 11 A. Mm-hmm.
 12 Q. -- programme, no doubt; and also things like the
 13 temporary condition of the works and what he has to
 14 build into the design to cope with the temporary
 15 condition before it gets to the permanent condition.
 16 You may add others to that list, but that as a group
 17 of considerations would seem to you to be a sensible
 18 series?
 19 A. Yes.
 20 Q. Am I right in understanding, then, that as a designer of
 21 such permanent works, having regard to what it is that
 22 one is putting together -- and we have spoken about
 23 reinforcement, for example, the extent of reinforcement
 24 one builds in -- you would be having regard to those
 25 five areas that I mentioned with a view to assessing not

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1 only what the job needs but also its likely
 2 acceptability to those who will have to approve it?
 3 Would that be fair?
 4 A. I think, unfortunately, that does appear to be the case.
 5 If I could help you slightly.
 6 Q. Yes.
 7 A. And I think it is a very good discussion, actually, and
 8 I don't think the commission really is set up for
 9 discussion, but here goes.
 10 I mentioned two very large projects, really. The
 11 governance structure in both of those projects is
 12 extremely shallow. The client, for example, on HS1 was
 13 only 50 people. They were the approval authority. We
 14 did everything else. It was an EPC contract --
 15 engineering, procurement, and construction management --
 16 so we were responsible for everything, all the
 17 engineering, all the procurement or whatever. And
 18 alongside us, we had a checker, who is an independent
 19 engineer, independent organisation. And by "checker" we
 20 don't mean line checker. We are talking about the basic
 21 principles, the key principles.
 22 We would agree between us what that design basis
 23 was, which the codes were going to be, agree those with
 24 the client, and we would progress. If we found, as
 25 designers, that we saw something which we could improve

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1 upon, we would discuss that with the checker, and, if we
 2 both agreed, we would literally go and see the client.
 3 We wouldn't send something through the post, because --
 4 it's this immediacy. It's this sense of one-to-one
 5 communication. It's not ten-page letters going
 6 backwards and forwards to each other, which slows the
 7 process down.
 8 Just think how long it takes to produce
 9 a ten-page letter, and then to go through it time and
 10 time again.
 11 So the process is entirely different. The client
 12 has authority and responsibility. If I look at -- and
 13 I am probably exceeding my brief here but -- in fact
 14 I am exceeding, I guess, but I will say what I say --
 15 there is no proper client on this particular project.
 16 There's not a single entity. There's a grouping of
 17 organisations that have an interest in the project, but
 18 one party has to do everything, has to be responsible
 19 for the approvals and the direction of the works for
 20 efficient working. You can't go to one part to get
 21 approvals and get direction from the other. It doesn't
 22 make sense. And if the people that are giving the
 23 approval don't have ownership of the outcome, what does
 24 that mean? How does my flag on the hill work with that?
 25 Unless everybody in the team is working towards the

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1 same objective rather than their own protective silo --
 2 that's when things go wrong.
 3 So I've probably exceeded my brief and I've exceeded
 4 what the Commission is about, but those are the key
 5 issues. That's at the source of what you are sitting
 6 around here.
 7 COMMISSIONER HANSFORD: I don't know your precise brief but
 8 you certainly haven't exceeded the terms of the
 9 Commission of Inquiry, because these go to matters that
 10 we are considering.
 11 A. Okay. I hope I've been articulate enough. It was
 12 a rather rambling response.
 13 MR CONNOR: Definitely articulate enough. Thank you,
 14 Dr Glover.
 15 Sir, if you are happy, I will move on to develop the
 16 thought a little.
 17 CHAIRMAN: Of course, yes.
 18 MR CONNOR: We have heard a little bit about your use of the
 19 word "conservative" with design. So I guess against the
 20 background of what you described to us, in terms of the
 21 rule book, the interpretation and application of the
 22 rule book, shall we say the range of stakeholders that
 23 you've just described to us, all of whom may have a view
 24 on whether or not a particular design is appropriate or
 25 not -- these are the things that drive a conservative

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<p>1 and prudent design, because if one doesn't put 2 a conservative and prudent design forward, then frankly 3 it's going to, to use a railway metaphor, hit the 4 buffers somewhat; would that be fair? 5 A. It would be an interesting -- our experience in the UK 6 at the moment with Brexit is a classic example, really, 7 where -- 8 Q. No, we definitely don't have time for that! 9 A. It's a classic example where you can't satisfy all the 10 parties, and in the end because someone quite genuinely 11 sets out to satisfy all the parties, you end up with 12 an absolute mess that doesn't satisfy anybody. 13 COMMISSIONER HANSFORD: I think that is beyond the brief. 14 A. I know. Sorry, that was ex-censorship. We can delete 15 that from the record. 16 COMMISSIONER HANSFORD: We do understand that point. 17 A. That's what I'm saying. You've got to have people who 18 have authority and responsibility. If you have people 19 who have authority but no real responsibility for the 20 final outcome, then you've really got a problem on your 21 hands. 22 MR CONNOR: So with that -- and I mention those five areas 23 that I at least have in mind for the purpose of looking 24 at influences on the approach to design -- the first of 25 those I suggest to you was the nature of the project in</p>	<p>1 issues, that the designer has to take into account at 2 that stage, of bringing the permanent works design 3 together, to ensure that he puts forward something which 4 is going to do the job, but again, having regard to the 5 stakeholders and all the interests and the rules you 6 mention, is articulated in a way that is not going to 7 hit opposition? 8 A. Yes. 9 Q. Just to give a flavour of that -- and thank you for your 10 response to that -- if you could have before you just 11 a drawing to illustrate matters, drawing H559, please. 12 That should appear on the screen in just a moment there. 13 A. Yes. I've got it. 14 Q. Thank you. A drawing that you will be well familiar 15 with or ones rather like it. 16 But again, just to emphasise the nature of the 17 project itself, what we see to the left-hand side of the 18 structure as shown in the drawing in shading, as you 19 will see at about the line from the top, K1, and to the 20 left of that, the designer, in approaching this project, 21 would have had to have regard of course to the perimeter 22 walls and the reinforcement of those perimeter walls to 23 minimise the ground movements, to prevent damage to the 24 existing infrastructure, et cetera, around it. So that 25 would be an example of the kind of thing you and I have</p>
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<p>1 question, and I think you do come to say some words on 2 this in your report which I think we might come to 3 tomorrow, but I think you have very fairly shared it 4 with us earlier on in your presentation, that in terms 5 of the nature of this project and approaching the design 6 of it, one would have had to have regard to not only, 7 shall we say, the job in hand, the extension of the 8 station in the form that's been anticipated, but the 9 protection of the existing structure? 10 A. Mm-hmm. 11 Q. The consideration of adjacent land and other structures? 12 A. Yes. 13 Q. But perhaps in circumstances where the construction 14 types were less certain than might otherwise be ideal? 15 A. Mm-hmm. 16 Q. Of course the need to do all of this, that is to design 17 and then to have it built while allowing operational 18 activities in the station to continue -- yes? 19 A. Yes. 20 Q. Not to interfere with the transport interchange that 21 also existed at Hung Hom; yes? 22 A. Yes. 23 Q. And all of that, when you take it together, as far as 24 the nature of the project, before we even get to 25 complexity, there's a whole bundle of things, big</p>	<p>1 just been talking about? 2 A. Yes. 3 Q. Thank you. The second area -- we may come back to that 4 drawing in a moment, or tomorrow morning, if I'm 5 permitted -- was complexity itself of the project, and 6 in particular the structure that's required to be 7 designed. 8 Again, we have talked a lot this afternoon and on 9 other days about the EWL slab in particular and its very 10 significant proportions in terms of its thickness, 11 et cetera, which you gave us your initial expressions of 12 before. But in some ways, if I might say, and not 13 attributing the view to you, that could be a simplistic 14 way of describing what is actually in itself a very 15 intricate piece of work; would you agree? 16 A. Yes, I would. 17 Q. Again, just for illustration, if you could have in front 18 of you H576. This is a view of, amongst other things, 19 that slab itself, and I guess what this might show, 20 subject to your thoughts, is an illustration of the very 21 considerable number of openings, for example, that had 22 to be facilitated within that very substantial 3 metre 23 slab, openings and cut-outs which deal with stairways 24 and services and all sorts of additional requirements 25 that run through it. Would you agree?</p>

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1 A. Yes. It's heavily perforated, yes. I'm not sure what
2 I'm agreeing to, because you've told me it's got lots of
3 holes in it and I've agreed with you. Is that what you
4 meant?
5 Q. It is, but I'll take your engineering expression in
6 those circumstances.
7 A. And you could also add they are at mid-span -- does that
8 help you to put your argument?
9 Q. It does, because the inclusion of all of those and the
10 demand for all those would have otherwise constrained
11 the spanning capability of that slab, but of course the
12 intricacy with which the work is applied has to
13 anticipate that and deal with it; yes?
14 That in itself raises, no doubt, demands as to the
15 way in which the arrangement of rebar is allowed for
16 within a structure like that or a piece of structure
17 like that.
18 A. I think I know where you are coming from. Can I help
19 you to get to what you want? Because, I mean, it's
20 a very nice story, but what is it you want me to say?
21 I'm sorry, I don't mean to be -- I didn't mean it like
22 that but it's getting towards the end of the day and I'm
23 sure I'm going to agree with you but I'm not sure what
24 it is you want me to agree with.
25 Q. I like your approach. It's a very, very helpful

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1 approach.
2 MR PENNICOTT: Dr Glover, if I may say, I think we'd all
3 like some guidance on where all this is going because
4 I have to say at the moment I'm a little bit confused.
5 CHAIRMAN: I'm just wondering, Mr Connor, all of it is
6 helpful, but I wonder if it's not more helpful by way of
7 final submissions, because it seems to me that what you
8 are putting is self-evident, and not only to an expert
9 but I would imagine to well-informed laypersons. We
10 appreciate it's a complex project. We appreciate that
11 the slab is not merely just a great chunk of concrete,
12 it's something far more complex than that. And we
13 appreciate the dynamics which both help and constrict
14 designers.
15 So all of that we would be delighted to hear from
16 you within your final submissions, but I don't know that
17 it needs the imprimatur of Dr Glover necessarily, in
18 this area.
19 MR CONNOR: That's helpful in itself, sir, but to an extent,
20 because of the wording and the opinions which he has
21 sought to apply, which we will be coming to tomorrow, in
22 certain of his opinion and report to you, it is
23 something that one has to address. But it may well be
24 that given where we have got to already with him, one
25 can do it fairly briskly in the morning, because I think

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1 he has given an indication of a number of helpful
2 observations, and a view that perhaps, shall we say,
3 puts the comments in his report in greater context for
4 these purposes.
5 COMMISSIONER HANSFORD: I think we should be careful that he
6 hasn't agreed to something you haven't asked him yet.
7 MR CONNOR: No, absolutely. Perhaps, with your blessing, we
8 might close off on this particular point, sir.
9 CHAIRMAN: Yes.
10 MR CONNOR: And then resume in the morning with a view to
11 concluding this number of questions.
12 If I may, sir --
13 CHAIRMAN: Yes.
14 MR CONNOR: You were kind enough to suggest that you might
15 agree, but let us see if you do.
16 You have agreed that the complexity of a project is
17 something which quite rightly, against the background of
18 the rules of approval, the way in which it may be
19 applied, et cetera, is something which a designer will
20 have in contemplation and consideration when putting his
21 permanent works design together in Hong Kong, and that
22 would apply to the Hung Hom project, and of course this:
23 that it is understandable, against that background --
24 bearing in mind the nature of the project and complexity
25 of it, the demands for programme and so on -- that

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1 a conservative approach, which anticipates the likely
2 blockages, views and application of the rules may have
3 in mind, would be deployed?
4 A. I think that's true. What you are trading there is you
5 are trading, let's say, the efficiency of the design
6 against a time scale, and you've got limited time and
7 you've got some very real constraints on that side,
8 exacerbated by the limitations that have been placed on
9 such constructions, and I mean by that the 25 millimetre
10 displacement or settlement at ground level which in some
11 situations is remarkable in terms of its difficulty.
12 So with that as a backcloth, yes, you've got to take
13 a conservative view. If you had more time, if you had
14 a more benevolent approval system, then I think you
15 would have ended up with a better design, less
16 conservative, more considered. But within the context
17 of the limitations you had, I can fully understand what
18 you've done, and I've not said anything to the contrary,
19 to the best of my knowledge, maybe; I had to think about
20 that one.
21 MR CONNOR: Thank you. That's a helpful point on which
22 I might suggest, sir and Professor, we might pause this
23 evening.
24 CHAIRMAN: All right.
25 MR CONNOR: And probably as far as tomorrow is concerned,

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<p>1 I'm estimating something in the order of about 2 15 minutes or so to conclude matters. 3 CHAIRMAN: All right. Thank you. It's very difficult. 4 Either Mr To -- I suppose it's impossible for you to 5 know because you don't know what you are going to be 6 instructed. 7 MR TO: That's true. I was aiming this afternoon for maybe 8 15 minutes but Prof Yeung does have something he wants 9 me to convey. 10 CHAIRMAN: All right. May I just give a warning order: we 11 would very much like to finish the expert evidence 12 tomorrow, and depending on how we are going and subject 13 to guidance from counsel, if necessary we would look to 14 sitting a little bit later, if we can clear everything. 15 We are thinking of maybe 6 o'clock or something like 16 that. We are not talking about people sort of having to 17 have supper here or anything like that, but even if it's 18 6.10 or something but we can clear it all, then all the 19 expert evidence is finished. I'm sure you will agree 20 it's better than coming back at the end of the weekend. 21 All right? 22 So absent anybody having any particular pressing 23 other engagement, which we will obviously take into 24 account, just bear that in mind. We hope it won't be 25 necessary but bear it in mind.</p>	<p>1 issues with that, no doubt they will tell us. 2 Certainly for our part, when we have been 3 struggling, despite the endeavours of this week, to 4 progress our closing addresses in writing, we have 5 certainly managed to incorporate some drawings and 6 photographs and so forth into our closing submissions, 7 and I hope -- I'm sure that's all very acceptable. But 8 of course your report is far more important because 9 that's going to be made public in due course. 10 So if anybody has a problem, no doubt they will let 11 us know. 12 CHAIRMAN: Thank you. 13 MR BOULDING: Sir, may I just raise two points? 14 CHAIRMAN: Yes. 15 MR BOULDING: Firstly, I wonder whether it's attractive to 16 you to start at 9.30 tomorrow to ensure we finish and we 17 don't have to sit too late. 18 I suspect you are just about to read the riot act to 19 Dr Glover but those instructing me need to re-arrange 20 his flight home and I wonder whether they can be 21 permitted to speak to him about that. 22 MR PENNICOTT: Of course. There's absolutely no objection 23 to that. 24 CHAIRMAN: Dr Glover, in his evidence so far, has said 25 nothing about his flights home, so we will work on the</p>
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<p>1 MR PENNICOTT: Sir, I very much hope it won't be necessary 2 because the indication is that hopefully Dr Glover will 3 finish his evidence, say, within a maximum of an hour, 4 from indications we have just been given. Obviously 5 that will leave Prof McQuillan to give evidence, and on 6 the estimations that I've received, which are only 7 three, the maximum for the government is an hour and 8 a half, China Tech 20 minutes and Leighton half an hour. 9 CHAIRMAN: All right. 10 MR PENNICOTT: So subject to how long Prof McQuillan's 11 presentation is going to take, I would hope we will 12 finish comfortably within tomorrow and well before 13 5 o'clock. Famous last words. 14 CHAIRMAN: There is one thing I just wanted to ask before we 15 go. The expert reports contain some very helpful 16 diagrams for myself and for Prof Hansford. I take it 17 that if we wish to include any of these diagrams in our 18 report, there's no -- we're not going to stumble across 19 copyright issues or something like that? 20 MR PENNICOTT: I hope not. 21 CHAIRMAN: In other words, I want to be able to purloin as 22 much as I can from those expert reports, where I think 23 it will be of help, including drawings and photographs. 24 MR PENNICOTT: I hope it's not of concern to anybody, but, 25 sir, since you have raised it, if anybody does have any</p>	<p>1 basis that's an entirely extraneous matter. 2 Mr Boulding, of course you may. 3 MR PENNICOTT: Certainly if we don't finish tomorrow 4 evening, then we will be having to re-arrange 5 Prof McQuillan's flight tomorrow night. 6 CHAIRMAN: Good. Thank you very much. 9.30 tomorrow? 7 Mr To, that's okay for you? 8 MR TO: Yes. 9 CHAIRMAN: Good. Then 9.30 tomorrow. Thank you. 10 (5.23 pm) 11 (The hearing adjourned until 9.30 am the following day) 12 13 14 15 16 17 18 19 20 21 22 23 24 25</p>

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