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<p>1 Monday, 6 January 2020 2 (10.05 am) 3 DR LAU CHI WANG, JAMES (on former oath) 4 Presentation by DR LAU (continued) 5 MR KHAW: Good morning, Dr Lau. I believe when we adjourned 6 last Friday, you had just finished page 47 of your 7 slides. 8 A. Yes. 9 MR KHAW: Please continue. 10 A. Page 48, I started by commenting on Mr Southward's COI 1 11 report. We have a number of disagreements. First of 12 all, about the conclusion. First of all, I disagree 13 with him -- I think there is a need for suitable 14 measures at this point. 15 I also talk about entering judgment. For me, what 16 MTRC and Atkins are doing is actually exercising 17 engineering judgment in the stage 3 assessment report. 18 Next one, please. On couplers, for me, the couplers 19 need to be butt-to-butt for it to be acceptable, because 20 apart from static tension, a very important 21 consideration is the permanent elongation test. We 22 don't want the coupler to have excessive elongation at 23 working stress. As I said, it will cause cracking in 24 the concrete because of the elongation. 25 Secondly, we have no proof that partially engaged</p>	<p>1 length, there is still strength in the shear links. 2 I have no disagreement with him on this analysis. It's 3 totally all right. But I disagree with him mainly 4 because of my concern that there might not be shear 5 links in the critical locations where shear links are 6 required. This is my disagreement with him. 7 In fact, there are photographs of missing shear 8 links in the honeycomb area. There were 22 locations 9 with honeycomb area, and ten of these locations have no 10 shear links, as well as 22 locations where opening-up 11 investigation was carried out. In these 22 locations, 12 six locations have no shear links. So altogether there 13 were 16 locations without shear links out of 40 14 locations. 15 Mr Southward commented about the MTRCL's opening-up. 16 He said that shear links could be hidden in the 1 metre 17 by 1 metre L-shaped opening-up by MTRC. I disagree. 18 The spacing of shear links is at most 300 millimetres, 19 sometimes 150 millimetres or even 75 millimetres. If 20 shear links were not discovered within the 1 metre by 21 1 metre L-shaped opening-up, then the shear links were 22 not there. 23 In fact, Leighton has opened up one area, whereas 24 MTRC have opened up 40 areas, so there's a big 25 difference between the MTRC investigation and Leighton's</p>
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<p>1 couplers can satisfy a structural engineer the 2 requirements of safety, deformation, crack width and 3 durability, because at one stage the government did ask 4 MTRC to provide certain tests about partially engaged 5 couplers to satisfy government about deformation, crack 6 width and durability. That was not done at all. 7 On defective rates, last Friday I think that the 8 Commission was a bit worried about the figures. First 9 of all, the EWL slab, the figure was 36.6 per cent. 10 Despite the high value, actually no suitable measure was 11 required according to the stage 3 assessment; there was 12 no suitable measure for EWL slab. Similarly, for the 13 NSL slab, the 33.2 per cent defective rate, again there 14 was no requirement for suitable measure, so the argument 15 is just academic. For the EWL slab in area A, there was 16 a figure of 68 per cent, but this 68 per cent was 17 a statistical figure, and suitable measures was required 18 in this area, but when I look at the design for suitable 19 measures in this area, I found that there were only 20 15 panels, only 15 panels required suitable measures. 21 Next one, please. On shear links, Mr Southward 22 assumed that there were shear links in the critical 23 sections or the critical positions where shear links 24 were required, and then he carried out different 25 analysis to show that despite the shorter anchorage</p>	<p>1 investigation. So, for me, the MTRC investigation is 2 more convincing than the investigation of Leighton. 3 Mr Southward made comment about the higher cube 4 strength. This is a very important point. He said that 5 the high cube strength obtained from the cube strength 6 should be taken as the strength of in-situ concrete for 7 the purpose of structural assessment. For me, this 8 should not be used. For me, the only reliable test on 9 the concrete strength in the structure is actually the 10 core, the structure, to find out what is the strength in 11 the structure itself. 12 First of all, the cube strengths are used for 13 quality control purposes. They are not used for your 14 design purposes, because if a supplier gives you 15 grade 40 concrete, you should use the grade 40 concrete 16 strength for design purposes, because, first of all, in 17 the cube strength -- it depends on workmanship and 18 curing; it's very important. In the cubes, they were 19 properly compacted by the workers, they were properly 20 cured in the curing tank before they were tested in the 21 laboratory, whereas in the in-situ concrete, they were 22 placed in the structure, they may not be properly 23 compacted, they may not be properly cured. In fact, if 24 you look at the structure, at this particular structure 25 in the station, there are a lot of defects: look at the</p>

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<p>1 honeycomb area. So I don't think we should use the cube 2 strength test -- the cube strength result as the 3 strength of the concrete structure.</p> <p>4 There was also comment about the concrete gaining 5 strength over time. I also disagree that he should use 6 this, because I agree that the concrete would gain 7 strength for the first two to three years because of, as 8 I said last time, chemical reaction being continued.</p> <p>9 But after two to three years the chemical reaction stops 10 and the strength of the concrete begins to deteriorate 11 because of the accumulation of micro-cracks in the 12 structure, because of use of the structure, and the 13 micro-cracks will never disappear; they only accumulate.</p> <p>14 That's why the strength of the concrete can only 15 decrease, not increase, after certain period of time.</p> <p>16 There was also talk about arch action in the slab.</p> <p>17 Well, it depends on the depth span ratio. I showed last 18 week that in the slab there are a lot of openings. If 19 there are a lot of openings in the slab, there may not 20 be arch action in the slab for the sheer calculation.</p> <p>21 Next one, please, on construction joint. Now, we 22 all agree that it is not a structural problem anymore; 23 it's purely a workmanship problem on the construction 24 joint. We only disagree on the method of suitable 25 measures. For Mr Southward, he said that you only have</p>	<p>1 a contractual requirement. It is a durability 2 requirement. So I think, for fitness for purpose, we 3 should consider also the long intended design life of 4 the building structure.</p> <p>5 He said that the code is a "one size fits all" 6 standard. I disagree with him on this point, because 7 I was on the steering committee of the Hong Kong 8 Concrete Code. In fact, the code allows different 9 approaches to be adopted by the designer. They do not 10 restrict you to do whatever you want. But of course if 11 you want to do something different, then the rules 12 inside the code may not apply; you have to do more 13 checking. That's all.</p> <p>14 About the combination of test data for the 15 statistical analysis of coupler connections, I have to 16 disagree with him about combining the test results for 17 purpose 1 with purpose 2. I'm not an expert in 18 statistics, but I know that purpose 2 are properly 19 designed random samples. You should not contaminate the 20 random samples with purpose 1 data; they should be 21 separated.</p> <p>22 Also, one last point I want to comment on Dr Glover 23 is that he comments on Atkins' stage 3 assessment being 24 too conservative. I looked at the assessment, the OAP 25 settlement agreement and the Atkins assessment myself.</p>
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<p>1 to grout the two holes, but for me, I think we have to 2 grout -- you have to use dowel bar and grout as 3 a suitable measure. And according to the design by 4 Atkins, we need this grouting action and dowel bar 5 action on 23 panels, altogether 23 panels.</p> <p>6 For me, the dowel bars are important because the 7 joint is actually a fixed-end moment joint and there 8 should not be a construction joint in the concrete. If 9 there's a construction joint in the concrete, you can 10 imagine that you are trying to open up the bending 11 moment, trying to open up the joint, and the crack may 12 propagate in the long term. So I think it is important 13 to put in a dowel bar to stop any opening of the crack 14 in the long term.</p> <p>15 Next one, please. Dr Glover's COI 1 report. My 16 disagreement with Dr Glover is this. He said the 17 partial safety factors are meant to cover the 18 uncertainties during the construction period.</p> <p>19 I disagree with him, because the partial safety factors 20 are meant to cover the uncertainties during the long 21 intended design life of the structure, which is 22 120 years, not for the temporary stage of the 23 construction period.</p> <p>24 Second point is fitness for purpose. For me, the 25 design working life of the structure is not</p>	<p>1 Basically, they used more or less the same software, 2 Plaxis, the same software, the same applied load -- the 3 same dead load, same live load, same soil load, same 4 water pressure load, the same -- and they should come 5 out to be about the same in all the -- the stresses in 6 the structure should be the same. In fact, when OAP 7 adopt a very important parameter, which is the modulus 8 of the soil which is E equal to 1 times N -- N is the 9 value of the standard penetration result from ground 10 investigation. If they use the same stated modulus, 11 they get more or less the same result, but OAP go one 12 step further. They also do another assessment based on 13 a very important parameter, that is E. This time they 14 change it to E equals 1.5 N. By doing that, the 15 utilisation factor in the structure becomes lower, and 16 then he criticises the Atkins result as being too 17 conservative. This I have to disagree because the equal 18 to 1 N is a parameter required by the Geotechnical 19 Engineering Office in Hong Kong. All structures in 20 Hong Kong have to be designed to E equal to 1 N, not E 21 equal to 1.5 N. This is the main difference between the 22 two.</p> <p>23 Next one, please. We come to COI 2. When I look 24 at -- in the COI 2, I understand that -- I only want to 25 concentrate on two areas rather than all these: the</p>

Page 9	<p>1 coupler and the shear link, because these are the areas 2 we have to concentrate on.</p> <p>3 For the couplers, I know that there were no 4 opening-up in the COI 2 investigation or assessment, but 5 there were discoveries of bad coupler installation at 6 three points. The first one is the VRV room. The 7 second one is the three stitch joints leading to water 8 seepage, and there was also defective coupler connection 9 at the shunt neck.</p> <p>10 Next one, please. So even without opening-up, the 11 MTRC adopted a 35 per cent reduction rate, strength 12 reduction rate, for the coupler assessment. This is 13 a proposal proposed by MTRC. There's nothing I can do 14 about that because I have to look at the evidence before 15 me -- right? So I look at -- I think, still, it is 16 okay, the 35 per cent defective rate is okay, because if 17 you look at the -- next one, please -- if you look at 18 the investigation report on the couplers at the VRV room 19 as well as the stitch joint -- next one, please. Now, 20 this is the stitch joint. You can see that the couplers 21 are not connected at all in the stitch joint.</p> <p>22 Next one, please. And next one, please. This is 23 the VRV room. Again, the couplers are not connected at 24 all. So this evidence convinced me that something must 25 be done on the defective rate of the couplers.</p>	Page 11	<p>1 Next one, please. Next one, please. For me, 2 I think only fully engaged couplers should be used in 3 the structural assessment of the trough walls. The 4 35 per cent strength reduction rate for me is 5 a reasonable assumption. And remember that the trough 6 walls were designed to take collision loads in accident 7 involving train derailment. And the assumption of no 8 shear links is adopted in the assessment -- I think it 9 is satisfactory.</p> <p>10 At this stage, I would like to go back to the -- 11 actually, let me continue. In the SAT area, again, in 12 the SAT, because of missing shear links, suitable 13 measure was required on the base slab of this 14 particular -- in the SAT area. I have to point out to 15 the Commission that the diaphragm wall, some diaphragm 16 walls are called "hit" diaphragm walls; that means they 17 go down to the rock. Some diaphragm walls are called 18 "miss" because they don't go down to the rock. So 19 there's water coming in through the "miss" diaphragm 20 walls, so future dewatering in the surrounding area can 21 cause ground settlement. The groundwater table actually 22 is near the top of the EWL slab at the moment.</p> <p>23 Next one, please. You can see that the SAT slab is 24 not resting on rock at all; it's not resting on rock, 25 because actually rockhead changes a lot. It changes</p>
Page 10	<p>1 Next one, please. The structural review done by 2 MTRC is like the COI 1 -- they compare the spare 3 structural capacity of the structural elements and look 4 at the extent of strength reduction required. In the 5 case of the defective couplers, they checked the two, 6 they checked the spare capacity against the required 7 strength reduction, to determine if suitable measures 8 are required, and in the case of COI 2, they found that 9 NAT/SAT, as far as couplers are concerned, there's no 10 need for any suitable measures, but the only suitable 11 measure they recommended is the trough walls.</p> <p>12 Next one. According to AECOM, MTRC's DDC, they 13 found that the trough walls in HHS cannot safely resist 14 the horizontal impact load from a derailed train, and as 15 far as the SAT is concerned, they also found that 16 because of the lack of -- the missing shear links, 17 suitable measures would be required on the SAT as well.</p> <p>18 Next one. Let us look at the columns. Inside the 19 trough wall, there are a lot of columns that support the 20 podium above. Some of the columns are very close to the 21 trough wall itself.</p> <p>22 Next one. You can see that the trough wall and the 23 relationship with the columns, they are very close.</p> <p>24 Next one. These are the proposal by -- well, this 25 is the location of the trough wall.</p>	Page 12	<p>1 from minus 7mPD to minus 50mPD. There's a big change in 2 rock level for this project, a big change.</p> <p>3 Next one. What suitable measures are required for 4 the SAT area?</p> <p>5 CHAIRMAN: Sorry, can you tell me what that means, the big 6 change in the rock level.</p> <p>7 A. In area A, the rockhead is about minus 7mPD, which is 8 still below the NSL slab level. When we go down to --</p> <p>9 CHAIRMAN: I see. You are talking about -- I understand it. 10 Thank you very much indeed. So you are talking about 11 the levels, the actual physical -- how wide they are 12 when taken against the PD, the --</p> <p>13 A. 0mPD is sea level. And in area C it goes down to 14 minus 50mPD. It's very deep.</p> <p>15 CHAIRMAN: All right. Sorry, just while I'm just asking 16 questions, you say that there should be an assumption of 17 no shear links, when we are talking about couplers and 18 shear links.</p> <p>19 A. We are talking about shear links. There are two 20 problems here in this particular COI 2. The first one 21 is couplers, and the couplers only affect the trough 22 wall design.</p> <p>23 CHAIRMAN: Yes.</p> <p>24 A. And the shear links affect the SAT slab design. If you 25 assume there's no shear link, then according to Atkins</p>

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<p>1 we require suitable measures.</p> <p>2 CHAIRMAN: I'm with you, yes. And you make what is</p> <p>3 effectively a statistical assumption of no shear links,</p> <p>4 for purposes of deciding what work needs to be done?</p> <p>5 A. Yes. I did not do any statistical analysis.</p> <p>6 CHAIRMAN: No.</p> <p>7 A. It's MTR proposed that.</p> <p>8 CHAIRMAN: MTR's done that. Yes.</p> <p>9 Sorry, Mr Pennicott, can I ask, when did shear links</p> <p>10 become a problem? The only reason I ask is I don't</p> <p>11 recall that right at the outset, I don't recall anything</p> <p>12 about shear links.</p> <p>13 MR PENNICOTT: It emerged, sir, during the course of the</p> <p>14 first part of the Inquiry.</p> <p>15 CHAIRMAN: Yes, that's right.</p> <p>16 MR PENNICOTT: And when I show this witness some</p> <p>17 cross-examination by Mr Chow of Louis Chan [Kwan], one</p> <p>18 of the MTR's officers, we will perhaps remind ourselves</p> <p>19 of how it came about.</p> <p>20 CHAIRMAN: Thank you very much.</p> <p>21 A. Actually, in the SAT area, assuming that there are no</p> <p>22 shear links and the suitable measure required is shown</p> <p>23 in this blue strip, there's a requirement of thickening</p> <p>24 of the slab for about a length of 42 metres, thickening</p> <p>25 of the slab to cater for the assumption of no shear</p>	<p>1 NAT and SAT.</p> <p>2 Actually, for me, in view of the workmanship of the</p> <p>3 coupler connections at the stitch joints, the shunt neck</p> <p>4 joint and the VRV room, I agree that the 35 per cent</p> <p>5 strength reduction factor is a reasonable assumption.</p> <p>6 Next one, please. In the trough walls design -- in</p> <p>7 Mr Southward's COI 2 report, the trough walls were</p> <p>8 designed to take accidental collision loads in the event</p> <p>9 of train derailment. For me, during the 120 years</p> <p>10 intended design working life of the trough walls, the</p> <p>11 accident of train derailment may or may not happen. We</p> <p>12 don't know. It may never happen. But if it happens, it</p> <p>13 can have serious consequences, because there were a lot</p> <p>14 of columns behind the trough walls.</p> <p>15 Based on the strength reduction factor of</p> <p>16 35 per cent, MTRC analysed the trough walls as</p> <p>17 cantilevers with the weak point at the defective coupler</p> <p>18 level, that is the kicker level. This is a conventional</p> <p>19 method adopted by structural engineers everywhere.</p> <p>20 Next one. Mr Southward adopts a yield line</p> <p>21 analysis, and he is allowed because in the Hong Kong</p> <p>22 Concrete Code you are allowed to use yield line</p> <p>23 analysis; it is okay. But the yield line pattern</p> <p>24 proposed by Mr Southward has to be correct at the time</p> <p>25 of failure, otherwise he overestimates the strength.</p>
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<p>1 links in the slab.</p> <p>2 Next one. In fact, this is a summary of the</p> <p>3 calculation by MTR, and they show where -- which part,</p> <p>4 which point of the slab is overstressed.</p> <p>5 Next one. I go to Mr Southward's COI 2 report. He</p> <p>6 said there is no opening up of the structure by MTRC to</p> <p>7 identify defects, which I agree; there was no</p> <p>8 opening-up. For me, the only opening-up are the VRV</p> <p>9 room and the stitch joint area.</p> <p>10 COMMISSIONER HANSFORD: What do you mean -- sorry, on here,</p> <p>11 Dr Lau, you say "which is preferred". What do you mean</p> <p>12 by that?</p> <p>13 A. Preferred by me. If I have the chance, I would ask for</p> <p>14 opening-up.</p> <p>15 COMMISSIONER HANSFORD: Ah, you are saying that there was no</p> <p>16 opening-up, but you would have preferred that there had</p> <p>17 been opening-up?</p> <p>18 A. Yes, I would prefer.</p> <p>19 COMMISSIONER HANSFORD: Okay.</p> <p>20 A. That's why I say I agree with Mr Southward, because this</p> <p>21 is the evidence to support any design, but anyway there</p> <p>22 was no opening-up. This is a decision by MTR so there</p> <p>23 is nothing I can do about that.</p> <p>24 Then MTR recommend a strength reduction of</p> <p>25 35 per cent in the checking of the trough walls and the</p>	<p>1 And also he did not check the shear capacity of the</p> <p>2 trough wall. I think he should check; at least he</p> <p>3 should check it. I'm not saying it will fail but at</p> <p>4 least he has to check it.</p> <p>5 COMMISSIONER HANSFORD: Have you checked it, Dr Lau?</p> <p>6 A. I checked it somewhere -- I tell you how I did it;</p> <p>7 I checked it in other way, I checked it, I used very</p> <p>8 simple method to check it.</p> <p>9 He also assumed that the strength reduction was</p> <p>10 evenly distributed over the whole trough wall. I think</p> <p>11 it's okay, but that's what he did.</p> <p>12 Next one, please. In reality, if there was strength</p> <p>13 reduction, the weak points in the trough wall will be</p> <p>14 located at the coupler level. If there is</p> <p>15 an established line of weakness in the trough wall,</p> <p>16 Mr Southward's yield line pattern would not be correct.</p> <p>17 So for me I prefer DDC's method of analysis.</p> <p>18 Next one, please. Before I go to these shear links,</p> <p>19 let me tell you what I did. When Mr Southward was</p> <p>20 asked, I think on Friday morning, whether he checked the</p> <p>21 deformation of the trough wall at the time of collision,</p> <p>22 he said he did not, so what I did was, when I returned</p> <p>23 to my office, I carried out a very simple calculation,</p> <p>24 hand calculation, because according to his design there</p> <p>25 was a -- if you can put up his -- there's a drawing,</p>

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<p>1 he's got a drawing. Can we put it up, his slide, in his 2 report? He did a yield line analysis; he's got a yield 3 line analysis. He's got a PowerPoint. I think it's 4 very interesting. I need to show the Commission what 5 I did. 6 This is it. Remember there's a column behind this 7 wall. The distance between the column and the wall is 8 60 millimetres. In fact the wall, there was a recess in 9 the wall to accommodate the column. On the right-hand 10 side, there's the so-called expansion joint, it's 11 a movement joint, on the right-hand side, so it's free. 12 But this is not the yield line. It should be -- next 13 one. Yes, this is it. This is the yield line. This is 14 the yield line pattern adopted by -- this is the yield 15 line pattern adopted by Mr Southward (indicating). He 16 said the wall breaks along this line as the top portion 17 falls away from the lower portion. This is yield line. 18 You know that when a yield line forms, there's 19 a plastic hinge there. That means -- and it's free, on 20 the right-hand side, and if the wall on impact by the 21 train, it will rotate towards the column; right? 22 What I did was I used very simple hand calculation. 23 The wall is 1.8 metres high. At the midpoint, it's 24 about 1.2, 1.3; right? Then I calculate how much 25 rotation it needs for the wall to hit the column. The</p>	<p>1 accept this at all. 2 He also said that there is an alleged redistribution 3 of shear forces. I disagree with him as well, because 4 shear failure are brittle failure and sudden failure. 5 You cannot redistribute -- if it is bending, I can 6 understand there is a redistribution. Moreover, in the 7 original design, there was already a -- the so-called 8 redistribution already taken into account. If there's 9 a shear failure on the slab, the failure will happen 10 first because there will not be any other redistribution 11 because there's no support and the column will be 12 hanging on the slab beam above. So I disagree with him 13 that there will be a redistribution of shear forces at 14 all. 15 Next one. This is a very important point because 16 the other three experts keep on insisting that we should 17 use the concrete strength from the cube in the analysis. 18 First of all, I tell you, nobody in Hong Kong does that. 19 We only use the design strength supplied to you by the 20 concrete supplier as the design strength, just like what 21 Atkins did. I would not use the cube strength test 22 result in my design at all. 23 So what I said is that the concrete strength must 24 depend on the design mix proposed by Leighton and 25 accepted by MTR at the beginning of the project. The</p>
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<p>1 rotation is only 2.7 degrees. That means a very small 2 rotation of the wall will hit the column. 3 So, for me, it is very important that the wall 4 should be stopped from rotating at the point of failure, 5 and the proposal by AECOM to strengthen the wall from 6 behind is very important, because in case there was 7 an accident during the 120-year design life of the 8 trough wall, an accident happens, the column will be 9 severely damaged by the train and something will happen 10 to the podium. 11 It's not just one area; there were a lot of other 12 columns, all along the trough walls, a lot of other 13 columns. So this is what I did in terms of deformation. 14 Can we go back to ... 15 Shear links. Mr Southward referred to EIC's shear 16 calculations that take into account of, first of all, 17 the correct steel area. I agree. I think he can do 18 that; I have no disagreement with that. 19 Secondly, higher in-situ concrete strength obtained 20 from tests performed on concrete cubes prepared on site. 21 I disagree with this point, as I said before. It 22 depends on the workmanship in the concrete. It doesn't 23 depend on the workmanship of the cube; right? The 24 workmanship on the cube and the workmanship of the 25 in-situ concrete are totally different, so I will not</p>	<p>1 concrete cube strength tests are only used for quality 2 control. As I said, the results are always higher than 3 the strengths required by the design mix and also higher 4 than the in-situ concrete in the structure itself. 5 Next. The strength of concrete supplied by the 6 concrete supplier was not less than the design strength 7 if on-site quality control was satisfactory. Good 8 concrete strength also depends on -- important -- 9 workmanship, it depends on workmanship, it depends on 10 how you compact the concrete in the structure and how to 11 cure the concrete in the structure. It doesn't depend 12 on the cube strength you get; right? Of course the 13 strength is always high because we have different 14 workmanship on the cube strength and the workmanship on 15 the in-situ concrete. So, for me, it is inappropriate 16 to assume that the in-situ concrete strength is higher 17 than the design strength. It's inappropriate, at all. 18 Next one. Again, I talk about that you cannot 19 redistribute shear stresses, because it is not ductile; 20 it is brittle failure. You cannot. 21 Next one. Okay, I repeat this again. I don't want 22 to repeat this. 23 Next one, please. Let me look at Dr Glover's COI 2 24 report. About the 35 per cent strength reduction, 25 I already responded, and there is no need for me to talk</p>

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<p>1 about that again.</p> <p>2 On the strength design checks for trough walls, he</p> <p>3 said he relied on the concrete slab and the soil behind</p> <p>4 the trough walls and concluded that the structure was</p> <p>5 safe.</p> <p>6 First of all, the soil was not relied on in the</p> <p>7 original design; it was not relied on. Secondly, you</p> <p>8 can see that if the columns are so close to the trough</p> <p>9 walls, the soil is not that important because the wall</p> <p>10 will just hit the column, in time of accident. He said</p> <p>11 that we can rely on the concrete slab between the trough</p> <p>12 walls because it was not designed for -- it was not</p> <p>13 designed like that. They were supposed to be temporary</p> <p>14 works. If you want to rely on them, you have to make</p> <p>15 them permanent, as what AECOM is doing now. They put in</p> <p>16 the soil and the suitable measures and the concrete now</p> <p>17 and that now becomes permanent work, then we can rely on</p> <p>18 it now, but not before.</p> <p>19 He also suggested we should use a 3D model of the</p> <p>20 SAT structure to show that no requirement of shear link</p> <p>21 reinforcement in the NSL slab, but I haven't seen this</p> <p>22 3D model. Maybe he can demonstrate to me but it is not</p> <p>23 there.</p> <p>24 Next one. Prof McQuillan's COI 2 report. The</p> <p>25 35 per cent reduction, I already responded.</p>	<p>1 Next one. I talked about that. As I said, the</p> <p>2 lowering of the groundwater table can increase the</p> <p>3 effective soil pressure, will cause consolidation and</p> <p>4 settlement of soil beneath the suspended slab. So</p> <p>5 I don't think we can rely on the soil beneath the</p> <p>6 suspended slab.</p> <p>7 COMMISSIONER HANSFORD: Sorry, Dr Lau. Can we just go back</p> <p>8 one slide. Your final sentence there, what do you mean</p> <p>9 by that, "If it is punching shear"?</p> <p>10 A. Suppose you have a raft foundation and there is a column</p> <p>11 there. The column has punching shear. There is soil</p> <p>12 underneath; you can still punch through the raft</p> <p>13 foundation. If the concrete in the raft foundation is</p> <p>14 not strong enough to support the shear, it can still</p> <p>15 happen.</p> <p>16 COMMISSIONER HANSFORD: Okay. Thank you.</p> <p>17 Sorry, we seem to have some confusion about what you</p> <p>18 actually said. Did you say "raft foundation"?</p> <p>19 A. Yes, raft foundation. But this is not raft foundation</p> <p>20 here, we are not talking about, but I suppose, if it is</p> <p>21 a raft foundation, you have a column punching through</p> <p>22 the foundation.</p> <p>23 COMMISSIONER HANSFORD: Yes.</p> <p>24 A. There is soil beneath.</p> <p>25 COMMISSIONER HANSFORD: Yes, and you are saying here there</p>
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<p>1 On the trough walls, Prof McQuillan said there would</p> <p>2 be energy dissipation into the soil fill between the</p> <p>3 trough walls. First of all, the soil is not supposed to</p> <p>4 be permanent in the original design but now, after the</p> <p>5 suitable measures, it is permanent. But remember that</p> <p>6 if the column is so close to the trough walls, the soil</p> <p>7 may not be that useful in time of accident.</p> <p>8 Anyway, AECOM's design is an universally accepted</p> <p>9 method of cantilever analysis and it is a prudent</p> <p>10 approach.</p> <p>11 Next one. Shear links. Professor said he disagreed</p> <p>12 about the shear link proposal by AECOM. He said there's</p> <p>13 no opening-up investigation in area A. In fact, there</p> <p>14 were three locations, but still I agree with him that if</p> <p>15 possible we should have an opening-up.</p> <p>16 He said that the shear failure on the slab will not</p> <p>17 occur because the slab was in contact with soil which</p> <p>18 would prevent the slab from failure. Well, I cannot</p> <p>19 agree with him because the slab was supposed to be</p> <p>20 suspended slab. We have to remember that this structure</p> <p>21 is supposed to last for 120 years. We don't know what</p> <p>22 will happen in 10 years/15 years afterwards. There may</p> <p>23 not be any soil in contact with the slab because of</p> <p>24 dewatering and settlement of the soil. So it's better</p> <p>25 to be prudent, to assume that the soil is not there.</p>	<p>1 isn't.</p> <p>2 A. But in this case, we have no -- we have to assume it is</p> <p>3 suspended slab.</p> <p>4 COMMISSIONER HANSFORD: Okay. Understood.</p> <p>5 A. Also, it is important to understand what happened during</p> <p>6 the construction. I'm a contractor; I know what will</p> <p>7 happen in the basement construction. When you excavate,</p> <p>8 you always excavate more, because you have to allow for</p> <p>9 drainage at the soil level, so you have to excavate more</p> <p>10 so that there's a gradient so the water can flow along</p> <p>11 the surface of the soil, so the water can be accumulated</p> <p>12 in certain sump pit to be pumped away. So you always</p> <p>13 over-excavate and then you compact the soil back, put</p> <p>14 the soil back, before you cast the slab.</p> <p>15 So the soil will not be the original soil. The soil</p> <p>16 will be loose soil, because you over-excavate and then</p> <p>17 put it back. So we should not be thinking that there is</p> <p>18 CDG underneath the -- CDG means completely decomposed</p> <p>19 granite. It will not be CDG underneath the suspended</p> <p>20 slab. It will be fill soil underneath the suspended</p> <p>21 slab.</p> <p>22 In Hong Kong, it is well-accepted practice in</p> <p>23 Hong Kong that for pile caps and suspended slab, the</p> <p>24 contribution of soil is neglected in the design of</p> <p>25 suspended slab, always. We always neglect the</p>

Page 25	<p>1 contribution of soil for all suspended slabs. 2 Next one. The end. 3 Before I finish, I would like to give a conclusion. 4 I think it's important for me to put this in. In both 5 COI 1 and COI 2, defects and workmanship problems were 6 found. In fact, a lot of assessment and calculations 7 were done by different consultants. In all this 8 analysis, we identify certain weak areas in the 9 structure. We all agree that these are weak areas, all 10 concerned agree that it is weak, I think including the 11 experts agree what are the weak areas. But the 12 difference between me and the other experts is they 13 think, even though there are weak areas, there's no need 14 for any suitable measures, but for me, I think we need 15 to put in the suitable measures. 16 CHAIRMAN: Sorry, when you say "weak", do you mean "weaker"? 17 A. I'm not saying weak. Utilisation ratio is high. 18 COMMISSIONER HANSFORD: Okay. I think we need to be careful 19 with the word "weak" there. 20 A. Sorry. These are areas we identify with high 21 utilisation ratio and I think we need to put in suitable 22 measures. They should be monitored in the long term as 23 well. These are the areas we should monitor in the long 24 term. 25 COMMISSIONER HANSFORD: So what you are saying is -- your</p>	Page 27	<p>1 measures we are talking about. In COI 1, as far as the 2 couplers are concerned, we required 15 panels for 3 suitable measures, only 15 panels. On the CJ issue, we 4 required 23 panels. On the shear links, we are talking 5 about 1 per cent of the area. On COI 2, the trough 6 wall, I think definitely we need suitable measures 7 because it is very important to protect the columns. 8 Basically, as far as I understand, it is basically 9 completed on site at the moment. The shear links in SAT 10 area, we are talking about a strip of 42 metre long, 11 1 metre wide, thickened concrete. This is the suitable 12 measure required by Atkins and MTRC. 13 COMMISSIONER HANSFORD: How thick? 14 A. I forgot how thick, sorry. I cannot answer you. 15 COMMISSIONER HANSFORD: That's fine. 16 A. But it's not a thick -- just to increase the thickness 17 of the slab to improve the shear strength. That's all. 18 COMMISSIONER HANSFORD: Okay. 19 A. That's the end of my presentation, sir. 20 CHAIRMAN: Very good. Thank you very much. Thank you, 21 Doctor. 22 Examination-in-chief by MR KHAW 23 MR KHAW: Dr Lau, perhaps there's just one minor point 24 I would like to follow up on in relation to your 25 PowerPoint presentation. If you go back to slide 13,</p>
Page 26	<p>1 submission is that all of the engineers involved agree 2 that some areas have higher utilisation than others? 3 A. Yes, that's right. 4 COMMISSIONER HANSFORD: Thank you. 5 A. Also, don't forget -- 6 CHAIRMAN: Sorry, just remind me again: higher utilisation 7 means, in layman's terms ...? 8 A. Reaching the -- there's a limit of the strength, the 9 strength limit. In theory, we should have the applied 10 strength -- applied stress lower than the limit; right? 11 If it is close, then we should be more -- we should look 12 at that more carefully. If we have a high margin, then 13 we are more happy; right? If the applied stress on the 14 structure is close to the limit, then we need to be more 15 careful about those areas, in those areas. 16 COMMISSIONER HANSFORD: Yes. Maybe, in layman's terms, what 17 we are really saying is that in areas of high 18 utilisation, the structural capacity is being used more 19 than in areas of low utilisation. 20 CHAIRMAN: That's what I imagine, yes. 21 A. Thank you, Professor. 22 COMMISSIONER HANSFORD: Is that correct? 23 A. That's it. 24 The so-called suitable measures are -- I think he 25 need to put into perspective what sort of suitable</p>	Page 28	<p>1 under the heading of "Serviceability limit state 2 design", point 4, "Cracking", there's a bracket saying 3 "(exposure condition of the structures should not be 4 considered as 'mild', ie not exposure condition 1)". 5 You recall that when you were discussing this point 6 you told Mr Chairman and also Prof Hansford that you 7 might come back to this point. Would you like to have 8 anything to say on this point? 9 A. Okay. First of all, I hope that the Commission 10 understand that diaphragm walls are discrete panels. 11 They are not watertight diaphragm walls. So, actually, 12 even though there is no seepage through the diaphragm 13 wall joint, it is still moist. Still moist. 14 First of all, so I don't think it is "mild" in that 15 sense. That means inside the diaphragm wall enclosure, 16 it is quite moist, because of -- sometimes you will have 17 seepage. Even though there's no seepage, it is still 18 moist, so it is not "mild" in this sense. 19 Secondly, as I mentioned previously, there would be 20 cracks on the diaphragm wall top and the soil side of 21 the diaphragm wall, and there may be in the long term 22 water seepage into the inside of the concrete of the 23 diaphragm wall and it may cause corrosion of the 24 reinforcement. So we need to be careful about all this. 25 This is what I mean, that's why I said I need to discuss</p>

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<p>1 this point later on.</p> <p>2 Q. Thank you. Just to complete the picture, Dr Lau, for</p> <p>3 the purpose of this Inquiry, you have produced two</p> <p>4 reports.</p> <p>5 A. Yes.</p> <p>6 Q. Your COI report dated --</p> <p>7 CHAIRMAN: Sorry, I apologise. It takes me a little while</p> <p>8 to catch up sometimes.</p> <p>9 You would not, therefore, describe the atmosphere as</p> <p>10 "mild"?</p> <p>11 A. I would not, no.</p> <p>12 CHAIRMAN: You would describe it, rather, as being ...?</p> <p>13 A. I wouldn't say severe but it's definitely not mild.</p> <p>14 CHAIRMAN: Okay. So one up from mild on the severity</p> <p>15 stakes, or more than that perhaps?</p> <p>16 A. The worry I have is the reinforcement inside the panels.</p> <p>17 This is my worry. I'm not talking about the condition</p> <p>18 of people working inside the station. I'm worried about</p> <p>19 the condition of reinforcement inside the panel, the</p> <p>20 condition of reinforcement at the joint.</p> <p>21 CHAIRMAN: Yes, of course.</p> <p>22 A. This is what I worry about. And if the reinforcement</p> <p>23 corrodes, the reinforcement will expand, when it</p> <p>24 expands, it will cause spalling of concrete. This is</p> <p>25 the sort of thing I am worried about. And for diaphragm</p>	<p>1 assuming if it's not severe --</p> <p>2 A. I think it may be moderate to severe, somewhere between</p> <p>3 the two.</p> <p>4 COMMISSIONER HANSFORD: I see. Okay.</p> <p>5 MR KHAW: Thank you.</p> <p>6 For the purpose of this Inquiry, you have produced</p> <p>7 two reports, the COI 1 report --</p> <p>8 A. Yes.</p> <p>9 Q. -- dated 10 December. If we can just have a quick look</p> <p>10 at that report. It consists of about 69 pages. If you</p> <p>11 could just identify your signature at page 49; do you</p> <p>12 see that?</p> <p>13 A. My signature, yes.</p> <p>14 Q. There are various appendices attached to this COI 1</p> <p>15 report as well.</p> <p>16 A. Yes.</p> <p>17 Q. We can all see that.</p> <p>18 If we can go to the COI 2 report, dated 12 December</p> <p>19 2019. It's a shorter report, consisting of about</p> <p>20 17 pages; do you see that?</p> <p>21 A. Yes.</p> <p>22 Q. At page 17 there's your signature?</p> <p>23 A. Yes.</p> <p>24 Q. And also there are some appendices attached to this</p> <p>25 report.</p>
Page 30	Page 32
<p>1 wall and for the joint, this may happen in the long</p> <p>2 term.</p> <p>3 COMMISSIONER HANSFORD: Maybe to answer the chairman's point</p> <p>4 it would be helpful if we could look at -- I think it</p> <p>5 was Mr Southward's presentation where you had a table of</p> <p>6 the different exposure conditions; am I right?</p> <p>7 MR KHAW: He has a table showing condition 1 only.</p> <p>8 COMMISSIONER HANSFORD: Okay. Yes.</p> <p>9 MR KHAW: Perhaps I will show Dr Lau the table consisting of</p> <p>10 all the conditions.</p> <p>11 COMMISSIONER HANSFORD: Yes. That would be helpful.</p> <p>12 MR KHAW: It's H8 --</p> <p>13 COMMISSIONER HANSFORD: Thank you.</p> <p>14 MR KHAW: -- starting from 2856. The last bit, 4.3.2.2,</p> <p>15 "Classification of exposure conditions", then we can see</p> <p>16 the following conditions.</p> <p>17 COMMISSIONER HANSFORD: I see. So if it's not mild and it's</p> <p>18 not severe, presumably you are saying it's moderate,</p> <p>19 Dr Law?</p> <p>20 A. Well, in our case, I think it's between 3 and 4, because</p> <p>21 remember that the diaphragm wall, outside diaphragm wall</p> <p>22 we have high groundwater table, and remember I talked</p> <p>23 about the tidal effect, I talked about --</p> <p>24 COMMISSIONER HANSFORD: Sorry, the only reason I said that</p> <p>25 is you said you wouldn't say it's severe, so I am</p>	<p>1 Can you just confirm, Dr Lau, that insofar as the</p> <p>2 two reports contain factual matters --</p> <p>3 A. Yes.</p> <p>4 Q. -- the facts are true and correct?</p> <p>5 A. Yes.</p> <p>6 Q. Insofar as they contain your opinions, they contain your</p> <p>7 true and honest opinions?</p> <p>8 A. Yes.</p> <p>9 Q. Thank you. What will happen now is that various parties</p> <p>10 will have questions for you --</p> <p>11 A. Sure.</p> <p>12 Q. -- for cross-examination, and obviously meanwhile the</p> <p>13 chairman and Prof Hansford may have questions for you.</p> <p>14 A. Sure.</p> <p>15 MR KHAW: Thank you.</p> <p>16 Examination by MR PENNICOTT</p> <p>17 MR PENNICOTT: Dr Lau, good morning.</p> <p>18 A. Good morning.</p> <p>19 Q. I get to go first. Thank you very much for coming along</p> <p>20 to give evidence to the Commission.</p> <p>21 A. Yes.</p> <p>22 Q. Dr Lau, you were appointed relatively recently by the</p> <p>23 government to give expert evidence to the Commission.</p> <p>24 When were you appointed?</p> <p>25 A. I forgot. I think it's end of September.</p>

Page 33	<p>1 Q. You say in your first report that you were joined, as it</p> <p>2 were, in the second stage of the Inquiry.</p> <p>3 A. Yes.</p> <p>4 Q. So that would be right. So you think it was in</p> <p>5 September?</p> <p>6 A. Well, actually, I was consulted by the Highways</p> <p>7 Department around May. First of all, I helped the</p> <p>8 Highways Department in May, not necessarily as</p> <p>9 an expert.</p> <p>10 Q. Right.</p> <p>11 A. So I looked at the report around May, and then</p> <p>12 afterwards I was appointed by the DoJ to be the expert.</p> <p>13 Q. When you say you looked at the report, what report are</p> <p>14 you referring to?</p> <p>15 A. The holistic report and the verification report, the</p> <p>16 draft form.</p> <p>17 Q. Why were you asked to look at those?</p> <p>18 A. Well, as a consultant or something like that, to assist</p> <p>19 them. I don't know what, I don't know --</p> <p>20 Q. Were you paid to do that?</p> <p>21 A. Yes.</p> <p>22 Q. You looked at both the holistic report and the</p> <p>23 verification report?</p> <p>24 A. Yes.</p> <p>25 Q. So you had some input into those reports?</p>	Page 35	<p>1 Q. Did they influence the contents of either of your</p> <p>2 reports, Dr Lau?</p> <p>3 A. No, no.</p> <p>4 Q. Are you sure?</p> <p>5 A. I'm sure. I'm an expert. I don't have to be influenced</p> <p>6 by other people.</p> <p>7 Q. Can we just go back a moment to your review of the</p> <p>8 verification report and the holistic report. Did you</p> <p>9 meet any representatives of the MTR during that period?</p> <p>10 A. No, not at all.</p> <p>11 Q. When you were first appointed, Dr Lau, do you recall</p> <p>12 whether the proposed list of issues for the structural</p> <p>13 engineers was already in existence?</p> <p>14 A. Not -- let me see. Let me try to recollect. When I was</p> <p>15 preparing my report, I think there were the issues, but</p> <p>16 they change, every now and then they change. I think</p> <p>17 there were some issues -- I looked at some of the</p> <p>18 issues, yes.</p> <p>19 Q. Because those lists of issues came into existence in</p> <p>20 about mid-August 2019 and were the subject of directions</p> <p>21 by the Commission at the end of August 2019. And</p> <p>22 I think you've just said that you were appointed in</p> <p>23 September 2019 officially.</p> <p>24 A. Yes, officially.</p> <p>25 Q. Okay. And so, if that's right, then the list of issues</p>
Page 34	<p>1 A. No. Just look at.</p> <p>2 Q. Why did you look at them then?</p> <p>3 A. Just to explain to the engineer at the Highways</p> <p>4 Department what's the implication.</p> <p>5 Q. Who did you meet in the context of reviewing those</p> <p>6 reports?</p> <p>7 A. The Chief Engineer, the senior engineer, of -- I think</p> <p>8 they have a railway division there.</p> <p>9 Q. Of the RDO?</p> <p>10 A. Yes.</p> <p>11 Q. During the course of that initial review of those</p> <p>12 reports, did you have occasion to meet any of the expert</p> <p>13 advisory team appointed by the government?</p> <p>14 A. Later on, not at the time, no. Later on.</p> <p>15 Q. When did you first meet with the EAT representatives?</p> <p>16 A. I think after I presented my report, the first report.</p> <p>17 Q. Right. The first draft of your report?</p> <p>18 A. I forgot exactly when, but maybe somewhere between the</p> <p>19 draft report and the final report. I forgot exactly</p> <p>20 when, but I did meet them.</p> <p>21 Q. All three of them?</p> <p>22 A. Sometimes together, sometimes not together.</p> <p>23 Q. What was the purpose of meeting them?</p> <p>24 A. They hear what I -- they hear my comment on -- they just</p> <p>25 listened. They just listened to what I said.</p>	Page 36	<p>1 would have been in existence at that point?</p> <p>2 A. Would be. Would be.</p> <p>3 Q. Okay.</p> <p>4 A. But I did not look at that carefully because I was not</p> <p>5 supposed to be an expert at that time. I just looked at</p> <p>6 the report for --</p> <p>7 Q. No, I am just talking about September now. So far as</p> <p>8 I'm aware from what you've just said, you were appointed</p> <p>9 as the expert on behalf of the government in September;</p> <p>10 is that right or wrong?</p> <p>11 A. That's right.</p> <p>12 Q. Okay. So you would have looked at the list of issues at</p> <p>13 that point?</p> <p>14 A. Yes.</p> <p>15 Q. All right. I'm sorry to press you about this, Dr Lau,</p> <p>16 but let's go back to the holistic report in May. Can</p> <p>17 you now just recall why it was you were asked to review</p> <p>18 the holistic report; let's focus on that to start with?</p> <p>19 A. I was sent a copy of the draft report.</p> <p>20 Q. Why? Why were you sent it, Dr Lau?</p> <p>21 A. I don't -- well, they come to me and discuss with me,</p> <p>22 taking with them the draft report, and to give them some</p> <p>23 advice, whether the extent of investigation was</p> <p>24 sufficient or not, or something like that. There were</p> <p>25 investigations by the MTR and Atkins.</p>

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<p>1 Q. Did you provide any written advice at that time?</p> <p>2 A. No, no, no.</p> <p>3 Q. Was there any -- just advice given at meetings?</p> <p>4 A. At meetings, yes.</p> <p>5 Q. Did you keep any notes of those meetings?</p> <p>6 A. There may be some notes. I forgot. There may be some</p> <p>7 notes, maybe.</p> <p>8 Q. Can you recall they particular aspects that they asked</p> <p>9 you to focus on at that point, back in May?</p> <p>10 A. Basically, whether the investigation was sufficient or</p> <p>11 not, basically, the investigation.</p> <p>12 Q. Any particular aspect of the investigations?</p> <p>13 A. The coupler, the shear link, the honeycomb, things like</p> <p>14 that. That's all. I did not participate very actively.</p> <p>15 They just come every now and then to talk to me about</p> <p>16 that, yes.</p> <p>17 Q. But why you, Dr Lau? What was the initial contact? Did</p> <p>18 you know somebody who was looking into this? What was</p> <p>19 the reason they came to you; do you know?</p> <p>20 A. They also took me to meet a Prof Au as well.</p> <p>21 Q. Prof Au?</p> <p>22 A. Prof Francis Au.</p> <p>23 Q. From HKU?</p> <p>24 A. Yes. I know Francis Au for many years previously. We</p> <p>25 talk about the particular construction joint, the</p>	<p>1 you don't know?</p> <p>2 A. I don't know.</p> <p>3 Q. When you came to look at the final versions of the</p> <p>4 holistic report and the verification report, could you</p> <p>5 tell whether your observations and comments had been</p> <p>6 taken on board or not?</p> <p>7 A. I don't think they took on board anything I said.</p> <p>8 I don't think so.</p> <p>9 Q. All right.</p> <p>10 A. No.</p> <p>11 Q. We know the two reports, the holistic report and</p> <p>12 verification report, were produced on 18 July 2019.</p> <p>13 When you did you first see them in their final versions?</p> <p>14 A. Oh, the final version were supplied to me when</p> <p>15 I actually have to write my expert report, the final</p> <p>16 version, but because I have different copies of these</p> <p>17 two reports, in the draft form, I hardly know which one</p> <p>18 was the final copy, the final version. There were so</p> <p>19 many copies. Every now and then, I was sent copies</p> <p>20 of -- they were not exactly the same.</p> <p>21 Q. All right. We know, because they are in the files, that</p> <p>22 the final versions of both reports were produced and</p> <p>23 submitted to the Commission on 18 July 2019.</p> <p>24 A. That I don't know, sorry.</p> <p>25 Q. What I'm asking, what I'm trying to find out, is when</p>
Page 38	Page 40
<p>1 analysis at the construction joint at that time.</p> <p>2 I think mainly they rely on my expertise on finite</p> <p>3 element analysis, to talk about the construction joint.</p> <p>4 I think the most important point is the construction</p> <p>5 joint at that time.</p> <p>6 Q. Okay. Now, as far as the verification report is</p> <p>7 concerned, you were also asked to consider that; is that</p> <p>8 right?</p> <p>9 A. Yes.</p> <p>10 Q. Because the proposal, as I recollect it, in relation to</p> <p>11 the verification report, was not actually made by MTRC</p> <p>12 until the middle of May. So at what point did you look</p> <p>13 at the verification report or start looking at that?</p> <p>14 A. When they have a draft, they sent it me to have a look.</p> <p>15 That's all. I did not participate in the report itself.</p> <p>16 They just sent it to me to have a look, every now then,</p> <p>17 when there's a draft.</p> <p>18 Q. Does it come to this, Dr Lau: that you were sent copies</p> <p>19 of drafts of the holistic report and verification</p> <p>20 report, you had meetings with certain government</p> <p>21 officials?</p> <p>22 A. Yes.</p> <p>23 Q. You commented on certain aspects of those reports?</p> <p>24 A. Yes.</p> <p>25 Q. And whether those comments were taken on board or not</p>	<p>1 you first saw the final versions of those reports.</p> <p>2 A. I seriously looked at the final version when I had to</p> <p>3 prepare my expert report, actually, but before that, it</p> <p>4 was not serious. I was not appointed as an expert, so</p> <p>5 I did not do it very seriously.</p> <p>6 CHAIRMAN: Were you appointed then as a form of adviser?</p> <p>7 A. Before September, sir?</p> <p>8 CHAIRMAN: Yes.</p> <p>9 A. I don't know in what form. I don't even have a written</p> <p>10 contract with them.</p> <p>11 CHAIRMAN: But if you are being paid and if you are being</p> <p>12 sent what appears to be a good number of copies of</p> <p>13 various drafts, that would suggest --</p> <p>14 A. I think I have written them a letter and then they</p> <p>15 signed it back to me, saying that they want me to be</p> <p>16 sort of adviser -- I don't know whether it's adviser or</p> <p>17 what. They asked me to have a look at the report in the</p> <p>18 draft forms. That's all.</p> <p>19 CHAIRMAN: All right.</p> <p>20 A. At that time, I don't know what was my role, at that</p> <p>21 time.</p> <p>22 CHAIRMAN: Sorry, I don't mean to sound facetious, but that</p> <p>23 would suggest to a cynical outsider that you were being</p> <p>24 paid for something you didn't know what you were doing,</p> <p>25 in the sense that -- obviously you knew what you were</p>

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<p>1 doing, you are an expert and you have great experience, 2 it's not meant as an insult or a criticism in any way, 3 but the government was saying, "We are just going to 4 send you documents, we might ask for your assistance 5 from time to time and we will pay you"; would that be 6 right? 7 A. I think something like that, yes. 8 CHAIRMAN: All right. Thank you. 9 MR PENNICOTT: A rather loose arrangement, Dr Lau? 10 A. Sorry? 11 Q. A rather loose arrangement, it sounds? 12 A. I think it's a very loose arrangement. I think the 13 actual appointment came in September when I have to act 14 as an expert for the DoJ. That is a concrete 15 appointment. But before that, I don't know what was my 16 role. 17 Q. It doesn't sound typical of government, I am bound to 18 say, in terms of loose arrangements so far as finance is 19 concerned, for those of us who have experience. 20 A. I didn't know I have to attend this sort of Inquiry at 21 all, at that time. 22 Q. Presumably, in or around September last year then, 23 Dr Lau, you were officially engaged as the government's 24 expert for the Commission? 25 A. Yes.</p>	<p>1 you reviewed in appendix JL1-B to your COI 1 report. 2 A. Yes. 3 Q. Does that provide a comprehensive list of the material 4 that you had seen as at the date of the reports? 5 A. Yes, because I did ask for all this information so that 6 I can understand the project. 7 Q. To what extent had you read the transcripts of the 8 evidence of the Commission? 9 A. I only -- I read the transcript of the Commission on 10 Prof Au because I was quite interested in the 11 construction joint at the time. Because when I was 12 first asked to assist the Highways Department, my main 13 concern -- at that time our main concern was the 14 construction joint, to see analysis by different 15 companies, Mannings, Atkins, AECOM -- at that time, that 16 was the main concern. I don't know why, but that was 17 the main concern at that time, when I was first 18 appointed by Highways, just to look at the construction 19 joint. 20 Q. All right. So did you have occasion to look at any of 21 the transcripts of any of the factual witnesses? 22 A. Very briefly. I did not go very deep into it. Very 23 briefly. I did not put too much attention to that. 24 I was more interested in what happened to Prof Au during 25 the investigation.</p>
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<p>1 Q. And that would have been on a much more formal basis, 2 with exchange of letters and -- 3 A. Oh, it's formal. It's formal after that. 4 Q. Okay. Once that had happened, there would have been 5 a process, I assume, of the government providing you 6 with documentation? 7 A. Yes. 8 Q. Was that DoJ or was it Highways, or who was your main 9 point of contact in the provision of information? 10 A. Both departments, Highways and also DoJ. 11 Q. Did it go like this, that they supplied you with 12 documentation and then you called for more information 13 or more documentation if you thought you needed to 14 see it? 15 A. I called for more information. In fact, I called for 16 all the design calculations, the assessment report, the 17 report on the suitable measures. I want to know more 18 about the project. This is my -- I always do this. 19 I want to know more about the project. 20 Q. Right. So it was a two-way process: they would provide 21 you with information and documentation, but you would 22 also ask for more documents as you thought -- 23 A. I always ask for more. I always ask for more. I want 24 to understand more about the project. 25 Q. All right. I've seen a list of documentation you say</p>	<p>1 Q. So you focused on Prof Au's evidence? 2 A. Yes. I know very well about what happened to him. 3 Q. I see. All right. I may need to just show you one or 4 two aspects of the factual evidence a little bit later. 5 Dr Lau, do you agree that the Hung Hom Extension 6 structure has been subjected to a significant amount of 7 post-construction surveys, investigations and 8 opening-up? 9 A. I agree, yes. 10 Q. Would you agree that the extent and degree of those 11 investigations is unusual, perhaps not unique, but 12 unusual; there's been a lot of them? 13 A. I agree with you. Yes, I agree. 14 Q. And presumably you would also agree that certain aspects 15 of the structures have been subjected to a series of 16 sophisticated independent analyses by a number of 17 well-qualified people? 18 A. I agree. 19 Q. Do you agree as a general proposition that the 20 conclusions to be derived from those investigations and 21 analyses establish a high level of confidence in terms 22 of the overall safety of the structures? 23 A. I agree. 24 Q. Would you agree that none of the findings and 25 conclusions have uncovered or exposed any fatal flaws in</p>

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<p>1 the construction of the extension?</p> <p>2 A. In terms of stability, I don't think there's any fatal</p> <p>3 flaw.</p> <p>4 Q. Could I then just touch briefly on a topic which</p> <p>5 I think -- it might be called risk profiling.</p> <p>6 A. Okay.</p> <p>7 Q. You agree, I think, that at the inception, design stage</p> <p>8 of a project, despite perhaps much investigation and</p> <p>9 research being carried out, there are still inherent and</p> <p>10 inevitable uncertainties about, for example, the</p> <p>11 appropriate loadings to take when you are designing</p> <p>12 a structure; there are uncertainties about that?</p> <p>13 A. In what sense? Can you be more specific? In terms of</p> <p>14 dead load, I think it's quite certain. Live load is</p> <p>15 also very certain. What sort of thing are you talking</p> <p>16 about?</p> <p>17 Q. Okay. Let's just change the topic slightly. In Hong</p> <p>18 Kong, as you and I well know from previous cases, the</p> <p>19 ground conditions may not be quite as you expect them to</p> <p>20 be.</p> <p>21 A. I know that there were a bit of problem during the</p> <p>22 diaphragm wall construction, and this is the reason why</p> <p>23 they put in some capping beams, because they cannot</p> <p>24 reach rock level properly, because you don't have</p> <p>25 capping beams everywhere, only in certain locations you</p>	<p>1 For this reason, the international codes and standards</p> <p>2 contain partial safety factors. These factors include</p> <p>3 for the extremes of the variations in the applied loads</p> <p>4 and 'ignorance' factors -- 'ignorance' factors are</p> <p>5 intended to reflect the level of uncertainties in the</p> <p>6 assumptions made in the design and the sophistication of</p> <p>7 the analysis methods to be adopted, to mitigate these</p> <p>8 unknowns ..."</p> <p>9 Then he gives an example of a British Standard.</p> <p>10 Did you agree generally with those propositions,</p> <p>11 Dr Lau?</p> <p>12 A. Actually, I don't quite agree with him in this sense,</p> <p>13 because so-called partial safety factors are meant for</p> <p>14 the design life of the building rather than the</p> <p>15 construction stage. I know there are certain problems</p> <p>16 during the construction stage, if we talk about that</p> <p>17 sort of problem, then I can agree. I don't know whether</p> <p>18 the Commission is aware of what we call the locking</p> <p>19 effect or not, because there are a lot of arguments</p> <p>20 about this point during the design stage. If you would</p> <p>21 like me to explain, then I can, otherwise we can skip</p> <p>22 this point.</p> <p>23 Q. I think we can skip the point, Dr Lau. I just want us</p> <p>24 to stay on a relatively high level, if I may, at the</p> <p>25 moment.</p>
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<p>1 have capping beams, and that was caused by certain</p> <p>2 unforeseen ground conditions.</p> <p>3 Q. Yes. That's the type of thing I had in mind, that there</p> <p>4 are, when you are a designing a structure such as the</p> <p>5 Hung Hom Extension, inherent uncertainties; you don't</p> <p>6 quite know 100 per cent what you are going to face?</p> <p>7 A. I agree, I agree.</p> <p>8 Q. Right.</p> <p>9 A. But that's all, but not -- as far as dead load or live</p> <p>10 load, I don't think they are quite certain. But as far</p> <p>11 as uncertainty is concerned, I think the ground level,</p> <p>12 the rock level, there were a bit of problem. That's why</p> <p>13 they need certain ground -- capping beams to bridge over</p> <p>14 the diaphragm wall. This is also the reason why they</p> <p>15 have "miss" panels and "hit" panels in the diaphragm</p> <p>16 wall.</p> <p>17 Q. Yes. Understood. Could I ask you then to just look at</p> <p>18 one paragraph in Dr Glover's report. That's ER2,</p> <p>19 tab 16, page 8, paragraph 5.5.</p> <p>20 What Dr Glover says -- I assume you have read</p> <p>21 Dr Glover's report?</p> <p>22 A. Yes.</p> <p>23 Q. "In the inception and design stages of a project, much</p> <p>24 is unknown as to the actual future construction loadings</p> <p>25 and sequence, material strengths and geometric accuracy.</p>	<p>1 Can we scroll down a bit further, please.</p> <p>2 Dr Glover also refers to the fact that that British</p> <p>3 Standard was the code on which the Hong Kong Concrete</p> <p>4 Code was based.</p> <p>5 A. Yes.</p> <p>6 Q. It is right, is it not, Dr Lau, that the codes and</p> <p>7 standards, both domestic and international, are there</p> <p>8 because they contain built-in safety factors when you</p> <p>9 are designing a structure?</p> <p>10 A. Yes. These are the minimum factors we have to adhere to</p> <p>11 in the design, yes.</p> <p>12 Q. So what these codes are there for is to mitigate the</p> <p>13 unknowns or the "ignorance" factors, as Dr Glover calls</p> <p>14 them?</p> <p>15 A. Yes, he's talking about the short term; I'm talking</p> <p>16 about the long term. He's talking about the</p> <p>17 construction stage but I'm talking about the 120-year</p> <p>18 period.</p> <p>19 Q. Right.</p> <p>20 A. So we differ in this sense.</p> <p>21 Q. Understood. And by their very nature these codes and</p> <p>22 standards are conservative in nature?</p> <p>23 A. In terms of factor of safety, I don't think it is, but</p> <p>24 other things, it might. I don't know. But it's</p> <p>25 difficult to say whether they are conservative or not.</p>

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<p>1 Actually, if you follow all the rules in the code, then</p> <p>2 you can skip certain checks, for example. Take for</p> <p>3 example, if you follow all the detailed rules, then</p> <p>4 sometimes you don't have to check the crack width,</p> <p>5 provided you follow all the detailed rules. So, in</p> <p>6 a way, it helps the engineer in the design stage. It</p> <p>7 helps the engineers.</p> <p>8 Q. Dr Glover goes on at 5.6 to say:</p> <p>9 "In my opinion, the logical consequence of the</p> <p>10 substantial reduction in risk between inception and</p> <p>11 post-construction of a project is that the basis of</p> <p>12 assessment of the structure should recognise and take</p> <p>13 account of the fact that many of the safeguards and</p> <p>14 conservative assumptions included in the original design</p> <p>15 and construction no longer apply and should be relaxed."</p> <p>16 Do you agree with that?</p> <p>17 A. I have to disagree with him on this point.</p> <p>18 Q. All right.</p> <p>19 A. That means -- this is wrong. I'm sure it is wrong.</p> <p>20 Because the factors of safety are meant for the long</p> <p>21 intended design life of the building, in case of</p> <p>22 uncertainties in the change in load or accidental load</p> <p>23 on the structure, not for the short construction period;</p> <p>24 certainly it cannot be right. It can't be right.</p> <p>25 CHAIRMAN: I may have misread what Dr Glover says but</p>	<p>1 partial safety factor, nothing to do with that.</p> <p>2 Q. But all I understand him to be saying, as the chairman</p> <p>3 says, is that once, post-construction, you've got your</p> <p>4 building, you now know what you've got, and you now can</p> <p>5 use the knowledge that you have to analyse the safety</p> <p>6 and the fitness for purpose rather than having to go</p> <p>7 back and make all sorts of assumptions about -- derived</p> <p>8 from the codes and standards and so forth?</p> <p>9 A. But you don't reduce the factor of safety.</p> <p>10 Q. I don't think he's suggesting that.</p> <p>11 CHAIRMAN: No.</p> <p>12 A. He doesn't.</p> <p>13 CHAIRMAN: Let me put it this way. My understanding --</p> <p>14 Dr Glover is there, probably he is getting angrier by</p> <p>15 the moment, as he listens to us mutilate his sentences.</p> <p>16 MR PENNICOTT: That was the idea.</p> <p>17 CHAIRMAN: My understanding is he is really saying that the</p> <p>18 loading and material strength assumptions at the</p> <p>19 inception of a project will of course include durability</p> <p>20 factors for the life of the project, the life of the</p> <p>21 building. But you don't apply those, including the</p> <p>22 durability factors, once the project is surveyed and</p> <p>23 tested post-construction, and what you look at</p> <p>24 post-construction will obviously be different because</p> <p>25 you now have an opportunity to survey it, but will also</p>
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<p>1 I didn't read it quite the same. Perhaps wrongly, and</p> <p>2 I don't want to put words into Dr Glover's mouth, but</p> <p>3 I think what he's saying effectively is there is</p> <p>4 a difference between the assumptions you make at the</p> <p>5 design stage and the actual knowledge that you now have</p> <p>6 upon completion of a construction.</p> <p>7 A. Okay.</p> <p>8 CHAIRMAN: He is not saying that that doesn't take into</p> <p>9 account the long-term durability issue.</p> <p>10 A. He is talking about -- the factor of safety relates to</p> <p>11 the load and material; right? Only load and material.</p> <p>12 So, if you try to reduce the factor of safety in load or</p> <p>13 material, after the initial design, initial</p> <p>14 construction, then it must be wrong.</p> <p>15 COMMISSIONER HANSFORD: I'm sure we are going to hear from</p> <p>16 Dr Glover on this point in the next day or so, so --</p> <p>17 MR PENNICOTT: The reason of course I'm putting this to you,</p> <p>18 just in case nobody else does, is because I thought this</p> <p>19 was an area where you possibly disagree with Dr Glover,</p> <p>20 so I'm giving you an opportunity to say what you want to</p> <p>21 say and then Dr Glover can respond when he gives his</p> <p>22 evidence later today or tomorrow, I imagine.</p> <p>23 A. Because you are talking about rock level, of course</p> <p>24 there are bound to be unforeseen conditions in the rock</p> <p>25 level, bound to be, but this has nothing to do with the</p>	<p>1 include the durability factor. So the durability factor</p> <p>2 stays throughout.</p> <p>3 A. I believe that he's talking about reducing the partial</p> <p>4 safety factor, after the completion of construction.</p> <p>5 Am I right? Because I seem to understand --</p> <p>6 CHAIRMAN: No. I think he's just saying that certain</p> <p>7 assumptions you make at the beginning, which include</p> <p>8 perhaps extra loading, et cetera, you don't have to have</p> <p>9 those extra loadings necessarily once you have actual</p> <p>10 knowledge of the post-construction stage.</p> <p>11 A. But if I look at the design -- I looked at the design</p> <p>12 load very carefully, there's not -- I don't think</p> <p>13 there's any load called "construction load" on the</p> <p>14 design. So where do you take this away? If we do not</p> <p>15 understand something, we put in an additional load</p> <p>16 called construction load, after finishing the</p> <p>17 construction, we can take away the construction load,</p> <p>18 then I can understand it. But if I look at the full</p> <p>19 load in the design, I look at the design very carefully,</p> <p>20 there was no such a load. That's why I do not</p> <p>21 understand what he means.</p> <p>22 But I think I know what he means. I think I know</p> <p>23 what he means. Because what happened was this structure</p> <p>24 was constructed using top-down construction; right?</p> <p>25 After you finish the top-down construction, they go in</p>

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<p>1 to put in the column and the wall inside. Now, before</p> <p>2 you put in the column and the wall inside, the heavy</p> <p>3 slab already is deformed, and put in a lot of fixed-end</p> <p>4 moments at the diaphragm wall connection. Now, the</p> <p>5 point is when they use the dead load in the design, they</p> <p>6 put in 1.4, so if you put in 1.4 with the heavy dead</p> <p>7 load, there are a lot of bending moments, fixed-end</p> <p>8 moments at the ends. So there was an agreement between</p> <p>9 Atkins and also OAP that let us not use 1.4, let us use</p> <p>10 1.26. In fact, that's what they used, because using</p> <p>11 1.26 they reduce significantly the bending moment at the</p> <p>12 end.</p> <p>13 But I think this is acceptable. For me, this is</p> <p>14 acceptable. I'm not questioning them at all. But if</p> <p>15 you are talking about taking away a construction load,</p> <p>16 there was no such construction load at all in the whole</p> <p>17 site.</p> <p>18 CHAIRMAN: Obviously Dr Glover will be given an opportunity</p> <p>19 to explain.</p> <p>20 A. But if you talk about the locking effect, then I agree</p> <p>21 with him; you can do that.</p> <p>22 CHAIRMAN: Okay.</p> <p>23 MR PENNICOTT: Dr Lau, if I can just then, before we have</p> <p>24 a cup of coffee, discuss with you the definition of</p> <p>25 "safe" and "fit for purpose".</p>	<p>1 Q. -- robustness --</p> <p>2 A. Yes.</p> <p>3 Q. -- and ductility?</p> <p>4 A. Yes.</p> <p>5 Q. As I understand your report and your position, Dr Lau,</p> <p>6 you have no problems, no concerns regarding stability,</p> <p>7 robustness or ductility; is that correct?</p> <p>8 A. Now, no, because I think now they are using ductility</p> <p>9 couplers -- because ductility is very important in this</p> <p>10 structure, because we are talking about moment</p> <p>11 redistribution over 30 per cent. We need ductility in</p> <p>12 a structure to do that, very important.</p> <p>13 Q. But, as I understand it, you have not referred to</p> <p>14 anything in your reports where you express concern about</p> <p>15 ductility; am I right?</p> <p>16 A. I'm not concerned but I mention in my report that</p> <p>17 ductility is very important.</p> <p>18 Q. I know. I'm sure it may be and --</p> <p>19 A. I think there is ductility in the structure, definitely,</p> <p>20 in this structure.</p> <p>21 Q. As I understand it, your primary concern is rupture of</p> <p>22 section?</p> <p>23 A. Yes.</p> <p>24 Q. That item.</p> <p>25 A. Yes.</p>
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<p>1 First of all, do you agree with this, that "safe"</p> <p>2 and "fitness for purpose" is achieved provided</p> <p>3 durability and consequential longevity are not</p> <p>4 compromised; would you agree with that as a proposition?</p> <p>5 A. Agree. This is very important. Very important.</p> <p>6 Q. That's the way that Prof McQuillan expresses it.</p> <p>7 What about this: safety and fitness for purpose is</p> <p>8 achieved if, as constructed, the structure is capable of</p> <p>9 being used and functions, in this case as a station,</p> <p>10 safely and without physical restrictions on its</p> <p>11 operations and as anticipated by MTRC?</p> <p>12 A. Agree.</p> <p>13 Q. That's the way that Dr Glover puts it.</p> <p>14 You, however, say that the structure is only safe</p> <p>15 and fit for purpose when it is able to meet certain</p> <p>16 criteria during its intended working life?</p> <p>17 A. I think they are the same. He's talking about</p> <p>18 longevity. Are we talking about the same? I think they</p> <p>19 are the same. We are talking about the same thing.</p> <p>20 Q. Okay. If you are, that will be of great benefit.</p> <p>21 So far as safety is concerned, as we've seen in your</p> <p>22 slides, you identify four primary factors: stability --</p> <p>23 A. Yes.</p> <p>24 Q. -- rupture of section --</p> <p>25 A. Yes.</p>	<p>1 Q. Because you say that there is a risk -- and this is</p> <p>2 a point you made right at the end of your</p> <p>3 presentation -- of localised overstressing of individual</p> <p>4 structural elements.</p> <p>5 A. Yes.</p> <p>6 Q. And your view is, if I've understood this correctly --</p> <p>7 could we look at paragraph 44 of your report, please.</p> <p>8 That's the COI I report.</p> <p>9 A. Yes.</p> <p>10 Q. You say, under the heading, "The updated design by MTR":</p> <p>11 "I have been provided with the updated design</p> <p>12 calculations carried out by MTR. I believe that the</p> <p>13 other experts also are in possession of these</p> <p>14 calculations. My report relies on this set of</p> <p>15 calculations. From the updated design calculations, it</p> <p>16 is clear that the as-constructed structure has no</p> <p>17 structural stability problem."</p> <p>18 So that's why I tick the "stability" box.</p> <p>19 A. Yes.</p> <p>20 Q. "The only concern", you say, "is the overstressing of</p> <p>21 local areas in the structure."</p> <p>22 A. Yes.</p> <p>23 Q. That's as I understand your position. However, and we</p> <p>24 will perhaps discuss this a little bit more later,</p> <p>25 I think you do agree, despite having said that, that so</p>

Page 57	<p>1 far as the top of the EWL slab and the top of the east 2 diaphragm wall is concerned, there is no evidence of 3 oversteeringing? 4 A. Can you repeat your question? Is it shown here in my 5 report or what? 6 Q. No. 7 A. Okay. 8 Q. You say: 9 "The only concern is the oversteeringing of local 10 areas in the structure." 11 A. Yes. 12 Q. What I was suggesting to you is there is no 13 oversteeringing at the top of the EWL slab and the top of 14 the east diaphragm wall. That is correct, is it not? 15 A. Actually, there were oversteeringing, otherwise there's no 16 need for redistribution. There was, because of 17 oversteeringing, that's why the consultant recommended 18 a 30 per cent redistribution of moment from the fixed 19 end to the mid-span of the structure. 20 Q. The work to the construction joint at the top of the EWL 21 slab and top of the east diaphragm wall is not being 22 carried out because of oversteeringing, is it, the dowel 23 bars? That's not to do with oversteeringing; that's to do 24 with workmanship problems. 25 A. Okay. I understand what you are talking about. After</p>	Page 59	<p>1 theoretically there was oversteeringing? 2 A. Yes, okay, you can say that. 3 COMMISSIONER HANSFORD: Because they then redistributed. 4 I mean, that's a theoretical concept, isn't it? 5 A. It is allowed -- but it is also real, it's not just 6 theoretical. If you don't allow redistribution -- 7 COMMISSIONER HANSFORD: The redistribution is real, but the 8 oversteeringing you referred to is theoretical? 9 A. After the redistribution, there's no more oversteeringing, 10 yes. 11 COMMISSIONER HANSFORD: Right. 12 A. But then the structure's got to be ductile, otherwise 13 you cannot do the redistribution. 14 COMMISSIONER HANSFORD: Yes. I see what you are saying. 15 MR PENNICOTT: Just to finish on this point, could you just 16 look at paragraph 67 of your report, please. 17 A. Yes. 18 Q. Probably we ought to find out where we are. Could you 19 scroll up, please, just to find out what heading we are 20 under. You are talking about the construction joint at 21 this section of your report, Dr Lau; do you see that? 22 A. Yes, okay, because -- okay. Let's -- okay. 23 Q. Then if you go to paragraph 67, you say: 24 "Without the L-shaped rebars, tensile forces in the 25 fixed moment joint had to be transferred through</p>
Page 58	<p>1 all the analysis we agree that there is no more 2 structural problem, it's a workmanship problem. I'm 3 sorry, because I didn't catch what you said. I'm sorry 4 about that. 5 Q. It's probably my fault, but anyway, so far as -- you 6 refer to oversteeringing in local areas, but at the top of 7 the east diaphragm wall and the EWL slab, that's not to 8 do with oversteeringing, that's to do with workmanship? 9 A. Workmanship. Okay. 10 Q. All right. 11 A. Because actually your question is not too specific. Can 12 I tell you what I understand? If I'm wrong, then you 13 correct me. 14 Q. Yes. Please do. 15 A. In the original design, after discovery of all these 16 defects, Atkins carried out an analysis. They found 17 that the joint, the fixed-end moment, there were 18 oversteeringing, so they carried out a 30 per cent 19 redistribution, to redistribute the bending moment to 20 the mid-span, and for that, because of that, they 21 reduced the utilisation factor at the joint. So there 22 were oversteeringing initially, but after the updated 23 design there were no more -- no more. So, if we go this 24 sort of step, then I can agree with you. 25 COMMISSIONER HANSFORD: Presumably you are saying: so</p>	Page 60	<p>1 concrete. It is not desirable to rely on concrete to 2 take tensile force. MTR's consultants then carried out 3 analyses of the joint in question based on the updated 4 design." 5 This is the point you are making. 6 A. Yes. 7 Q. "It is now found that the concrete at the construction 8 joints is not overstressed under the updated design 9 despite the lack of L-shaped vertical reinforcements at 10 the top of the diaphragm wall. It is probably due to 11 the fact that the internal stresses generated under the 12 updated design are lower than those under the original 13 design." 14 And so forth. 15 A. Agree. 16 MR PENNICOTT: Sir, would that be a convenient moment? 17 CHAIRMAN: Certainly. 15 minutes. 18 (11.38 am) 19 (The luncheon adjournment) 20 (11.59 am) 21 MR PENNICOTT: Dr Lau, good morning again. 22 Dr Lau, can we just focus for a few minutes on 23 rupture of sections -- 24 A. Yes. 25 Q. -- which is of primary concern. There are, as</p>

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<p>1 I understand it, two essential causes of localised 2 overstressing, concerning the coupler assemblies and the 3 shear links. 4 A. Yes. 5 Q. Those are the two primary drivers or causes of local 6 overstressing, as you see it? 7 A. Agree. 8 Q. So far as the defective coupler connections are 9 concerned, what that has led to in terms of suitable 10 measures is a strengthening of the connections between 11 the capping beam and the EWL slab at area A? 12 A. Yes. 13 Q. So despite -- and I think you made this point at the end 14 of your presentation, quite helpfully -- all that has 15 been said about the coupler connections and the coupler 16 assemblies, no suitable measures, in relation to coupler 17 assemblies specifically, are required in the HKC, area B 18 and area C? 19 A. Agree. 20 Q. Even then, so far as the suitable measures in area A are 21 concerned, they are just in three specific locations; is 22 that right? 23 A. About 15 panels, yes. 24 Q. And so far as the SAT area is concerned, in one 25 location?</p>	<p>1 there area A? 2 A. Yes. 3 Q. The reason I suggested it was three areas -- two yellow 4 and one green; do you see that? 5 A. Yes. 6 Q. And you think that's about 15 panels? 7 A. About 15 panels. Actually, I counted myself. It's 8 exactly 15, yes. 9 Q. All right. Then, as far as the SAT is concerned, to do 10 with shear links rather than coupler assemblies, we've 11 got a few panels down here in the SAT area as well? 12 A. Yes. 13 Q. Okay. Of course also we know, so far as area A is 14 concerned, that the work is being done not on the basis 15 of any extensive opening-up in area A but by way of 16 extrapolation -- 17 A. Sure. 18 Q. -- from the opening-up that's been done in HKC, area B 19 and area C? 20 A. Agree, yes. 21 Q. So far as the shear links are concerned, we've 22 identified the area in the SAT, and as I understand it 23 in areas B and C there are also some localised areas. 24 If we look at, please -- it could be the previous page 25 or it could be the next page -- that's the HHS, we don't</p>
Page 62	Page 64
<p>1 A. In one -- no, shear link. 2 Q. You think that's just to do with the shear links? 3 A. Shear links, not couplers. 4 Q. Okay. Just shear links? 5 A. Just shear links. 6 Q. Can we just look at a diagram or plan, drawing: 7 OU9/11375. 8 Dr Lau, I'm not sure whether you would be aware, but 9 every week over the last few months MTRC have been 10 updating the Commission as to the progress of the 11 suitable measures. 12 A. Okay. 13 Q. This is the cover sheet -- you can look at it on the 14 screen -- it's probably going to be easier on the screen 15 at the moment -- this is the cover sheet for the status 16 as of Christmas Day, 25 December. 17 A. Okay. 18 Q. Have you been looking at these documents? 19 A. I think I have read a few of them, yes. I think I have 20 read the latest one. 21 Q. There is one later than this -- 22 A. I read the latest one. 23 Q. -- which I think might have just gone into the bundle, 24 but for my purposes it doesn't matter. 25 Can we then go on to page 11382, please. We can see</p>	<p>1 need to worry about that for the moment. One back, 2 please. That's the construction joint. Then one back, 3 please. Right. Okay, here. 4 I think you mentioned a figure of 1 per cent in your 5 presentation just a moment ago? 6 A. Yes. It used to be 2.5 per cent, used to be, but now, 7 after they sharpen the pencil, they look at the 8 design -- in fact, they also incorporate some of the 9 comments from actually Mr Southward. They allow for the 10 actual reinforcement area, so now it's tightened up. At 11 the moment, it's about 1 per cent. It may still reduce. 12 Q. It may be that people with better eyesight than me can 13 identify the areas -- is it possible to identify the 14 areas on here? 15 A. I can't. 16 Q. I can't either. 17 A. My eyesight is bad as yours. 18 CHAIRMAN: Is it possible to do what? 19 MR PENNICOTT: To actually identify where the areas are on 20 here. 21 CHAIRMAN: Yes, I can. 22 MR PENNICOTT: There's some colour in certain places, 23 towards the left-hand end in area A, but for example -- 24 yes, if we blow up area B, if we go along there, there's 25 a green area there, with the hand. These are the items</p>

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<p>1 we are looking for it, is it?</p> <p>2 A. Yes. I think they are normally coloured.</p> <p>3 Q. But those green ones will be the construction joints,</p> <p>4 though, won't they?</p> <p>5 A. I think these are construction joints. The construction</p> <p>6 joints, I think there are 23. I counted them.</p> <p>7 Q. Yes, there are 23.</p> <p>8 A. 23, yes.</p> <p>9 Q. All right. I was going to ask you: in paragraph 70 of</p> <p>10 your report, you refer to 2.5 per cent area --</p> <p>11 A. At the time.</p> <p>12 Q. -- but you now -- it's gone down to 1 per cent?</p> <p>13 A. Yes.</p> <p>14 Q. All right.</p> <p>15 A. I think it is what we call engineering judgment. We</p> <p>16 exercise engineering judgment. I think it's a good</p> <p>17 point, yes.</p> <p>18 Q. You've not been involved in any of these decisions about</p> <p>19 suitable measures?</p> <p>20 A. No, I'm just an observer, but I did check the</p> <p>21 calculations. I'm just an observer. I was not involved</p> <p>22 at all.</p> <p>23 Q. All right.</p> <p>24 Now, so far as fitness for purpose is concerned,</p> <p>25 could we please go back to your report at paragraph 39.</p>	<p>1 A. Yes. They reduce the stress level; the main point is.</p> <p>2 This is very important, reduce the stress level so we</p> <p>3 can improve the durability and improve the crack width.</p> <p>4 Q. I should have said, perhaps, the two factors that you</p> <p>5 emphasise in paragraph 42 of your report are durability</p> <p>6 and cracking?</p> <p>7 A. Yes.</p> <p>8 Q. Okay. Could we then look at a few points on the coupler</p> <p>9 connections.</p> <p>10 A. Yes.</p> <p>11 Q. As we've discussed already, this is the first topic</p> <p>12 relating to safety and fitness for purpose.</p> <p>13 A. Yes.</p> <p>14 Q. What happened was that a comprehensive coupler testing</p> <p>15 programme was carried out together with opening-up work,</p> <p>16 and do you accept that the programme -- and I assume</p> <p>17 you've looked at the results of the testing programme --</p> <p>18 A. Yes.</p> <p>19 Q. -- provides a basis to establish an acceptance criteria</p> <p>20 for the safety of the coupler connections?</p> <p>21 A. Exactly what do you -- well, I know that there were</p> <p>22 tests on the couplers.</p> <p>23 Q. Yes.</p> <p>24 A. In particular, partially engaged couplers. I know that.</p> <p>25 I knew that. And I knew the result as well. So exactly</p>
Page 66	Page 68
<p>1 The factors that you consider to be relevant to</p> <p>2 fitness for purpose you list out in paragraph 39.</p> <p>3 A. Yes.</p> <p>4 Q. So, at (a), durability -- if we could scroll down,</p> <p>5 please -- deformation --</p> <p>6 A. Yes.</p> <p>7 Q. -- fire resistance, cracking, vibration and fatigue?</p> <p>8 A. Yes.</p> <p>9 Q. It we go to the next page, please, you also bring back</p> <p>10 in seismic design under this fitness for purpose as</p> <p>11 well?</p> <p>12 A. Yes.</p> <p>13 Q. Can I ask you this, Dr Lau: do any of those seven</p> <p>14 factors add anything to what we've just been discussing</p> <p>15 under the general heading of rupture of section?</p> <p>16 A. Durability, for example. I think we need to consider</p> <p>17 durability. Crack width. I think we need to consider</p> <p>18 these two points in the long term. I'm not talking</p> <p>19 about at the moment. At the moment, we just check the</p> <p>20 rupture of section, but we need to consider durability,</p> <p>21 crack width, et cetera, in the long term.</p> <p>22 Q. Are you satisfied that the suitable measures that we've</p> <p>23 just been discussing or some of the ones we have just</p> <p>24 been discussing are going to address all these fitness</p> <p>25 for purpose factors that you've mentioned?</p>	<p>1 what you want me to respond to your question, exactly?</p> <p>2 Q. The two primary factors in the coupler testing programme</p> <p>3 were an engagement length of at least 37 millimetres --</p> <p>4 A. Yes.</p> <p>5 Q. -- and no more than two threads showing.</p> <p>6 A. Yes.</p> <p>7 Q. You are aware of that. And that was established through</p> <p>8 this testing programme as the acceptance criteria; do</p> <p>9 you agree?</p> <p>10 A. Oh, I see. You are talking about the PAUT test?</p> <p>11 Q. Yes.</p> <p>12 A. Okay. Okay.</p> <p>13 Q. Those acceptance criteria, the 37 millimetres and the</p> <p>14 two threads showing, did you have any involvement at</p> <p>15 all --</p> <p>16 A. No.</p> <p>17 Q. -- in the drawing up of those criteria?</p> <p>18 A. No. I'm just an observer. I have no involvement at</p> <p>19 all.</p> <p>20 Q. When you saw the draft holistic report in particular in</p> <p>21 May last year, as you told us this morning, were you</p> <p>22 asked to comment on the coupler testing criteria?</p> <p>23 A. No, not at all.</p> <p>24 Q. Do you have a view now about the efficacy of that</p> <p>25 testing criteria, the 37 millimetres and the two threads</p>

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<p>1 showing? Do you agree with it?</p> <p>2 A. I have no particular view. This is a method done by the</p> <p>3 MTR. I have no particular view on that, no.</p> <p>4 Q. One of the issues between yourself and the other experts</p> <p>5 is whether a partially engaged coupler connection</p> <p>6 should, if at all, be regarded as safe and fit for</p> <p>7 purpose; do you agree?</p> <p>8 A. Yes.</p> <p>9 Q. To your way of thinking, is a threaded rebar engaged to</p> <p>10 the extent of 37 millimetres into a coupler fully or</p> <p>11 partially engaged?</p> <p>12 A. There are two issues here. The first one is we want the</p> <p>13 couplers to be butt-to-butt; right? This is the most</p> <p>14 important point. Now, according to the PAUT test,</p> <p>15 that's the only acceptance level we can have. If you</p> <p>16 don't accept this acceptance level, I don't know what</p> <p>17 sort of level we can accept.</p> <p>18 Q. Is, to your way of thinking, Dr Lau, a threaded rebar</p> <p>19 engaged to the extent of 37 millimetres into a coupler</p> <p>20 fully or partially engaged? Please answer my question.</p> <p>21 A. If using the PAUT, according to the test, it's supposed</p> <p>22 to be fully engaged. You know, this is the acceptance</p> <p>23 criteria. Whether it's correct or not, I can't comment</p> <p>24 on that. This is something I did not participate in.</p> <p>25 This is the test.</p>	<p>1 test, I looked at it very carefully. I try to identify</p> <p>2 what happened. If it is more than 37, according to the</p> <p>3 PAUT test, they accept it. If there are two threads --</p> <p>4 more than two threads outside, they reject it. So this</p> <p>5 is the only way to test whether a coupler is acceptable</p> <p>6 or not.</p> <p>7 MR PENNICOTT: Yes. But the point is, Dr Lau, they are not</p> <p>8 testing whether they are butt-to-butt. They can't be.</p> <p>9 On your analysis, they cannot be, can they?</p> <p>10 A. Now, but the thing is --</p> <p>11 Q. Am I right?</p> <p>12 A. Let me put it this way. If I look at all the tests,</p> <p>13 quite often there are more than 37. In fact, in all the</p> <p>14 tests, in the appendix, quite often there are more than</p> <p>15 37, and of course they were accepted, and if they were</p> <p>16 less than 37 they were rejected; right? And if there</p> <p>17 are two threads exposed, more than two threads exposed,</p> <p>18 they were also rejected. So this is the criteria to see</p> <p>19 whether certain couplers is accepted or not. Now,</p> <p>20 whether it is right or not, I cannot make any major</p> <p>21 comment, but this is the test accepted by all the</p> <p>22 parties at the time.</p> <p>23 Q. Yes.</p> <p>24 A. But if you ask me, if you do not accept this type of</p> <p>25 criteria, there could be even more defective couplers.</p>
Page 70	Page 72
<p>1 Now, if you do not accept this criteria, there could</p> <p>2 be more defective couplers.</p> <p>3 Q. Quite.</p> <p>4 A. It could be.</p> <p>5 Q. The reality is, Dr Lau -- we'll look at it in</p> <p>6 a moment -- if a threaded rebar has an engagement length</p> <p>7 of 37 millimetres, there's no way of telling whether</p> <p>8 it's butt-to-butt or not, is there?</p> <p>9 A. Now, this is the failure criteria rather -- if you ask</p> <p>10 me, I would look at it as a failure criteria rather than</p> <p>11 an acceptance criteria. If you have -- in the PAUT</p> <p>12 test, if you've got 37 millimetres with a 3 millimetre</p> <p>13 tolerance, and the exposed thread is two, then it's</p> <p>14 supposed to be butt-to-butt. So I look at it as</p> <p>15 a failure criteria. I wouldn't look at it as</p> <p>16 an acceptance criteria.</p> <p>17 COMMISSIONER HANSFORD: What's the difference?</p> <p>18 A. Because otherwise there would be more defective</p> <p>19 couplers, in reality; am I right? Because if you are</p> <p>20 right, there would be more defective couplers. There's</p> <p>21 no end.</p> <p>22 COMMISSIONER HANSFORD: I understand what you are saying</p> <p>23 Dr Lau, but something that is -- if something hasn't</p> <p>24 failed, presumably it's accepted; is that right?</p> <p>25 A. Take, for example, if you look at the appendix for the</p>	<p>1 Q. Could I ask you, please, to be shown one of your slides,</p> <p>2 and could we please look at 24.</p> <p>3 A. Yes.</p> <p>4 Q. If we look at the top diagram first --</p> <p>5 A. Yes.</p> <p>6 Q. -- Dr Lau -- actually, no. Let's look at the bottom one</p> <p>7 first, the 48 millimetre. So this is assuming, the</p> <p>8 bottom diagram, that the thread on both pieces of rebar</p> <p>9 is 48 millimetres.</p> <p>10 A. Yes.</p> <p>11 Q. If I've understood this correctly, Dr Lau, what you are</p> <p>12 assuming is on the left-hand side, the 48 is, as it</p> <p>13 were, fully engaged to all 48?</p> <p>14 A. Yes.</p> <p>15 Q. So there's nothing showing on the left-hand side. If</p> <p>16 that's the position, then because we know the coupler is</p> <p>17 88 millimetres long, of necessity there will be two</p> <p>18 threads showing, 8 millimetres, on the right-hand side?</p> <p>19 A. Yes.</p> <p>20 Q. In your report -- we don't need to look at it -- you</p> <p>21 refer to the fact that you were given seven couplers,</p> <p>22 and I imagine some pieces of threaded rebar.</p> <p>23 A. Yes.</p> <p>24 Q. Did you measure -- who gave you those samples?</p> <p>25 A. I asked Highways Department to send me all these</p>

<p>Page 73</p> <p>1 couplers so that I can fit around. I want to understand 2 all this concept about -- I just want to test it. In 3 particular, what I want to do is I want to test whether, 4 if it is not fully butt-to-butt, what will happen. 5 Q. Did you measure the total length of the thread on any of 6 those seven that you were given? 7 A. Yes. Yes. 8 Q. What was the answer? 9 A. They vary from 44 to 48. 10 Q. Right. How many 48s were there? 11 A. Maybe one or two. 12 Q. So, going back to your diagrams, the next one up, you 13 illustrate a position where you've got a 44 millimetre 14 piece of rebar on the left-hand side, as it were -- 15 A. Yes. 16 Q. -- and 48 on the other, and that would give you one 17 thread showing, in that situation? 18 A. Yes. 19 Q. Then, perhaps the more interesting one, you've got the 20 44 millimetre coupler on the left-hand side fully 21 engaged? 22 A. Yes. 23 Q. And you are assuming this time that the 44 millimetre on 24 the right-hand side was also fully engaged? 25 A. Yes.</p>	<p>Page 75</p> <p>1 Q. -- Dr Lau, is a position where the enhanced PAUT 2 engagement length is 39.9 millimetres? 3 A. Yes. 4 Q. And the number of exposed threads is zero? 5 A. Yes. 6 Q. One simply wouldn't know whether that is a butt-to-butt 7 joint or not? 8 A. If we do not accept that, that would be -- because you 9 accept this as acceptable. 10 Q. Yes. 11 A. This is the problem. If we do not have this sort of 12 criteria, we don't know how to accept it. There would 13 be a lot of defective couplers. So we have to draw 14 a line, because below the limitation of the PAUT test 15 there would be a 3 millimetre tolerance, and that's -- 16 Q. So that could go either way. 17 A. Well, in fact I look at this and give this a lot of 18 thought myself, because if we do not accept this, simply 19 that there are too many defective couplers, so we need 20 to draw a line, and this line, I can accept that, 21 because -- 22 Q. There would only be too many defective couplers is your 23 starting point is they've got to be butt-to-butt? 24 A. But at the same time, I do have a lot -- I do have seven 25 couplers in my office. I tested so many times. If they</p>
<p>Page 74</p> <p>1 Q. So, going back to the question I asked you just now, if 2 that coupler on the right-hand side was only engaged up 3 to 37 millimetres, it could not, by definition, be 4 butt-to-butt, could it? 5 A. Agree. 6 Q. And so, going back to the acceptance criteria, 7 37 millimetres and two threads, you simply do not know 8 and cannot be sure whether or not butt-to-butt has been 9 achieved? 10 A. Based on that particular test limitation, yes. Based on 11 the test limitation, that's all that we can do, based on 12 the PAUT test. But if we do not accept that as 13 acceptance criteria, then the point is there would be 14 even more defective couplers. 15 Q. Yes. 16 And so if we could look at appendix B3 to the 17 holistic report, please, so that's OU3309 in OU5. There 18 are several sheets, Dr Lau. I expect you have looked at 19 these. 20 A. I have looked at these quite a number of times. 21 Q. All right. We can take a number of these by way of 22 example. Let's scroll down to the next page and take 23 item 29, towards the foot of the page. 24 So what we have here -- 25 A. Yes.</p>	<p>Page 76</p> <p>1 are not butt-to-butt, it would be slack, and I do not 2 want this slack coupler in the structure. Because even 3 at very low stress level, the structure starts to crack, 4 the concrete starts to crack, this is bad. As 5 an engineer, I cannot accept that. 6 Q. Dr Lau, you are aware, and I'm not going to dwell on all 7 those results, but there are very, very few bars of 8 48 millimetres, they are the exception rather than the 9 rule. There are quite a number at 44 or thereabouts 10 millimetres. As we've just seen, there are quite a lot 11 less than 44 millimetres. There's clearly no silence, 12 absolute silence, in the production of these threads, 13 the threaded rebars, is there? 14 A. I think they are all over 44 millimetres. That's how 15 I understand. It's between 44 to 48. I don't think 16 any -- well, if it's less than 44 millimetres, there 17 would be a problem, and I think the whole idea by the 18 manufacturer is that they make sure that it is more than 19 44, up to 48. 20 Q. How can that be the case, Dr Lau? The one I've just 21 showed you was engaged to 39.9 with no exposed threads. 22 A. But this is a PAUT result. This is not the true result. 23 Q. Right. 24 A. I think we have to be very careful. This is the PAUT 25 result. We don't know exactly what happened inside.</p>

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<p>1 Of course, we do not know. But the PAUT has a tolerance</p> <p>2 of 3 millimetres, so we've got to draw a line in the</p> <p>3 acceptance criteria of the PAUT result, and if we do not</p> <p>4 accept that, there would be a lot of unacceptable</p> <p>5 couplers.</p> <p>6 Q. All right. You are aware that the other three experts</p> <p>7 are all agreed that if there's a minimum engagement</p> <p>8 length of about seven threads or 32 millimetres, the</p> <p>9 coupler connection should be regarded as having</p> <p>10 sufficient strength to pass all the necessary strength</p> <p>11 tests?</p> <p>12 A. Strength tests, yes.</p> <p>13 Q. Do you agree?</p> <p>14 A. But not fit for purpose. When we talk about fitness for</p> <p>15 purpose, we talk about elongation as well. The two have</p> <p>16 to go together.</p> <p>17 Q. Let's taken it in stages. The other three experts agree</p> <p>18 that if there's a minimum engagement of seven</p> <p>19 threads/32 millimetres, the coupler connection will have</p> <p>20 sufficient strength to pass all the strength tests. Do</p> <p>21 you agree with that as a proposition?</p> <p>22 A. For the -- this is the case, as far as the test is</p> <p>23 concerned. There were 54 tests so far. I accept that</p> <p>24 this is the case.</p> <p>25 Q. Right. And that opinion is derived by the other experts</p>	<p>1 an explanation; we might not. I don't know.</p> <p>2 CHAIRMAN: Thank you very much.</p> <p>3 MR PENNICOTT: This is part of your report, Dr Lau, where</p> <p>4 you are discussing various aspects of Mr Southward's</p> <p>5 report.</p> <p>6 A. Yes.</p> <p>7 Q. You refer at paragraph 94 to elongation tests, and then</p> <p>8 you say:</p> <p>9 "My comment: This is the main concern of MTR."</p> <p>10 I think it's your main concern as well.</p> <p>11 A. Yes.</p> <p>12 Q. Because that's what you say. Then you say:</p> <p>13 "Failure to meet this requirement [the elongation</p> <p>14 test] has implication on ductility, crack width,</p> <p>15 durability and deformation which are parts of the</p> <p>16 requirements in respect of 'fitness for purpose'</p> <p>17 including safety."</p> <p>18 Do you see that?</p> <p>19 A. Yes.</p> <p>20 Q. So, as I understand it, you say that if the coupler</p> <p>21 assemblies, the coupler connections, are incapable of</p> <p>22 passing the elongation tests, then it gives rise to</p> <p>23 a risk of crack width, durability and deformation?</p> <p>24 A. Yes.</p> <p>25 Q. And that's your point. Okay.</p>
Page 78	Page 80
<p>1 on the basis of the partial engagement test that has</p> <p>2 been carried out by MTR?</p> <p>3 A. I know, yes.</p> <p>4 Q. So you agree that if you are only looking at strength,</p> <p>5 they are right?</p> <p>6 A. Yes.</p> <p>7 Q. However, as I understand it, your point is they won't</p> <p>8 pass the elongation test?</p> <p>9 A. Agree.</p> <p>10 Q. So your main concern is not strength at all but rather</p> <p>11 the consequences of the failure to pass the elongation</p> <p>12 tests?</p> <p>13 A. Agree, yes, because the two things have to go together,</p> <p>14 strength and fit for purpose.</p> <p>15 Q. If you look at paragraphs 94 and 95 of your report --</p> <p>16 I think this is --</p> <p>17 CHAIRMAN: Sorry, could you help me, Mr Pennicott. The</p> <p>18 answer given by Dr Lau was:</p> <p>19 "Agree, yes, because the two things have to go</p> <p>20 together, strength and fit for purpose."</p> <p>21 MR PENNICOTT: Yes.</p> <p>22 CHAIRMAN: Strength I obviously understand. I'm not quite</p> <p>23 sure how that fits in with fit for purpose. Do you see</p> <p>24 the points I make?</p> <p>25 MR PENNICOTT: That's where I'm about to go. We might get</p>	<p>1 You are aware, presumably, that the completed</p> <p>2 structures at the COI -- that we're concerned with in</p> <p>3 COI 1 and COI 2 have been completed for a number of</p> <p>4 years now?</p> <p>5 A. I know. About two years, yes.</p> <p>6 Q. I think a bit longer than that, actually, for some of</p> <p>7 them. Have you seen any evidence on any of your visits</p> <p>8 or have you seen any photographs, any other evidence,</p> <p>9 that there are such cracks?</p> <p>10 A. If there are cracks, they will be inside the concrete,</p> <p>11 yes, because --</p> <p>12 Q. You have seen no external evidence of any such cracks?</p> <p>13 A. I have not inspected the structure myself anyway.</p> <p>14 I assume that there is no such crack appearing at the</p> <p>15 moment, because they all appear in the joint; right?</p> <p>16 And I mentioned that looking at the finite element</p> <p>17 analysis provided by all the consultants, there would be</p> <p>18 cracks -- even without this sort of elongation in the</p> <p>19 couplers, assuming that the reinforcement is all</p> <p>20 perfect, there are still cracks on the top of the</p> <p>21 diaphragm wall and on the soil side of the diaphragm</p> <p>22 wall. Assuming there's no problem with the</p> <p>23 reinforcement, there are still cracks on the outside,</p> <p>24 and you can't see them because they are on the soil side</p> <p>25 of the diaphragm wall and on the top of the diaphragm</p>

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<p>1 wall.</p> <p>2 If we have this sort of partially engaged coupler</p> <p>3 used in the assessment, there would be even more cracks</p> <p>4 in the structure. I tell you, cracks, once you have</p> <p>5 cracks, you cannot recover. They only accumulate. They</p> <p>6 can only accumulate, they cannot recover. So, with the</p> <p>7 passage of time, there will be even more cracks in the</p> <p>8 future. This is what I worry about for durability.</p> <p>9 Q. You are worried about -- you are speculating, Dr Lau.</p> <p>10 A. I'm not speculating.</p> <p>11 Q. You are speculating.</p> <p>12 A. No, I'm not speculating.</p> <p>13 Q. You haven't seen any evidence of any cracks at all.</p> <p>14 A. I tell you, my speciality in my research is crack</p> <p>15 propagation in strain-softened material which is</p> <p>16 concrete and rock, and I've done so much analysis on</p> <p>17 this sort of material in the laboratory and under the</p> <p>18 computer. I know what will happen, you know, according</p> <p>19 to my theory, I know what will happen.</p> <p>20 Q. Do you agree with this, that the highest loading of the</p> <p>21 structures was actually during the construction stage</p> <p>22 rather than the permanent stage?</p> <p>23 A. Why? I disagree.</p> <p>24 Q. The answer to your question is that in the permanent</p> <p>25 stage there is intermediate support for a lot of these</p>	<p>1 Q. But that's all to do with calculations based on the</p> <p>2 failures, not anything to do with elongation tests at</p> <p>3 all.</p> <p>4 A. No, no, no. They try to reduce the stress level in the</p> <p>5 joint so that the elongation would be smaller. So I do</p> <p>6 not agree with you.</p> <p>7 Q. All right.</p> <p>8 CHAIRMAN: So, Doctor, it would be your position that if</p> <p>9 there is no butt-to-butt connection in the coupler, then</p> <p>10 that assembly is going to fail an elongation test?</p> <p>11 A. Elongation test, yes.</p> <p>12 CHAIRMAN: Okay. And that failure will give rise to a real</p> <p>13 risk of the various matters to which you have already</p> <p>14 referred?</p> <p>15 A. It gives rise to at least cracks in the concrete,</p> <p>16 because the amount of elongation is large. Actually,</p> <p>17 it's large. Because concrete will crack even at very,</p> <p>18 very small strain. Very small strain. At the moment,</p> <p>19 we are talking about 0.24 up to 0.25 millimetres just on</p> <p>20 one particular coupler. This is going to crack the</p> <p>21 contract.</p> <p>22 CHAIRMAN: Again, returning to -- I don't know if you were</p> <p>23 the witness last week, when I referred to what I might</p> <p>24 call straightforward, simple language given to the</p> <p>25 workers, just like in the military, you know, you give</p>
Page 82	Page 84
<p>1 structures, whereas during the course of construction</p> <p>2 they were not? And I think all the other experts agree</p> <p>3 and have agreed in the past that the highest loading was</p> <p>4 during the construction stage, not in the permanent</p> <p>5 stage. Do you agree or disagree?</p> <p>6 A. I disagree because in the updated design, they analyse</p> <p>7 the structure as it is now -- as it is now -- and</p> <p>8 according to Atkins, we still require the suitable</p> <p>9 measures, as it is now. We take account all the moment</p> <p>10 redistribution, we take in account the 1.26 partial</p> <p>11 safety factor, which should be 1.4. Despite all this,</p> <p>12 Atkins still found that we need suitable measures.</p> <p>13 Q. What suitable measures do you say are addressing the</p> <p>14 particular problem of the failure to pass the elongation</p> <p>15 tests?</p> <p>16 A. To reduce the stress level in the joint. That's what</p> <p>17 they are doing at the moment. To lower the stress level</p> <p>18 in the joint.</p> <p>19 Q. Can you point to anything specific that is being done by</p> <p>20 way of suitable measures to address the failure to pass</p> <p>21 elongation tests?</p> <p>22 A. They are increasing the thickness of the slab locally.</p> <p>23 They increase the thickness of the slab locally, to</p> <p>24 reduce the stress inside the joint. That's what we are</p> <p>25 doing. That's what Atkins is doing at the moment.</p>	<p>1 straightforward directions to your soldiers and so you</p> <p>2 do here to workmen who are not as qualified as you would</p> <p>3 be, for example.</p> <p>4 I don't recall anything where there's any emphasis</p> <p>5 placed by anybody in a position to do so on the real</p> <p>6 importance of ensuring butt-to-butt connection, because</p> <p>7 otherwise there will be a failure of the assembly to</p> <p>8 meet an elongation requirement, and that will render the</p> <p>9 area of the assembly unsafe for various reasons you've</p> <p>10 given. It seems to me to be quite important, you know.</p> <p>11 It's a bit like saying, you know, to a soldier, when</p> <p>12 you've still got a bullet up the barrel of your gun,</p> <p>13 don't drop the gun on the floor; you are likely to shoot</p> <p>14 someone by mistake. This is the same sort of thing, is</p> <p>15 it not? You've got to be really careful here because if</p> <p>16 you have a number of failures to ensure butt-to-butt</p> <p>17 connection, then you are rendering each assembly of no</p> <p>18 benefit at all and in fact you are endangering the</p> <p>19 entire structure.</p> <p>20 A. In the long term, yes.</p> <p>21 CHAIRMAN: Well, in the long term -- in 40 years or</p> <p>22 60/70 years you might get bad cracking --</p> <p>23 A. Yes. That's what --</p> <p>24 CHAIRMAN: -- a requirement for urgent repairs, et cetera.</p> <p>25 A. Actually, this 0.1 millimetre permanent elongation very</p>

Page 85	<p>1 strict by government. If a coupler fails this</p> <p>2 particular requirement, they wouldn't allow you to use</p> <p>3 it. This is very important.</p> <p>4 CHAIRMAN: Again, you will have to help me, because my</p> <p>5 understanding was that that testing, the elongation</p> <p>6 test, was done on the coupler prior to its sale, if</p> <p>7 I can put it that way. In other words, you have to go</p> <p>8 to government and say, "Here's what we intend to</p> <p>9 supply." They check it for elongation and all the other</p> <p>10 tests and they say, "That's fine." What you are saying</p> <p>11 is that that unit which has already passed that test,</p> <p>12 unless it's assembled butt-to-butt, you've still got</p> <p>13 a failure of elongation?</p> <p>14 A. Yes. The whole idea that we want the 0.1 millimetre</p> <p>15 limitation was to stop all these cracks forming in the</p> <p>16 concrete. Now, as far as the site is concerned, it's up</p> <p>17 to the individual contractor as to how to enforce the</p> <p>18 assembly, to make sure there is no permanent elongation.</p> <p>19 CHAIRMAN: All right. And can you tell me: how is that done</p> <p>20 on a simple, straightforward manner where you've got</p> <p>21 workmen doing an awful lot of these in conditions where</p> <p>22 the light is not necessarily that good, where it's</p> <p>23 dusty, where the units are dirty? How do you ensure</p> <p>24 that in a clear and definitive manner?</p> <p>25 A. Because in Hong Kong there is what we call the quality</p>	Page 87	<p>1 shown me is far more subtle than that. I'm talking</p> <p>2 about something where you can say to the workmen, "There</p> <p>3 it is, now all of you, it doesn't matter what your level</p> <p>4 of education, you can see quite clearly what is</p> <p>5 absolutely required."</p> <p>6 A. I do not know what happened on this site, but in other</p> <p>7 sites there were proper training by people like BOSA to</p> <p>8 the workers.</p> <p>9 CHAIRMAN: Okay.</p> <p>10 A. I don't know what happened on this site.</p> <p>11 CHAIRMAN: So the answer is you haven't seen any actual</p> <p>12 document like that?</p> <p>13 A. I haven't seen any, but in theory the BOSA people will</p> <p>14 train the workers on site to ensure that it is</p> <p>15 butt-to-butt, because it's a very important point.</p> <p>16 CHAIRMAN: All right. Then also, on your basis, the</p> <p>17 inspectors and engineers who were responsible for</p> <p>18 checking these things, of the MTR and of Leighton, they</p> <p>19 would have known or should have known --</p> <p>20 A. They should.</p> <p>21 CHAIRMAN: -- as qualified persons that there was a critical</p> <p>22 matter that they had to ensure in each and every respect</p> <p>23 of each and every assembly of couplers, namely</p> <p>24 butt-to-butt?</p> <p>25 A. Actually, there's a quality supervision plan issued by</p>
Page 86	<p>1 supervision plan, and these sort of couplers are</p> <p>2 supposed to be inspected by the technically competent</p> <p>3 person. It's specified in the approved plan in</p> <p>4 Hong Kong.</p> <p>5 CHAIRMAN: All right. But how does -- because what I</p> <p>6 remember is things like the PAUT test, we were suddenly</p> <p>7 having to come up with a lot of high technology to judge</p> <p>8 whether it was butt-to-butt inside, and I can't imagine</p> <p>9 people walking around with a sort of back-loaded PAUT</p> <p>10 test which they kind of use on each individual one, so</p> <p>11 it has to be something more simple, does it not?</p> <p>12 A. That's why BOSA have a drawing or the picture showing</p> <p>13 that the maximum threads exposed is 2 millimetres. And</p> <p>14 you are supposed to look at that particular -- remember</p> <p>15 there are four couplers with zero threads exposed, one,</p> <p>16 and then eventually there are two threads --</p> <p>17 CHAIRMAN: All right.</p> <p>18 A. -- and the technically competent person has to check the</p> <p>19 couplers installed against that particular picture.</p> <p>20 CHAIRMAN: Okay. I understand that. But have you found any</p> <p>21 document, in looking through BOSA's or MTR's or</p> <p>22 Leighton's documentation, that in clear, unambiguous</p> <p>23 terms, makes quite clear to a dodo like myself, and</p> <p>24 I would be a dodo down there, what has to be done in</p> <p>25 ensuring butt-to-butt? Because the document you've</p>	Page 88	<p>1 Leighton or the MTR to BD, telling BD what they are</p> <p>2 going to inspect. The same thing happens to every other</p> <p>3 site in Hong Kong.</p> <p>4 CHAIRMAN: I appreciate that. It doesn't quite answer my</p> <p>5 question.</p> <p>6 A. Okay.</p> <p>7 CHAIRMAN: Because I'm a layperson and I'm speaking to you</p> <p>8 as an expert. As a layperson I'm saying have you got --</p> <p>9 would it be correct to say that each qualified person</p> <p>10 responsible for inspection would have known that there</p> <p>11 was one central critical issue to ensure, and namely</p> <p>12 that was butt-to-butt assembly?</p> <p>13 A. They should. They should. I don't know what happened</p> <p>14 on this site, but they should.</p> <p>15 CHAIRMAN: Okay. Thank you.</p> <p>16 MR PENNICOTT: Could we please see slide 23 of Dr Lau's</p> <p>17 presentation, please. That's the one before this one.</p> <p>18 It's the one immediately above it. I don't know whether</p> <p>19 it is possible to get two slides on the screen, this one</p> <p>20 and the next one.</p> <p>21 Dr Lau, on the left-hand side --</p> <p>22 A. Yes.</p> <p>23 Q. -- we have a document generated by BOSA?</p> <p>24 A. Yes.</p> <p>25 Q. It is headed, in large letters, "BOSA acceptable thread</p>

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<p>1 tolerance"; do you see that?</p> <p>2 A. Yes.</p> <p>3 Q. In the summary it says:</p> <p>4 "After connection has been fully tightened, one</p> <p>5 should see a maximum of TWO FULL THREADS ...", in</p> <p>6 capital letters; do you see that?</p> <p>7 A. Yes.</p> <p>8 Q. "... to ensure a proper installation."</p> <p>9 A. Yes.</p> <p>10 Q. And thinking about the installation process, we have the</p> <p>11 diaphragm wall and the couplers have been installed into</p> <p>12 the end of the rebar in the diaphragm wall and they are</p> <p>13 essentially sticking out after they have been</p> <p>14 jet-sprayed, and Leighton's sub-contractor is coming</p> <p>15 along to put his threaded rebar into the couplers; yes?</p> <p>16 A. Yes.</p> <p>17 Q. And two or three guys, a 6 metre long piece of rebar</p> <p>18 with a 44 millimetre thread on the end?</p> <p>19 A. Yes.</p> <p>20 Q. And they start screwing the rebar into the coupler.</p> <p>21 They get so far and they've got four threads showing,</p> <p>22 but they can't go any further. What do they do?</p> <p>23 Answer, presumably: unscrew it.</p> <p>24 A. Unscrew, yes.</p> <p>25 Q. Take it out, clean up the thread perhaps, have a look</p>	<p>1 there would be two threads showing. This is what it</p> <p>2 shows on this particular picture. And it's the duty of</p> <p>3 BOSA to go and train the workers on what to do.</p> <p>4 CHAIRMAN: All right. We appreciate your point. I think</p> <p>5 the point you are making, Doctor -- and thank you very</p> <p>6 much, it's been of assistance -- is that however you may</p> <p>7 read this particular document and any other documents,</p> <p>8 your understanding, both as an expert and as</p> <p>9 a contractor, is that it must be butt-to-butt?</p> <p>10 A. Yes.</p> <p>11 CHAIRMAN: And if it's not butt-to-butt, the risks which you</p> <p>12 have already described will be present?</p> <p>13 A. Yes. That's all that I can say.</p> <p>14 CHAIRMAN: Yes, and you cannot say what BOSA may or may not</p> <p>15 have done.</p> <p>16 A. I can't. I'm not the BOSA man. I'm not the</p> <p>17 manufacturer. I don't know how they train the people.</p> <p>18 CHAIRMAN: All right.</p> <p>19 A. But BOSA said it's got to be butt-to-butt and in fact</p> <p>20 all the tests show that if it is not butt-to-butt, there</p> <p>21 will be permanent elongation. This is something I don't</p> <p>22 want, I don't like. That's all. That's all I can say</p> <p>23 as an expert.</p> <p>24 CHAIRMAN: Thank you very much.</p> <p>25 MR PENNICOTT: Sir, a very last point on this.</p>
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<p>1 inside the coupler to make sure it's all clean. Right.</p> <p>2 Having done that, have another go. This time they screw</p> <p>3 in and they get to a situation where it's fully</p> <p>4 tightened but there are two threads showing. That's</p> <p>5 perfectly acceptable, according to BOSA, and by</p> <p>6 definition cannot be butt-to-butt. Do you agree?</p> <p>7 A. If it is 44, there should be no thread showing. It's</p> <p>8 only when it is 48.</p> <p>9 Q. But you are allowed to have two threads showing,</p> <p>10 provided it's fully tightened. That's what it says.</p> <p>11 A. This is -- actually, you know --</p> <p>12 Q. We can't go any further.</p> <p>13 A. -- this particular drawing, what they are saying is if</p> <p>14 you have 44, there should be no thread showing, but</p> <p>15 there's --</p> <p>16 Q. Where do they say that? Where do they say that?</p> <p>17 A. Anyway --</p> <p>18 Q. Where do they say it?</p> <p>19 A. Anyway --</p> <p>20 Q. It doesn't say that, with respect.</p> <p>21 A. Okay, okay. I don't know what BOSA is going to teach or</p> <p>22 train the workers. If they train the workers, they</p> <p>23 should tell them what to do. I don't know what. I'm</p> <p>24 not on site. I have no evidence about all this. But</p> <p>25 anyway, the whole idea is that if it is 48 millimetres,</p>	<p>1 CHAIRMAN: Yes.</p> <p>2 MR PENNICOTT: Can we look at the transcript for Day 36 of</p> <p>3 the Original Inquiry. I think it's page 82.</p> <p>4 A. Can you make it bigger?</p> <p>5 Q. We will, don't worry.</p> <p>6 Sorry, I should have said this is during the</p> <p>7 cross-examination of Mr Paulino Lim from BOSA.</p> <p>8 A. Okay.</p> <p>9 Q. Prof Hansford will see he asked the question at the top</p> <p>10 of the page:</p> <p>11 "I'll ask it at this point rather than later: and</p> <p>12 how important is it for them to be butt-to-butt? What</p> <p>13 does that do?"</p> <p>14 Then the answer was this:</p> <p>15 "When you are -- if you -- because some of -- the</p> <p>16 requirement for a type 1 coupler is you -- there's two</p> <p>17 testing required."</p> <p>18 I'm not sure what all that meant.</p> <p>19 "The first one is an elongation test, where the</p> <p>20 sample is loaded to 0.6 FY, and in between you've got</p> <p>21 a gauge that actually checks to see how much of the</p> <p>22 rebar, once the stress has been released, how much</p> <p>23 movement is within that connection, and if it exceeds</p> <p>24 0.1mm then it's deemed as a failed sample. Butt-to-butt</p> <p>25 ensures that you actually would not have a problem.</p>

Page 93	<p>1 Commissioner Hansford: I see. Thank you." 2 That's your understanding, is it, Dr Lau, of where 3 this butt-to-butt requirement comes from; is that right? 4 A. And also from their literature. 5 Q. Right. 6 A. Their literature also required butt-to-butt. 7 Q. Could we scroll down a bit, please. 8 A. Actually, I did not read this transcript. 9 Q. You haven't read this before? Okay. Can we scroll down 10 a bit more, please; I'm not sure where it is. Keep 11 going. Sorry, can we go back up again, up above where 12 we were just now. Keep going up. Up further, please. 13 Scroll down a bit, please. 14 Sorry, sir, there is a piece of the transcript where 15 you were asking Paulino Lim what happens when it was 16 fully tightened, and the answer was, "It is assumed to 17 be butt-to-butt", and I was trying to find that and 18 I can't. 19 COMMISSIONER HANSFORD: Is that the extract we were looking 20 at on Friday -- 21 MR PENNICOTT: I think it was. 22 COMMISSIONER HANSFORD: -- that I think comes before this. 23 MR PENNICOTT: It's around there somewhere but I can't find 24 it. 25 COMMISSIONER HANSFORD: It comes before this, I think.</p>	Page 95	<p>1 then what? 2 A. Always slip or movement, always. 3 CHAIRMAN: Always ...? 4 A. Even by hand, you can see that there's a movement. If 5 you tighten it, there will be no movement. If you don't 6 tighten, there will be movement. 7 So for all partially engaged couplers, there is 8 bound to be movement. 9 CHAIRMAN: So that's how you can tell whether or not, if you 10 have less threading, it isn't butt-to-butt? 11 A. If it's not butt-to-butt, there is bound to be movement 12 in the assembly, bound to be. I tried so many times 13 using different types of bar and coupler in my office. 14 I like to try to see what happens and there's bound to 15 be movement if it's not butt-to-butt. 16 CHAIRMAN: Again, please forgive me. Coming back down to 17 the ordinary workman trying to do his job under some 18 pressure to get as much done in a day as possible -- 19 A. Sure. 20 CHAIRMAN: -- you are holding onto a rebar that's how long? 21 6 metres? You've got it in and maybe there's a little 22 clip or something, there's dirt inside the coupler which 23 is already -- we are talking about a horizontal coupler 24 now. Will they always be able to discover some sort of 25 movement or rattling?</p>
Page 94	<p>1 MR PENNICOTT: There it is. Thank you very much. "And when 2 one or two threads are exposed" -- do you see that, 3 Dr Lau? 4 A. Yes. 5 Q. -- "am I right in saying it's therefore butt-to-butt?" 6 Then the answer from the witness was: 7 "It is assumed to be butt-to-butt", and then and so 8 forth and so on. 9 The point being, once it is fully tightened, even if 10 you have threads showing, it is assumed to be 11 butt-to-butt? 12 A. Okay. I tried myself many times. Actually if you 13 tighten it even by hand, you can't have any slip in the 14 assembly. Of course I'm talking about by hand. 15 Q. All right. 16 COMMISSIONER HANSFORD: Sorry, can I just be clear? 17 A. Sure. 18 COMMISSIONER HANSFORD: Were you referring then to threads 19 that were 48 millimetres long? 20 A. If it is 48 millimetres long -- because one end is 21 always threaded in, the other end, if it is 22 48 millimetres, there would be two threads outside, but 23 if we tighten it, there will be no slip at all. 24 COMMISSIONER HANSFORD: But if it was less than 25 48 millimetres long and there were two threads exposed,</p>	Page 96	<p>1 A. If it's stuck there, you mean? 2 CHAIRMAN: Yes. You are looking at a very long rebar. You 3 are putting it in. There's a little bit of difficulty. 4 I think Mr Pennicott gave an ideal example earlier. You 5 can't get it in at all, you pull it out, clean something 6 off, put it in again. It's now got two threads showing 7 but it's, you know, a 6 metre thing, it's stuck. How do 8 you do the rattle test, if I can call it that? You 9 probably can't; it's stuck there. 10 A. If it is stuck because of, say for example, a piece of 11 sand inside -- it's possible, right -- there would be 12 a problem because when the structure is loaded later on, 13 it may crush this piece of sand and there would still be 14 movement. 15 CHAIRMAN: But that's the point. I suppose what I'm trying 16 to do is -- because as part of a Commission, one's 17 looking not only to what happened and why but how you 18 may improve matters generally for the future. 19 A. Sure. 20 CHAIRMAN: I suppose in my rather lame way I'm looking all 21 the time for something that is clear to the average 22 hard-working man down on the floor there who has to do 23 the fitting of the rebars. 24 A. I agree. 25 CHAIRMAN: And it doesn't seem to be clear, unless you've</p>

Page 97	<p>1 got a qualified guy standing right next to you the whole</p> <p>2 time, which is another question, of course.</p> <p>3 A. Yes, I think the BOSA people must train the workers</p> <p>4 properly on site. This is proper training, I think. It</p> <p>5 has to be done properly. If it is so important, then it</p> <p>6 must be done properly.</p> <p>7 CHAIRMAN: But you yourself have just said this is the</p> <p>8 problem because if you've got some sand in there or</p> <p>9 something like that, a long, 6 metre bar, it gets stuck,</p> <p>10 there is no rattling, it's solid.</p> <p>11 A. Then you look at the number of threads exposed.</p> <p>12 CHAIRMAN: And you see two threads exposed?</p> <p>13 A. If it's 44 millimetres and two threads exposed, then</p> <p>14 it's not good enough.</p> <p>15 CHAIRMAN: That's right. But you haven't measured the</p> <p>16 number of threads, so there are going to be occasions,</p> <p>17 therefore, when without any lack of competence on your</p> <p>18 part you just haven't got it butt-to-butt?</p> <p>19 A. Then this is supervision problem and training problem.</p> <p>20 I think it's also training problem by the manufacturer.</p> <p>21 CHAIRMAN: Yes.</p> <p>22 A. Because if they know that -- if the manufacturer knows</p> <p>23 that butt-to-butt is very important, they should ensure</p> <p>24 that it is butt-to-butt.</p> <p>25 CHAIRMAN: Good. it seems to be 1 o'clock.</p>	Page 99	<p>1 A. Yes.</p> <p>2 Q. As I think we've already discussed, at the time of the</p> <p>3 holistic report suitable measures were proposed for</p> <p>4 about 65 metres of slab length in area, and that has now</p> <p>5 been reduced by something of the order of 20 metres or</p> <p>6 so?</p> <p>7 A. I don't know. I just know that it is 15 panels.</p> <p>8 I think there's some reduction. Exactly how much, I did</p> <p>9 not know.</p> <p>10 Q. Right. And as I understand, your principal concern, as</p> <p>11 we've discussed, regarding the couplers, and therefore</p> <p>12 that suitable measures work, is the elongation tests and</p> <p>13 the failure of those tests --</p> <p>14 A. Yes.</p> <p>15 Q. -- according to you. What I'd like to do first of all</p> <p>16 is try to identify precisely where it is that these</p> <p>17 works were being carried out, because I then want to try</p> <p>18 to ascertain your views about the mild and moderate and</p> <p>19 severe conditions.</p> <p>20 A. Okay.</p> <p>21 Q. Because they seem to be somehow linked, but at the</p> <p>22 moment I'm in a state of confusion as to where these</p> <p>23 works precisely are being carried out.</p> <p>24 Can we start by looking at OU6/8590. I think we can</p> <p>25 just focus on the top diagram, please, which is</p>
Page 98	<p>1 MR PENNICOTT: Can I just -- actually, no, I think</p> <p>2 perhaps --</p> <p>3 CHAIRMAN: If you'd like to finish something off so that we</p> <p>4 round it off.</p> <p>5 MR PENNICOTT: I was going to go to mild, moderate and</p> <p>6 severe and so forth next but perhaps I will leave that</p> <p>7 until after lunch.</p> <p>8 CHAIRMAN: Good. Thank you. 2.30?</p> <p>9 MR PENNICOTT: Yes, sir.</p> <p>10 (1.01 pm)</p> <p>11 (The luncheon adjournment)</p> <p>12 (2.34 pm)</p> <p>13 MR PENNICOTT: Dr Lau, good afternoon.</p> <p>14 A. Good afternoon.</p> <p>15 Q. Can I just try to finish a couple of points off on the</p> <p>16 couplers. As we've already discussed, the only area</p> <p>17 that the coupler issue has given rise to the necessity,</p> <p>18 so it is said, to carry out suitable measures, is in</p> <p>19 area A at the EWL slab level.</p> <p>20 A. Yes, that's right.</p> <p>21 Q. I think I showed you a wrong drawing this morning and</p> <p>22 I'll put that right a little later or shortly. That's</p> <p>23 on the basis that in the other areas, the holistic</p> <p>24 report found those areas to have sufficient reserve</p> <p>25 capacity.</p>	Page 100	<p>1 a cross-section through area A; do you see that, Dr Lau?</p> <p>2 A. Yes.</p> <p>3 Q. It would be quite helpful if you now were given a hard</p> <p>4 copy of OU9 so that we've got two things to compare, at</p> <p>5 page 11379.</p> <p>6 Can we have that cross-section drawing back up,</p> <p>7 please. Looking at the cross-section on the screen,</p> <p>8 Dr Lau, and if you've got the plan in the hard copy --</p> <p>9 A. Yes.</p> <p>10 Q. -- can you identify for us where you believe the</p> <p>11 suitable measures are being worked on, on the</p> <p>12 cross-section?</p> <p>13 A. On the underside of the corner.</p> <p>14 Q. Somebody will give you a gadget to point to it.</p> <p>15 A. On the underside of this -- you see the underside of the</p> <p>16 corners.</p> <p>17 Q. When you say the underside --</p> <p>18 A. They thickened the slab, concrete slab, and then put in</p> <p>19 U-bars.</p> <p>20 Q. Can you give me the gadget.</p> <p>21 So you say -- is it here (indicating)?</p> <p>22 A. Yes.</p> <p>23 Q. What about over here (indicating)?</p> <p>24 A. I think the same.</p> <p>25 Q. Now look at the plan.</p>

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<p>1 A. This is the west side; right?</p> <p>2 Q. Yes.</p> <p>3 A. The west side, some of the west side, sometimes it's</p> <p>4 also for the shear.</p> <p>5 Q. Is it here (indicating)? Is it here (indicating)?</p> <p>6 A. Around that sort of area.</p> <p>7 Q. So that's the west side?</p> <p>8 A. That's also west side, as well, not just on the east</p> <p>9 side.</p> <p>10 Q. Dr Lau, I'm with you on the west side. We can see that</p> <p>11 there.</p> <p>12 A. Yes.</p> <p>13 Q. It looks as though there's a little bit of work there</p> <p>14 (indicating).</p> <p>15 A. Yes.</p> <p>16 Q. I don't see anything on the east side.</p> <p>17 A. I think there are also -- on this drawing, you cannot</p> <p>18 see it properly, but there's another better drawing just</p> <p>19 for the suitable measures.</p> <p>20 Q. All right. Let's just focus on the west side that we</p> <p>21 can see there, and then going back to the cross-section.</p> <p>22 That must be about there (indicating), is it?</p> <p>23 A. Yes.</p> <p>24 Q. So it's inside the diaphragm wall?</p> <p>25 A. Inside the diaphragm wall, yes. You cannot get -- you</p>	<p>1 experts about that.</p> <p>2 Dr Lau, I'm not going to go over with you the</p> <p>3 68 per cent reduction factor and how it's been derived</p> <p>4 and utilised in area A, and so forth, or statistical --</p> <p>5 A. I can't answer you those questions. I'm not the expert.</p> <p>6 Q. -- matters.</p> <p>7 A. Not my expertise.</p> <p>8 Q. All right.</p> <p>9 Now, so far as the coupler issue is concerned in the</p> <p>10 COI 2 areas --</p> <p>11 A. Okay.</p> <p>12 Q. -- we are concerned with the HHS area and the trough</p> <p>13 walls.</p> <p>14 A. Yes.</p> <p>15 Q. And you've explained your position with regard to,</p> <p>16 essentially, the protection of the columns in</p> <p>17 particular.</p> <p>18 A. Yes.</p> <p>19 Q. You say you -- I think you explained in your</p> <p>20 presentation this morning you've done a hand calculation</p> <p>21 and you worked out that the deflection that would be</p> <p>22 required to potentially harm the columns is quite small,</p> <p>23 2.7 degrees, I think you said?</p> <p>24 A. Agree, yes, 2.7 degrees.</p> <p>25 Q. Is that deflection, of that magnitude, is that going to</p>
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<p>1 cannot do it outside.</p> <p>2 Q. Okay. So it's just inside the diaphragm wall, before</p> <p>3 whatever the other column is there (indicating), yes,</p> <p>4 that bit? So it's about where the hand is now?</p> <p>5 A. Okay.</p> <p>6 Q. Is that the area you have been describing as somewhere</p> <p>7 between I think severe and very severe; is that right?</p> <p>8 A. Yes, because the whole structure is submerged in water.</p> <p>9 The whole structure is submerged in water, and the water</p> <p>10 table actually fluctuates due to tidal variations, so</p> <p>11 for me they are contaminated by salt water, and the</p> <p>12 diaphragm wall itself --</p> <p>13 Q. Despite the fact that we've got 1.2 metres of diaphragm</p> <p>14 wall in the way?</p> <p>15 A. But the diaphragm wall are not impermeable, because to</p> <p>16 construct a diaphragm wall has joints in between them,</p> <p>17 and they allow water to come in. Because diaphragm</p> <p>18 walls are not watertight.</p> <p>19 Q. Okay.</p> <p>20 A. So if you feel the diaphragm wall from the inside, it's</p> <p>21 always wet.</p> <p>22 Q. Okay. Thank you for that, Dr Lau. At least I now know</p> <p>23 precisely where it is we are talking about. I was</p> <p>24 unsure about that to start with, but I think I now</p> <p>25 understand it, and we can obviously hear from other</p>	<p>1 be prevented by the suitable measures that are being</p> <p>2 carried out?</p> <p>3 A. Yes.</p> <p>4 Q. All right. And again those works are being carried out</p> <p>5 on the footing that a 35 per cent reduction factor is</p> <p>6 applicable, and that again is derived from the</p> <p>7 calculations that have been done in relation to the</p> <p>8 other areas that have been tested?</p> <p>9 A. Yes, that's right.</p> <p>10 Q. I think we can see from recent reports from MTR that</p> <p>11 something of the order of 90 per cent of that work has</p> <p>12 been carried out?</p> <p>13 A. I think basically they are all completed by now, yes.</p> <p>14 Q. Okay. Have you been back to inspect any of that work?</p> <p>15 A. I cannot go in. I can't go in at all. I'm not allowed</p> <p>16 to go in.</p> <p>17 Q. I thought they would let you in! Right.</p> <p>18 As part of Mr Southward's analysis in relation to</p> <p>19 the trough walls, as we've seen already a couple of</p> <p>20 times, he carried out a yield line analysis?</p> <p>21 A. Yes.</p> <p>22 Q. And that's something that you criticise on the basis of,</p> <p>23 as I understand it -- is this right -- a misapplication</p> <p>24 of the American Association of State Highway and</p> <p>25 Transportation document?</p>

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<p>1 A. I would not say that. I would not say that.</p> <p>2 Q. How do you put it?</p> <p>3 A. What I said was that he should have carried out more</p> <p>4 checks. That's all. I think, if he carried out those</p> <p>5 checks, maybe it is okay.</p> <p>6 Q. Right.</p> <p>7 A. All that I said is he did not check the shear. That's</p> <p>8 all. I'm not saying that it is wrong. I said that that</p> <p>9 particular line may not be the critical shear -- yield</p> <p>10 line. That's all. I'm not saying it is wrong.</p> <p>11 Q. Okay.</p> <p>12 A. In fact I appreciate that he has done this sort of</p> <p>13 calculation.</p> <p>14 Q. All right.</p> <p>15 This may be not a straightforward structural</p> <p>16 engineering issue, Dr Lau, but I'll ask you to comment</p> <p>17 because others have. You're aware that the steel fixing</p> <p>18 work in the HHS trough areas --</p> <p>19 A. Yes.</p> <p>20 Q. -- were carried out by a different sub-contractor to the</p> <p>21 one that carried out the steel fixing works elsewhere on</p> <p>22 the structure?</p> <p>23 A. I know that.</p> <p>24 Q. So leaving aside the statistical point about whether</p> <p>25 it's appropriate to apply this 35 per cent reduction</p>	<p>1 CHAIRMAN: So work on the basis that the failure rate, if</p> <p>2 I can misdescribe it, would have been about the same for</p> <p>3 these new contractors?</p> <p>4 A. Yes, at the moment, yes, but luckily -- I don't know</p> <p>5 whether it's lucky or what -- but anyway, apply this</p> <p>6 reduction rate to NAT and SAT, there's no need for any</p> <p>7 suitable measure. So the only suitable measure required</p> <p>8 is on the trough walls at the moment.</p> <p>9 MR PENNICOTT: Yes. I think you were perhaps here on Friday</p> <p>10 when Mr Southward described the very different nature of</p> <p>11 the works to the trough walls compared to the coupler</p> <p>12 work in the slabs, and so forth. Did you hear all that?</p> <p>13 A. I heard.</p> <p>14 Q. Do you agree with what he said: it's very different type</p> <p>15 of works, different conditions, a lot easier in the</p> <p>16 trough walls?</p> <p>17 A. Easier, but on the other hand, if you look at the VRV</p> <p>18 room and the stitch joint is even more easier, and yet</p> <p>19 we have this sort of problem. So we have to balance,</p> <p>20 take some sort of balance. I'm not saying that there is</p> <p>21 definitely a coupler defect, but I think it's better to</p> <p>22 be prudent because those walls are very important in</p> <p>23 case of an accident.</p> <p>24 Q. Okay.</p> <p>25 A. For me, I think it's a prudent approach.</p>
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<p>1 factor, does the fact that the work was carried out by</p> <p>2 different sub-contractors -- is that of importance, do</p> <p>3 you think, in the applicability or the use of that</p> <p>4 reduction factor?</p> <p>5 A. It has some impact, definitely.</p> <p>6 Q. What sort of impact would you say it has?</p> <p>7 A. Well, it depends on: is it better than the other</p> <p>8 contractor? Secondly -- what shall I say? The best</p> <p>9 thing, as I said, like Mr Southward, is to open up. If</p> <p>10 we can open up, then it solves all the problems, but</p> <p>11 unfortunately there was a decision not to open up. That</p> <p>12 I can't help. So, in that case, we have to lead with</p> <p>13 certain assumptions, and that assumption is to have</p> <p>14 a 35 per cent strength reduction. I think that's the</p> <p>15 best one can do.</p> <p>16 Q. Right.</p> <p>17 CHAIRMAN: The assumption is based on a previous statistical</p> <p>18 analysis of a different area --</p> <p>19 A. In area A, yes.</p> <p>20 CHAIRMAN: -- carried out by --</p> <p>21 MR PENNICOTT: A different sub-contractor, yes.</p> <p>22 A. As I said, the best thing is to open up and have a look.</p> <p>23 CHAIRMAN: I appreciate that.</p> <p>24 A. Unfortunately, there was no such opening-up, and we have</p> <p>25 to live on the assumption.</p>	<p>1 Q. Understood.</p> <p>2 Dr Lau, shear links, a few questions about shear</p> <p>3 links.</p> <p>4 A. Sure.</p> <p>5 Q. That's obviously the second topic that we are focusing</p> <p>6 on. The issue regarding shear links arose during the</p> <p>7 course of the first part of the Inquiry as something of</p> <p>8 a side wind, because what had happened was various areas</p> <p>9 of honeycombing, honeycombed concrete --</p> <p>10 A. Yes.</p> <p>11 Q. -- were discovered, and when certain locations were</p> <p>12 opened up, that led to a consideration of whether or not</p> <p>13 the shear links were there, whether they were correctly</p> <p>14 spaced, and so forth.</p> <p>15 A. Yes.</p> <p>16 Q. You are aware that's all how it came about?</p> <p>17 A. I'm aware, yes.</p> <p>18 Q. Clearly you have now seen, presumably, a lot of</p> <p>19 photographs showing in-situ shear links, many, many</p> <p>20 shear links in many areas; is that right?</p> <p>21 A. You mean Mr Southward's photographs?</p> <p>22 Q. Yes.</p> <p>23 A. At the top?</p> <p>24 Q. Yes.</p> <p>25 A. Okay, yes, I agree.</p>

<p>Page 109</p> <p>1 Q. So it appears that there might be certain areas where 2 there are no shear links. I think you've referred to 3 40-odd locations that have been looked at -- 4 A. Yes. 5 Q. -- some of which appear to show no shear links. 6 A. Yes. 7 Q. Is this right, that, however, in terms of suitable 8 measures, the whole analysis has been approached on the 9 basis that there are no shear links? 10 A. Yes. 11 Q. And that's unreal, isn't it? 12 A. Sorry, can you repeat? 13 Q. It's unreal, is it not? 14 A. Let me put it this way. I looked at the opened-up area, 15 in particular the honeycombed area where it was opened 16 up. When I looked at -- in case when there was shear 17 links, I saw there was no steel wire tying them 18 together. I think this is the main problem of the shear 19 link issue on this particular site. The sub -- the 20 contractor should tie up all the reinforcement at the 21 intersection. If they tie it up, when they do the 22 concreting and do the vibration, they will not displace 23 the reinforcement. I have the feeling that what 24 Mr Southward showed us must be right, it must be right. 25 The problem is they were not tied up. When I looked at</p>	<p>Page 111</p> <p>1 a particular point in time, presumably because 2 physically they couldn't get them through the rebar, in 3 fact so not full-length shear links. So missing, not 4 full-length. And the third point I thought was not 5 correctly spaced, ie there but not correctly spaced. 6 I thought that was the third possibility. 7 A. And also the fourth is the wrong diameter. 8 Q. Okay, wrong diameter. Now you seem to be adding in 9 another one. 10 A. No, I'm not adding in. 11 Q. What are you doing then? 12 A. What I'm trying to do is -- I saw Mr Southward's 13 photographs. They showed the shear links there, but at 14 the bottom, when they opened up, there were no shear 15 links. Where did they go? I don't know, honestly. 16 Q. Okay. 17 COMMISSIONER HANSFORD: Is it possible to go back to one of 18 Mr Southward's photographs? Because I think you made 19 the point, Dr Lau, that you could see they weren't tied 20 properly. 21 A. If we look at them -- 22 COMMISSIONER HANSFORD: I don't recall seeing that. 23 A. Shall we have a look? 24 MR PENNICOTT: I think around about 22. 25 A. Actually, I'm not suggesting new thing. I'm just trying</p>
<p>Page 110</p> <p>1 the photographs, it seemed to me they were not tied up. 2 Maybe they were not at the stage to tie them up. But 3 normally you put the steel -- reinforce there, you tie 4 up right away. You will not leave them there and go 5 back to do the tying up; right? 6 So with all this reinforcement being placed there, 7 and when they do the concreting and vibration, if you 8 don't tie it up, they go everywhere. In fact, when 9 I looked at some of the opened-up and honeycomb thing, 10 there are a lot of so-called abandoned reinforcing bar 11 on the base of the concrete. How come there were so 12 many abandoned reinforcement on the base of the slab? 13 Obvious, they may be previous shear links. I don't know 14 what they are. There should not be any abandoned steel 15 reinforcement at the base of the EWL slab. 16 So I have the feeling that because they did not tie 17 them up properly, when you do the concreting they go 18 everywhere. 19 Q. With respect, Dr Lau, can I just ask you to pause there 20 for a moment. Up until your last answer, I thought that 21 there were three potential problems with the shear 22 links. One, they were simply missing. 23 A. Yes. 24 Q. Two, that instead of going all the way down, as it were, 25 from the top to the bottom of the rebar, they stopped at</p>	<p>Page 112</p> <p>1 to give some explanation. 2 COMMISSIONER HANSFORD: Yes, I understand. It will be 3 useful to see what makes you think that. 4 A. I think there is another photograph showing the bend at 5 the top. Shall we have a look? 6 MR PENNICOTT: There's one there. What about the next one, 7 23? 8 A. I can't see it properly. 9 Q. Next one? What about this one? 10 A. Look at the one closer to us. 11 Look at this one, for example (indicating). That 12 doesn't seem to have steel wire tying them together; 13 right? 14 Q. Can we blow that up? 15 COMMISSIONER HANSFORD: Yes. I can't imagine how they would 16 stay in place if they weren't tied, but maybe that's 17 your point. 18 A. I don't know. Because actually, what they should do is, 19 as soon as they put the steel there, the link there, 20 they should tie it up right away. 21 COMMISSIONER HANSFORD: Of course. I have some experience 22 in steel fixing. 23 A. If you look at this, I don't think it is tied at all, 24 none of them. 25 MR PENNICOTT: Okay. It seems to us that they do have some</p>

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<p>1 ties --</p> <p>2 A. I hope that's right, because my eyes are not that good.</p> <p>3 CHAIRMAN: Can I ask -- looking at how ordinary workmanship</p> <p>4 would proceed, and I may be wrong here -- it's</p> <p>5 a question, it's not an implied statement -- when you</p> <p>6 stick those shear links in, wouldn't you then tie each</p> <p>7 one as you go, rather than doing 100 and then go back</p> <p>8 and tie them?</p> <p>9 A. You wouldn't do that. You would just tie it right away.</p> <p>10 CHAIRMAN: Tie them right away. So there would have to be</p> <p>11 a complete break in normal procedure, wouldn't it?</p> <p>12 COMMISSIONER HANSFORD: It would be extraordinary.</p> <p>13 A. I think this perhaps explains why we missed the shear</p> <p>14 links at the bottom, because when you try to vibrate the</p> <p>15 concrete, they go anywhere, all these shear links.</p> <p>16 CHAIRMAN: But I'm talking about, you know, it would be, as</p> <p>17 Prof Hansford has said, if you can see the shear links</p> <p>18 put there, and if the quite compelling presumption is,</p> <p>19 unless you've got a very odd way of working, to tie them</p> <p>20 at the time you insert each one, and to do anything</p> <p>21 other than that would be extraordinary, surely the mere</p> <p>22 fact that a serial of shear links are shown would imply,</p> <p>23 absent really compelling proof to the contrary, that</p> <p>24 they must have been tied?</p> <p>25 A. They should be tied, yes. Well, I don't know, maybe --</p>	<p>1 COMMISSIONER HANSFORD: Okay. We can leave that point.</p> <p>2 A. Maybe they come back to do it later; I don't know.</p> <p>3 MR PENNICOTT: Okay.</p> <p>4 Sorry, can we just have a look -- we'd better try to</p> <p>5 just make sure we don't miss something -- C13,</p> <p>6 an Original Inquiry bundle, 8605.</p> <p>7 I'm not sure that you will be familiar with these</p> <p>8 documents, Dr Lau, but the Commission has seen many of</p> <p>9 these. They are the cast in-situ concrete quality</p> <p>10 control checklists that Leighton had to fill in at</p> <p>11 various stages of their works.</p> <p>12 A. Okay.</p> <p>13 Q. This was just one we found at random, but if you go</p> <p>14 down, please, to number 5, the reinforcement fixing, you</p> <p>15 will see one of the things that has to be ticked and</p> <p>16 signed off is:</p> <p>17 "Size, number, length and spacing of bars, lap</p> <p>18 lengths, starter bar lengths and levels, cover, tying</p> <p>19 wire (ends turned in)" -- do you see that?</p> <p>20 A. Yes.</p> <p>21 Q. "... rigidity, surface condition ...", and so forth.</p> <p>22 So one might indeed expect the wires to be tied in</p> <p>23 and therefore not necessarily entirely visible on the</p> <p>24 photographs, because they would be tied and tied in;</p> <p>25 yes?</p>
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<p>1 CHAIRMAN: An attempt must have been made to tie them?</p> <p>2 A. Maybe they come back to do the tying later on, I don't</p> <p>3 know. But looking at this photograph, they were not</p> <p>4 tied, that's all. I'm not implying anything.</p> <p>5 COMMISSIONER HANSFORD: Sorry, that's the bit I'm struggling</p> <p>6 with. How does this photograph show they are not tied?</p> <p>7 A. Sorry?</p> <p>8 COMMISSIONER HANSFORD: You said, "But looking at this</p> <p>9 photograph, they were not tied".</p> <p>10 A. Yes.</p> <p>11 COMMISSIONER HANSFORD: Where can you see that?</p> <p>12 A. If they are tied, you should see -- for example, here</p> <p>13 (indicating), you should see a steel wire tying them</p> <p>14 together. You should see steel wire tying them</p> <p>15 together.</p> <p>16 COMMISSIONER HANSFORD: Presumably the link then goes</p> <p>17 vertically downwards?</p> <p>18 A. Yes.</p> <p>19 COMMISSIONER HANSFORD: Giving the opportunity to tie it to</p> <p>20 the transverse horizontal bars?</p> <p>21 A. I don't think they -- I believe, only "I believe"; I'm</p> <p>22 not introducing new evidence at the moment -- but when</p> <p>23 I looked at the photograph from the bottom, I did not</p> <p>24 see the wire there either. I did not see any wire tying</p> <p>25 the beams there either.</p>	<p>1 A. Well, I am not making any new evidence. I'm just trying</p> <p>2 to say, looking at the photograph if doesn't seem to</p> <p>3 have wire. Maybe they are coming to do it later,</p> <p>4 I don't know.</p> <p>5 Q. You would also expect, for example, MTR's construction</p> <p>6 engineers and inspectors to check that the work had been</p> <p>7 done as well?</p> <p>8 A. Yes, they should.</p> <p>9 Q. You haven't seen, presumably, the evidence of Louis</p> <p>10 Kwan -- I think I might have called him Chan this</p> <p>11 morning, for which I apologise -- Louis Kwan's evidence</p> <p>12 about his inspection of the shear links?</p> <p>13 A. They should be inspected. Anyway, as an engineer, as</p> <p>14 a contractor, this sort of thing is very important.</p> <p>15 They should be inspected. That's all. I'm not implying</p> <p>16 anything.</p> <p>17 Q. Okay. I'm not going to take you to it but for the</p> <p>18 transcript, the relevant evidence was at Day 29,</p> <p>19 pages 60 to 63.</p> <p>20 Just, as I say, to correct something I got wrong</p> <p>21 this morning, can we just go back to OU9, and looking at</p> <p>22 page 11375. That's the report of 25 December. 11382.</p> <p>23 I think this morning, Dr Lau, I may have suggested to</p> <p>24 you that this work or at least some of it was</p> <p>25 a consequence of the couplers. This is the shear link</p>

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<p>1 work, as I understand it, at 11382; is that right?</p> <p>2 A. Yes.</p> <p>3 Q. Okay.</p> <p>4 Now, you've given some evidence, Dr Lau, about a gap</p> <p>5 opening up underneath the NSL slab; do you remember</p> <p>6 that?</p> <p>7 A. Okay.</p> <p>8 Q. The soil settling and a gap opening up; do you remember</p> <p>9 that?</p> <p>10 A. Yes.</p> <p>11 Q. As I understand it, this is also associated with the</p> <p>12 shear link issues?</p> <p>13 A. For the slab itself, yes.</p> <p>14 Q. Am I right in saying that the depth of the slab that</p> <p>15 we're talking about is something like 16 metres below</p> <p>16 ground level?</p> <p>17 A. Something like that, yes.</p> <p>18 Q. Would you really expect a gap to open up at that sort of</p> <p>19 depth in this location in Hong Kong?</p> <p>20 A. Yes, because if there's a dewatering -- if there's</p> <p>21 dewatering going on for the next 120 years -- remember,</p> <p>22 we are talking about the design life of the building --</p> <p>23 maybe in 10 years' or 20 years' time, because of</p> <p>24 dewatering, the ground will settle; right? And the</p> <p>25 settlement will not recover. Once it's settled, it's</p>	<p>1 A. The same. Same noise.</p> <p>2 Q. Are you sure?</p> <p>3 A. The same noise, the same sort of drill bit.</p> <p>4 Q. When it gets to depth, is there really going to be</p> <p>5 an indication that there's a difference between the</p> <p>6 rebar and the concrete?</p> <p>7 A. Of course there's a difference. When I do ground</p> <p>8 investigation, if I hit reinforced concrete, even though</p> <p>9 it's 10 metres, 20 metres down, when I hit the rebar,</p> <p>10 I know right away. I will know right away. Because</p> <p>11 also, it takes a long time to drill through a rebar; it</p> <p>12 takes a long time. You don't cut it in one minute. It</p> <p>13 may take hours to drill through the rebar, because you</p> <p>14 are using steel to cut steel, the core part.</p> <p>15 Q. I'm distinguishing or seeking to distinguish two</p> <p>16 situations. You've got the 12 millimetre drill, the</p> <p>17 16 millimetre drill, but now you're doing</p> <p>18 a 32 millimetre core.</p> <p>19 A. The same. The drilling bit is the same. They have</p> <p>20 a drilling bit there and then they have carbide steel</p> <p>21 bite at the end, and that is used for you to cut through</p> <p>22 the rock, but if it's steel -- this is steel, right,</p> <p>23 high-strength steel? When they cut the rebar, you have</p> <p>24 steel cutting steel. You know right away because of the</p> <p>25 noise.</p>
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<p>1 settled. It cannot return to the original level.</p> <p>2 In fact, as I said, I involved in quite a lot of --</p> <p>3 Q. Have you ever demolished a box structure such as we are</p> <p>4 talking about here at this sort of depth?</p> <p>5 A. No, not this sort of depth, no. But consolidation</p> <p>6 theory is applied to ground level as well as 60 metres</p> <p>7 down, the same theory.</p> <p>8 Q. Just one further question on the construction joints.</p> <p>9 A. Yes.</p> <p>10 Q. So this is the dowel bar issues that we're -- part of</p> <p>11 the suitable measures that have been carried out to</p> <p>12 23 panels.</p> <p>13 A. Yes.</p> <p>14 Q. You've expressed the view, as I understand it, that</p> <p>15 drilling what we understand now to be a 12 millimetre</p> <p>16 hole followed by a 16 millimetre hole, if the driller</p> <p>17 were to hit a piece of rebar, he would know it?</p> <p>18 A. He would know it.</p> <p>19 Q. Because presumably, what, the drill bit would jump back</p> <p>20 or what?</p> <p>21 A. No. It's the noise.</p> <p>22 Q. It's the noise?</p> <p>23 A. It's the noise.</p> <p>24 Q. Okay. But what happens when the 32 millimetre coring</p> <p>25 exercise is done, Dr Lau?</p>	<p>1 Q. All right. Prof McQuillan doesn't agree with you on</p> <p>2 that, Dr Lau --</p> <p>3 A. Sorry. We can have different opinion.</p> <p>4 Q. -- and I've given you a chance to explain.</p> <p>5 A. I'm a contractor so I think I know better.</p> <p>6 MR PENNICOTT: All right. Thank you very much, Dr Lau,</p> <p>7 I have no further questions. Thank you very much.</p> <p>8 CHAIRMAN: Thank you.</p> <p>9 Cross-examination by MR SHIEH</p> <p>10 MR SHIEH: Dr Lau, good afternoon. I represent Leighton.</p> <p>11 A. Yes.</p> <p>12 Q. I have a few topics to pick up with you.</p> <p>13 First, I'd like to explore further this idea of</p> <p>14 butt-to-butt connection.</p> <p>15 A. Okay.</p> <p>16 Q. Now, you would accept that threaded ends differ in</p> <p>17 length, and you have said that they range from 44 to</p> <p>18 48 millimetres; is that right?</p> <p>19 A. Yes.</p> <p>20 Q. As a kind of crude arithmetic, a coupler is</p> <p>21 88 millimetres in length; yes?</p> <p>22 A. Correct.</p> <p>23 Q. If you have a 48 millimetre threaded bar which is</p> <p>24 screwed in completely on one end --</p> <p>25 A. 48?</p>

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<p>1 Q. 48, yes -- that would leave 40 millimetres inside the 2 coupler; correct? 3 A. Yes. 4 Q. Then if you have another 48 millimetres threaded end bar 5 screwed in from the other end, completely filling up the 6 40 millimetres inside, butt-to-butt, you would leave 7 8 millimetres outside; correct? 8 A. Yes. 9 Q. 8 millimetres would be equivalent to two threads; 10 correct? 11 A. Yes. 12 Q. I suggest to you that if you want there to be 13 butt-to-butt connection and also two threads visible on 14 the outside, then a necessary precondition would be that 15 you need two threaded bars with 48 millimetres each. 16 With any other combination, you cannot achieve 17 butt-to-butt plus two threads visible on the outside? 18 A. Yes. 19 Q. As a matter of pure arithmetic? 20 A. Yes. 21 Q. In real life, we know that not all threaded bars are 22 48 millimetres; you have accepted that? 23 A. Yes. 24 Q. And in real life, as I think Mr Pennicott asked this 25 morning, when workers tried to screw in a threaded end,</p>	<p>1 A. Yes. 2 Q. Workmen try to screw in the threaded bar from the other 3 end. Let's say he got stuck somewhere before it's 4 completely screwed in and it got stuck when it's, say, 5 40 millimetres embedded, 44 on one end, but on the other 6 side, despite pushing in to the best of their ability, 7 misalignment or whatever reason, got stuck, so there 8 leaves 4 millimetre gap inside; right? 9 A. Yes. 10 Q. But then, on the outside, the workmen would see 11 a 4 millimetre thread exposed outside; right? 12 A. Okay. 13 Q. Because assuming the thread to be 44, you have 14 40 millimetres in and you have 4 millimetres that is one 15 thread exposed outside, so the workman would think to 16 himself, "I have pushed in as best as I could, I don't 17 have x-ray eyes so I couldn't see whether it's 18 butt-to-butt. I know I have done my best. I can see 19 one thread outside." So according to the two-thread 20 criteria, he would pass that particular job. 21 A. The two-thread criteria is for the maximum. If you are 22 using 44 threads, there should be zero threads exposed; 23 yes? 24 Q. Yes, but the poor workman, when he pushed it in, he 25 would not know whether it's 44 or 48. He would just</p>
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<p>1 sometimes he would feel he got somewhere stuck halfway 2 through and he saw, "Oh gosh, four threads remaining", 3 so he takes it out, cleans it, screws it in further, 4 until he couldn't screw in any further, but would you 5 agree that the fact that you couldn't screw in 6 a threaded end any further may be due to reasons other 7 than the fact that it's already achieved butt-to-butt? 8 A. What other reason are you suggesting? 9 Q. A misalignment, maybe, you would accept -- 10 A. Yes. 11 Q. -- misalignment? Because these are very heavy bars, you 12 would accept. To achieve a very smooth screwing-in, it 13 really had to be pushed in at a very precise angle; 14 would you accept that? So, if there is a slight tilt, 15 there could be misalignment; do you accept that? 16 A. Could be. 17 Q. We operate in a real world. 18 A. Yes. 19 Q. Therefore -- let me give you a numerical example -- 20 let's assume that you have a 44 millimetre rebar, 21 threaded end, 44 millimetres. 22 A. Okay, 44. 23 Q. Say 44.5 or whatever; it doesn't matter. The 44 screwed 24 in completely on the one hand, leaving 44 space on the 25 other.</p>	<p>1 know, as a rule of thumb, I push in until I see 2 a maximum of two threads, so one thread is below two 3 threads, he would pass it; do you agree? 4 A. To pass it has to depend on the supervisor. The 5 supervisor will know because, as I said, for 6 44 millimetre thread, there should be zero threads 7 exposed. It's only when you have 48 millimetre threaded 8 bar then you have two threads exposed, that is the 9 maximum. 10 Q. Yes. We are talking about on a theoretical basis, if 11 you have two exposed threads, then if it's butt-to-butt 12 it has to be 48? 13 A. There is also a device, according to the instructions, 14 that you use the pipe wrench to turn the steel bar, but 15 if you turn the steel bar, maybe you can get in further. 16 Q. Maybe. 17 A. I don't know, but this is supposed to be the method 18 statement. The method statement is you should thread 19 it, thread the bar in. If it is 44 millimetres, there 20 should be zero threads exposed; right? If, for example, 21 it is not zero threads exposed, you are using 22 44 millimetre threaded bar, you use a pipe wrench to 23 tighten it. 24 Q. But my point is the poor workman would not have been 25 told to measure the length of the threaded end before</p>

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<p>1 trying to screw in the threaded end.</p> <p>2 A. I think this is the responsibility of the supervisor,</p> <p>3 the foreman.</p> <p>4 Q. Are you seriously suggesting that there should be some</p> <p>5 kind of instructions, in a busy construction site, dark</p> <p>6 and dusty, to measure the length of the threaded ends so</p> <p>7 that the poor worker could then say to himself, "Ah,</p> <p>8 this is 46, so I do some mental math so that it would be</p> <p>9 a thread and a half"?</p> <p>10 A. The worker wouldn't do that, his supervisor should do</p> <p>11 this for him.</p> <p>12 Q. Okay. You told us on Friday that you would tell your</p> <p>13 workers always to screw in butt-to-butt.</p> <p>14 A. Yes.</p> <p>15 Q. On BOSA threads?</p> <p>16 A. Well, only one or two jobs, but most of the other jobs</p> <p>17 I use other types of -- like a Lenton coupler, other</p> <p>18 types of couplers.</p> <p>19 Q. Lenton maybe has a tapered end so let's leave Lenton to</p> <p>20 one side.</p> <p>21 A. But let's stick to BOSA.</p> <p>22 Q. Let's stick to BOSA. You have experience of BOSA?</p> <p>23 A. Yes.</p> <p>24 Q. Good. We are on the same wavelength. You would tell</p> <p>25 your men to always screw in butt-to-butt?</p>	<p>1 looking at just now. Let's say if the poor worker, he</p> <p>2 tried to screw it in to the best of his ability and he</p> <p>3 reaches a dead end, how is he to know that he has</p> <p>4 already accomplished his mission? He couldn't push it</p> <p>5 in any further.</p> <p>6 A. Usually, for a batch of threaded bar, after delivery to</p> <p>7 site, the supervisor will measure the threaded length.</p> <p>8 He will tell the workers that these are all</p> <p>9 44 millimetre bars.</p> <p>10 Q. Each and every one of them?</p> <p>11 A. Very often the supervisor will do. This is done by the</p> <p>12 supervisors, not by the workers. If the worker cannot</p> <p>13 thread it in, he has to tell the supervisor. And</p> <p>14 actually it's not difficult to thread the bar into the</p> <p>15 coupler. It's not difficult at all.</p> <p>16 Q. Bearing in mind the length and the weight of a rebar?</p> <p>17 A. Yes. It can be done quite easily by workers.</p> <p>18 Q. Let's rewind. When a batch of rebars arrive on site --</p> <p>19 A. Yes.</p> <p>20 Q. -- a supervisor would have the responsibility of</p> <p>21 measuring the threaded ends?</p> <p>22 A. Yes.</p> <p>23 Q. Which would range from 44 millimetres to 48 millimetres;</p> <p>24 that's what you are saying?</p> <p>25 A. Most of the bars are 44 millimetres, in most cases.</p>
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<p>1 A. Yes, and my supervisor knows exactly what I want.</p> <p>2 Q. Right. Let's leave the supervisor to one side. Let's</p> <p>3 look at the poor worker.</p> <p>4 A. Okay.</p> <p>5 Q. How would the poor worker know whether or not, when he</p> <p>6 couldn't push in any further, it's because it has</p> <p>7 already reached butt-to-butt or it's because of some</p> <p>8 misalignment or some mishap that he couldn't push any</p> <p>9 further? How was he to know?</p> <p>10 A. He has to tell his supervisor and let him decide, let</p> <p>11 the supervisor decide.</p> <p>12 Q. But every time he couldn't screw in further he tells his</p> <p>13 supervisor, but every bar at some stage he would reach</p> <p>14 a dead end, so every bar he couldn't screw any further</p> <p>15 he tells his supervisor?</p> <p>16 A. I tell you, it's not that difficult to fit in the</p> <p>17 threaded bar into the coupler. It's not as difficult as</p> <p>18 you said. It's not difficult. I tell you. We are</p> <p>19 sitting in this courtroom and imagining that it is very</p> <p>20 difficult, but it's not that difficult, I tell you.</p> <p>21 Most of the workers can put it in quite easily. On my</p> <p>22 site there's no problem. Here we are talking about</p> <p>23 an ideal condition saying you can't do this or you can't</p> <p>24 do that.</p> <p>25 Q. I know, but let's just imagine the scenario that we were</p>	<p>1 Most of the bars are 44. But there's a tolerance there.</p> <p>2 Particular 48 is supposed to be the maximum tolerance.</p> <p>3 They aim for 44 millimetres; okay?</p> <p>4 Q. Yes, but 44 is what they are called. They call them</p> <p>5 notionally 44 but there's a tolerance.</p> <p>6 A. Yes.</p> <p>7 Q. The tolerance, as we know, is a kind of a buffer,</p> <p>8 an allowance.</p> <p>9 A. Yes.</p> <p>10 Q. But it's not a binomial situation where it's either 44</p> <p>11 or 48. It could be 45 or 46 because when they come out</p> <p>12 of the factory, the length could differ; right?</p> <p>13 A. Yes, that's why the maximum tolerance is two threads</p> <p>14 outside. That's why. Normally, it should be less than</p> <p>15 two threads. If anything more than two threads, then</p> <p>16 there must be something wrong. The worker will discuss</p> <p>17 with his foreman about this and let them sort this out.</p> <p>18 The bar should be 44.</p> <p>19 Q. So let's say a poor worker screws in until he couldn't</p> <p>20 reach any further. He still sees, let's say, half</p> <p>21 a thread outside.</p> <p>22 A. Okay.</p> <p>23 Q. He couldn't push in any further. Half a thread outside.</p> <p>24 What judgment does he form on the spot?</p> <p>25 A. He then uses a pipe wrench to try one more time. If we</p>

<p>Page 129</p> <p>1 use a pipe wrench to try it one more time, there's 2 a chance it would be butt-to-butt. 3 Q. A chance? 4 A. Most likely it would be butt-to-butt, because the 5 coupler is designed to be like that. We use the pipe 6 wrench to tighten it, it will be butt-to-butt. Lock it 7 and it will be butt-to-butt. The important word is 8 "lock it". 9 Q. But you are saying in every case, in every case -- 10 A. Supposed to be, yes. 11 Q. -- it would be like this? 12 A. Yes. 13 Q. Until you screw in completely, there won't be any chance 14 of a gap remaining inside? 15 A. There wouldn't be any gap inside. 16 Q. Okay. Let's say, for whatever reason, that a gap 17 remained inside. Let's rewind. And let's look at the 18 poor inspector. The inspector is there to make sure 19 that there is quality control; correct? 20 A. Yes. 21 Q. Because however much you instruct the poor worker to use 22 a pipe wrench, he may or may not completely fulfil the 23 instructions; correct? That is why you need 24 an inspector to check -- 25 A. Okay.</p>	<p>Page 131</p> <p>1 you, would be defective; correct? Potentially failing 2 to spot non-butt-to-butt connections. 3 A. There should be -- if they are using 44 millimetre, 4 there should be zero threads exposed. If there's maybe 5 half a thread exposed, then the best thing is for the 6 inspector to ask the worker to use the pipe wrench to do 7 it once more. If he cannot go in, that means it is 8 butt-to-butt. If they expose one and a half, again they 9 use it, if it cannot go in, that is butt-to-butt as 10 well. 11 This is very important. Apart from the tolerance, 12 also use the pipe wrench to try it. 13 Q. Let me ask you one more time. According to what you 14 have said just now, any inspection protocol, whether on 15 the site for the inspector or government or holistic 16 report protocol which merely says, "Two threads visible 17 on the outside, I pass", that would be an invalid method 18 of inspection? 19 A. It's visual inspection, yes, for visual inspection, but 20 to be sure, you use a pipe wrench to do it properly. 21 The pipe wrench is -- because we want it to be locked. 22 The important point is "locked". You use the pipe 23 wrench to try and if it is locked then it is locked. 24 CHAIRMAN: Sorry, I think the question was that if the 25 inspector was to look and say, "Two threads outside,</p>
<p>Page 130</p> <p>1 Q. -- that it's properly done. 2 The poor inspector, he would go and see a whole 3 array of rebars with ends screwed in, some completely 4 screwed in, some with one thread outside, some with 5 a thread and a half outside, some with half a thread 6 outside, some with two threads outside. All would be 7 within the tolerance limit -- 8 A. Yes. 9 Q. -- instructed by BOSA. How was he to tell whether or 10 not, deep inside, it was actually butt-to-butt? 11 A. He will ask the workers to use the pipe wrench to try it 12 once more. If you try it once more and you cannot go in 13 anymore, then it will be butt-to-butt. 14 Q. So whenever he sees some threads exposed, he would say 15 to himself, "Let me ask the guy to show to me, to screw 16 it in using a pipe wrench. I want to be assured." 17 A. Yes. 18 Q. So that is how you expect the inspector to carry out his 19 task of inspecting? 20 A. Yes. 21 Q. Not just visually? 22 A. Visually as well as using the pipe wrench to do the job 23 properly. 24 Q. So any inspection protocol which merely involves 25 external visual inspection of two threads, according to</p>	<p>Page 132</p> <p>1 I pass", that I think, Mr Shieh said, would that be not 2 a full and proper inspection? 3 A. You can call it a pass inspection, but if I were the 4 inspector, I would at least try one or two of those two 5 threads exposed bars and use a pipe wrench to try it. 6 I think using a pipe wrench is the only way to ensure 7 butt-to-butt. That's the only way. 8 MR SHIEH: I'll try one last time. You are aware of the 9 protocol adopted for the opening-up exercise conducted 10 by -- opening-up for the purpose of the holistic report? 11 A. Okay. Are we talking about couplers still? 12 Q. Yes. You are aware that it did not involve screwing in 13 with a wrench pipe? 14 A. Agree. 15 Q. Would you suggest that that is potentially defective 16 because it would have failed to capture situations when 17 it is not butt-to-butt? 18 A. It can't use the pipe wrench in this case, because 19 there's not enough space for you to use the pipe wrench 20 anyway. That's why they are using the PAUT test, but 21 that's the best they can do, in the opening-up exercise 22 that's the best that they can do. 23 Q. PAUT is 37 millimetres? 24 A. Yes, I know. 25 Q. Plus the 3 millimetres allowance, it would be 40?</p>

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<p>1 A. Yes.</p> <p>2 Q. We have seen that if the threaded end on the other end,</p> <p>3 let's say, is only 46, let's say, if you have 44</p> <p>4 inside -- if you have 40 inside, leaving, let's say, 40</p> <p>5 visible outside -- you understand what I mean?</p> <p>6 A 88 millimetre coupler with, let's say, 46 millimetres</p> <p>7 embedded on the D-wall side, that leaves 42 millimetres</p> <p>8 space; yes? 88 minus 46 would be 42; yes?</p> <p>9 A. Okay.</p> <p>10 Q. You have a threaded end which you try to screw in on the</p> <p>11 other end.</p> <p>12 A. Okay.</p> <p>13 Q. Let's say there's a gap of 2 millimetres.</p> <p>14 A. Inside?</p> <p>15 Q. Inside.</p> <p>16 A. Okay.</p> <p>17 Q. So only 44 millimetres would be embedded; yes?</p> <p>18 A. Yes.</p> <p>19 Q. It would have passed the 38 millimetre PAUT test;</p> <p>20 correct?</p> <p>21 A. But you are wrong. I tell you why. On the other side,</p> <p>22 if you have a 48 millimetre threaded bar, the maximum</p> <p>23 you can get in is 44; you still have two threads</p> <p>24 outside, on the other side. So what you said cannot</p> <p>25 happen, because at the centre -- because I try it every</p>	<p>1 push in or because he's lazy or whatever, he pushed in,</p> <p>2 let's say, 44 millimetre length threaded end rebar. He</p> <p>3 pushes in but only to the extent of 40; yes? He pushes</p> <p>4 in only to the extent of 40. So inside the coupler</p> <p>5 there would be a 2 millimetre gap; yes?</p> <p>6 A. Okay.</p> <p>7 Q. 88 less 46, less 40, which would leave us a 2 millimetre</p> <p>8 gap, so not butt-to-butt, not locked. Let's say he's</p> <p>9 lazy. But 40 inside, according to the PAUT test, it</p> <p>10 would pass, because it's more than 37.</p> <p>11 A. (Nodded head).</p> <p>12 Q. Then on the outside, one thread would be visible;</p> <p>13 correct? Because if you assume this to be 44, 40 has</p> <p>14 gone in, so 4 millimetres are visible on the outside, so</p> <p>15 there's one thread remaining?</p> <p>16 A. Okay.</p> <p>17 Q. According to the test devised for the purpose of the</p> <p>18 opening-up, it passes both criteria: less than two</p> <p>19 threads visible and 37 millimetres according to the PAUT</p> <p>20 test.</p> <p>21 A. Okay.</p> <p>22 Q. But it would not achieve butt-to-butt; correct?</p> <p>23 A. Okay. But the thing is, just like I talked to</p> <p>24 Mr Pennicott this morning, in that case there would be</p> <p>25 more failed couplers.</p>
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<p>1 time, you screw it in one side, that's the maximum you</p> <p>2 can go in. The other side, there's also a maximum you</p> <p>3 can go in. You know, if you have 48 on the other side,</p> <p>4 the maximum it can go in is 44, and then you have two</p> <p>5 threads outside.</p> <p>6 COMMISSIONER HANSFORD: Why is that?</p> <p>7 A. I don't know, because when I screw in from one side,</p> <p>8 after certain tightening, you have to stop. That's the</p> <p>9 maximum you can go in. So on the other side, if you try</p> <p>10 to put it in, when it meets the other side -- so if it's</p> <p>11 48, in fact you should have two threads outside, on the</p> <p>12 other side.</p> <p>13 MR SHIEH: We are deep into the afternoon. Let me just give</p> <p>14 you some basic numbers. I've just written out some.</p> <p>15 88 millimetre coupler. On one side, the side of the</p> <p>16 D-wall --</p> <p>17 A. Yes.</p> <p>18 Q. You have a 46 millimetre threaded end, you screw it in</p> <p>19 completely, so all 46 millimetres inside the coupler;</p> <p>20 correct?</p> <p>21 A. Yes.</p> <p>22 Q. Simple arithmetic tells us that 88 less 46 would be</p> <p>23 42 millimetres left on the slab side; yes? 42 left;</p> <p>24 correct?</p> <p>25 Let's say some poor workman tried his very best to</p>	<p>1 Q. Yes. That is why --</p> <p>2 A. The number of failures would be even higher. So</p> <p>3 I think, for the purpose of this particular test,</p> <p>4 somebody has to draw a line for acceptance. So this</p> <p>5 37 millimetres plus 2 millimetres on the outside is</p> <p>6 an accepted criteria --</p> <p>7 CHAIRMAN: Sorry, that I don't understand, because if</p> <p>8 a coupler which is -- a threaded coupler is not</p> <p>9 butt-to-butt, then according to you it's of no value</p> <p>10 whatsoever, so there should be a simple test: is it</p> <p>11 butt-to-butt or not? Because if it's not butt-to-butt,</p> <p>12 then it's not doing its job.</p> <p>13 A. But the PAUT test, you can't do that, because -- you</p> <p>14 can't do anything about that for the PAUT test.</p> <p>15 COMMISSIONER HANSFORD: So why have a PAUT test?</p> <p>16 A. But this is something agreed in the investigation.</p> <p>17 MR SHIEH: But it would be completely valueless. Drawing</p> <p>18 a line which leaves the real risk of a gap remaining</p> <p>19 inside is a completely valueless protocol; would you</p> <p>20 accept that?</p> <p>21 A. But you see -- I'm not going to comment on the PAUT test</p> <p>22 because it was done before I came in.</p> <p>23 CHAIRMAN: No, you weren't part of it, and we are not asking</p> <p>24 you to do a critique of the test as such, but --</p> <p>25 A. In fact, I looked at that particular defect, how to</p>

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<p>1 classify as acceptance and defect. I had this sort of</p> <p>2 doubt to myself in the beginning, but somehow somebody</p> <p>3 has to draw a line to say this is acceptable, this is</p> <p>4 not a defect, this is acceptable; somebody has to draw</p> <p>5 the line.</p> <p>6 COMMISSIONER HANSFORD: I thought you had drawn the line --</p> <p>7 A. I did not.</p> <p>8 COMMISSIONER HANSFORD: -- that butt-to-butt is acceptable.</p> <p>9 A. Yes, butt-to-butt is -- well, I did not draw the line.</p> <p>10 It's drawn the line by the manufacturer. This</p> <p>11 butt-to-butt is required by the manufacturer, not by me.</p> <p>12 COMMISSIONER HANSFORD: Yes.</p> <p>13 MR SHIEH: Perhaps we can take the mid-afternoon break here</p> <p>14 and then we'll look at what the manufacturer says.</p> <p>15 Would it be an appropriate moment?</p> <p>16 CHAIRMAN: Yes, certainly. Thank you very much.</p> <p>17 15 minutes.</p> <p>18 (3.39 pm)</p> <p>19 (A short adjournment)</p> <p>20 (3.59 pm)</p> <p>21 MR SHIEH: Dr Lau, before I take you to the BOSA materials,</p> <p>22 can I round up your evidence about the drawing of</p> <p>23 a line. Would you say that according to your evidence,</p> <p>24 in particular the importance of butt-to-butt, that the</p> <p>25 line has been drawn wrongly?</p>	<p>1 the partially engaged coupler can satisfy strength and</p> <p>2 permanent elongation, and asked them to provide</p> <p>3 a programme of tests to demonstrate that the partially</p> <p>4 engaged coupler can satisfy these two criteria. But</p> <p>5 there was no response.</p> <p>6 So, in that case, we have to stick to the</p> <p>7 butt-to-butt. Government never asked for butt-to-butt.</p> <p>8 Never, we never. We just asked for strength and</p> <p>9 permanent elongation requirement. That's all.</p> <p>10 Q. But according to you, no butt-to-butt means failed</p> <p>11 permanent elongation test?</p> <p>12 A. In fact it shows, by all the tests, that when it is not</p> <p>13 butt-to-butt, it failed permanent elongation, not by me</p> <p>14 but by all the tests shown.</p> <p>15 Q. So looking at the matter now -- listen carefully -- you</p> <p>16 now know or you now say no butt-to-butt means fail</p> <p>17 permanent elongation; yes?</p> <p>18 A. The tests show that, yes.</p> <p>19 Q. You now know; yes? We now know, according to the</p> <p>20 tests --</p> <p>21 A. We now know, as well BOSA also tell us so.</p> <p>22 Q. Forget about what BOSA tells you. We have yet to get to</p> <p>23 what BOSA tells you. Don't bring in BOSA. You have</p> <p>24 said in your report --</p> <p>25 A. Yes.</p>
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<p>1 A. I don't -- I didn't say so.</p> <p>2 Let me put it this way. Government only want,</p> <p>3 strength-wise, it can satisfy the strength, and then we</p> <p>4 also want permanent elongation to be less than</p> <p>5 0.1 millimetre. That's all the government wants. And</p> <p>6 then BOSA said, to do so, it needs to be butt-to-butt.</p> <p>7 Government did not want it to be butt-to-butt. All that</p> <p>8 we want is strength and permanent elongation to be less</p> <p>9 than 0.1 millimetre. That's all that we want.</p> <p>10 It happened that BOSA said to get this permanent</p> <p>11 elongation requirement, it's got to be butt-to-butt.</p> <p>12 That's all.</p> <p>13 Q. I don't understand.</p> <p>14 A. Now --</p> <p>15 Q. Go ahead.</p> <p>16 A. -- in fact government wants two things: strength and</p> <p>17 permanent elongation being less than 0.1 millimetre. It</p> <p>18 doesn't matter what coupler you want, it doesn't matter</p> <p>19 what coupler we are using. You have to satisfy two</p> <p>20 criteria: strength and permanent elongation. That's</p> <p>21 all.</p> <p>22 Now, it happened that BOSA said if it is</p> <p>23 butt-to-butt, then you can satisfy both. In fact, it</p> <p>24 does, as demonstrated by all the tests. In fact, at one</p> <p>25 time, government did ask MTR to provide evidence that</p>	<p>1 Q. -- in your opinion, according to whatever test you have</p> <p>2 done, no butt-to-butt means fail permanent elongation?</p> <p>3 A. For BOSA type, yes.</p> <p>4 Q. We have also established that according to the protocol</p> <p>5 designed for the holistic report, the protocol --</p> <p>6 A. Yes.</p> <p>7 Q. -- it would fail to capture a situation where there's</p> <p>8 a small gap inside and yet have 37 millimetres on the</p> <p>9 PAUT test with two threads visible; it would not have</p> <p>10 failed that?</p> <p>11 A. Yes.</p> <p>12 Q. So it would inevitably follow that this test is</p> <p>13 defective in capturing a non-butt-to-butt scenario?</p> <p>14 A. I think the government --</p> <p>15 Q. Would you say that, according to what you now know?</p> <p>16 A. Yes and no. I tell you: because the 3mm is only</p> <p>17 a tolerance. They were given the benefit of the doubt</p> <p>18 here.</p> <p>19 Q. I know. So 37 could mean 40?</p> <p>20 A. Yes.</p> <p>21 Q. But from the example we worked on just now, even if it's</p> <p>22 40 inside, it would still not be butt-to-butt? There</p> <p>23 could be a situation where, even if it's 40 millimetres</p> <p>24 inside, it is not butt-to-butt?</p> <p>25 A. Could be.</p>

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<p>1 Q. Could be?</p> <p>2 A. Yes.</p> <p>3 Q. So let me ask you once again: this protocol, according</p> <p>4 to your very strict requirement of "must be</p> <p>5 butt-to-butt", is defective?</p> <p>6 A. I cannot answer you this, because for me, we want -- all</p> <p>7 that we want is simple: strength and permanent</p> <p>8 elongation; right? And we were told that only</p> <p>9 butt-to-butt can meet this requirement. That's all.</p> <p>10 Q. Okay. Dr Lau, can I be very blunt and brutal about it</p> <p>11 here. You were really caught between the devil and the</p> <p>12 deep blue sea here. You wanted to hang on to this very</p> <p>13 strict and unrealistic requirement of butt-to-butt, and</p> <p>14 yet you dare not actually criticise the protocol adopted</p> <p>15 for the holistic report. That's why you have to sit on</p> <p>16 the fence and say "yes and no".</p> <p>17 A. I don't know how to answer you as far as this is</p> <p>18 concerned. For me, we are trying to get a dividing line</p> <p>19 of what being acceptable and what being not acceptable,</p> <p>20 and this 37 millimetres plus two threads outside is the</p> <p>21 only -- is the dividing line. That's all.</p> <p>22 Q. Thank you. Let's look at what BOSA says.</p> <p>23 Can you look at H25, in COI 1 bundle H25, at</p> <p>24 44527.1. Here you have the thread strength calculation</p> <p>25 table, and the system specified thread length was stated</p>	<p>1 A. Yes.</p> <p>2 Q. "After connection has been fully tightened, one should</p> <p>3 see a maximum of TWO FULL THREADS to ensure a proper</p> <p>4 installation."</p> <p>5 Do you see that?</p> <p>6 A. Yes.</p> <p>7 Q. So what BOSA tells people is length of the coupler is</p> <p>8 2t?</p> <p>9 A. Yes.</p> <p>10 Q. And when you screw in, you can have a degree of</p> <p>11 tolerance, and if you look at the diagram, it could be</p> <p>12 from zero tolerance to maximum tolerance?</p> <p>13 A. Yes.</p> <p>14 Q. But there's no fixed, rigid tolerance. There's no</p> <p>15 fixed, rigid length, because obviously, as we</p> <p>16 established, if it's a tolerance, it could vary?</p> <p>17 A. Okay.</p> <p>18 Q. It could be from zero to one thread?</p> <p>19 A. Yes.</p> <p>20 Q. Or two threads; do you accept that?</p> <p>21 A. Yes.</p> <p>22 Q. Now I am going to show you what some witnesses have</p> <p>23 described --</p> <p>24 A. Can I also point out to you, number 1:</p> <p>25 "After connection has been fully tightened ..."</p>
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<p>1 to be 44; do you see that?</p> <p>2 A. Yes.</p> <p>3 Q. So that lays the groundwork because, as I said earlier,</p> <p>4 everyone has been referring to this type of threaded</p> <p>5 ends as 44 millimetres; right?</p> <p>6 A. Okay.</p> <p>7 Q. We've established that.</p> <p>8 Then let's look at bundle A1 at page 575. This is</p> <p>9 BOSA technical and qualitative assurance manual, and we</p> <p>10 see it set out the type A dimensions.</p> <p>11 A. Yes.</p> <p>12 Q. On a simple basis, 2t is the length of the coupler and t</p> <p>13 is the length of each threaded end?</p> <p>14 A. Yes.</p> <p>15 Q. Do you see that?</p> <p>16 A. Yes.</p> <p>17 Q. So it tells us, what we already know, that if it's</p> <p>18 a 44 millimetre threaded end, so the coupler would be</p> <p>19 88; yes?</p> <p>20 A. Yes.</p> <p>21 Q. Then let's look at BB2, page 1230. This is the same as</p> <p>22 what we have just seen; yes?</p> <p>23 A. Yes.</p> <p>24 Q. There is one more document which Mr Pennicott had shown</p> <p>25 you earlier. It's in bundle C10, page 7016.</p>	<p>1 Q. Yes.</p> <p>2 A. This is a very important point.</p> <p>3 Q. "Fully tightened", but as we have established, whether</p> <p>4 you do it by hand or use a pipe wrench --</p> <p>5 A. Pipe wrench.</p> <p>6 Q. -- there's no assurance or guarantee as to the reason</p> <p>7 why you couldn't go any further. You could well not be</p> <p>8 able to go further because something got stuck or</p> <p>9 because of misalignment; do you accept that?</p> <p>10 A. If it is fully tightened and if there are more than two</p> <p>11 full threads, then definitely it is -- in fact it is not</p> <p>12 good enough. Do you understand what I'm talking about?</p> <p>13 COMMISSIONER HANSFORD: Sorry --</p> <p>14 A. If it is fully tightened, if we have three full threads</p> <p>15 outside, certainly this is not acceptable; am I right?</p> <p>16 MR SHIEH: Yes, you are right, but you are not answering my</p> <p>17 question. My question is the fact that it's fully</p> <p>18 tightened may not mean it has already reached</p> <p>19 a butt-to-butt state, even with the help of a pipe</p> <p>20 wrench?</p> <p>21 A. That's the best we can do on site. That's the best.</p> <p>22 Q. Let me show you some witness evidence. Look at COI</p> <p>23 transcript Day 21, page 17, at line 24. This is the</p> <p>24 evidence of a gentleman called Edward Mok from Leighton.</p> <p>25 At line 20 he said:</p>

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<p>1 "To check the coupler connection, primarily it's 2 a visual inspection. I have to see how many threads are 3 exposed. For normal connection, we shouldn't be able to 4 see any threads. 5 Let me give some background. Why is it I would know 6 what the criteria were? Because, when I first joined in 7 2013, BOSA, the supplier of couplers, provided training. 8 I attended the training. So that's why I know what the 9 criteria were for acceptance. Now, it was mostly visual 10 inspection, that we were told there could be an 11 allowance of one to two threads that may be exposed. So 12 that's about it." 13 So that's what one witness said. He's not a worker 14 who screws in; he inspects. 15 A. Okay. 16 Q. Also an MTRC witness, Mr Kobe Wong, COI 1 transcript, 17 Day 30, page 20, line 18: 18 "... I had seen the installation of the couplers in 19 that area, because for the training given by BOSA to 20 us ... under the QSP, when inspectors went to see -- 21 went to check whether the coupler installation passed or 22 not, we would check whether there was a maximum 23 tolerance of 1 to 1.5 pitch of the thread." 24 So this witness actually said 1 to 1.5 pitch; do you 25 see?</p>	<p>1 what coupler you use, but you should satisfy tension 2 strength, tensile strength, as well as the permanent 3 elongation requirement. 4 Q. Now I'm going to move away from butt-to-butt. I'm going 5 to move on to the question about test requirements for 6 couplers be, whether it's 575 or 529. 7 Now, can I ask you to look at some requirements -- 8 A. Sure. 9 Q. -- as to strength tests. 10 A. Okay. 11 Q. Let's look at bundle H9, page 4044. This is a Buildings 12 Department acceptance letter setting out the 13 requirements for mechanical couplers -- 14 A. Yes. 15 Q. -- without ductility requirement. 16 A. Okay. 17 Q. Without. 18 A. Okay. 19 Q. Can you then turn to the next page, at 4045, at 20 paragraph 4(a): 21 "Strength tests of the mechanical splice should 22 satisfy the following criteria". 23 Permanent elongation should not exceed 0.1mm. 24 Tensile strength should exceed 287.5 for grade 250 and 25 529, that's megapascals, for grade 460.</p>
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<p>1 A. Yes. 2 Q. So there's a witness from Leighton who said visual two 3 threads maximum; MTR, 1 to 1.5, and we have seen the 4 BOSA manual. 5 What I am suggesting to you is this. From the 6 evidence we have seen, from the BOSA literature and from 7 witness testimony as to what BOSA taught the relevant 8 personnel, it's all based on visual inspection of 9 a certain number of threads visible on the outside -- 10 A. Okay. 11 Q. -- with no requirement of butt-to-butt. Do you accept 12 that? 13 A. If they are tightened, this is good enough. If it is 14 tightened -- well, if they tighten the bar into the 15 coupler, and with 1 to 1.5 or 2 pitch, that will be good 16 enough, according to the BOSA specification. 17 Q. Okay. The one to two threads tolerance or try to screw 18 in as best you could may be an admirable aspiration to 19 push it in as far as possible, or even an aspiration or 20 attempt to reach butt-to-butt, but it is not the same as 21 a requirement that it must be butt-to-butt. Do you 22 accept that? 23 A. If it is not butt-to-butt, simply it cannot satisfy the 24 requirement of permanent elongation. That's all. In 25 fact, as far as government is concerned, they don't mind</p>	<p>1 Do you see that? 2 A. Yes. 3 Q. So relevantly for our purposes, if it's non-ductile 4 couplers, the relevant strength to be reached, minimum, 5 is 529 megapascals; correct? 6 A. Okay. 7 Q. If it's couplers without ductility requirement; do you 8 see that? 9 A. Yes. 10 Q. We then turn to couplers with ductility requirement. We 11 look at the same bundle, at 4040. This is mechanical 12 couplers for steel reinforcing bars for ductility 13 requirement. So this sets out the requirement for 14 couplers with ductility requirement. 15 Turn over to page 4042, paragraph 5(b). It sets out 16 the static tension test. Now, the permanent elongation 17 test, it says 0.1 millimetre; you can see that? 18 A. I agree. 19 Q. At (b): 20 "Static tension test: The splicing assemblies must 21 develop in tension the greater of 100 per cent of the 22 tensile strength of the bar ... and 125 per cent of the 23 specified characteristic strength of the bar." 24 Do you see that? 25 A. Yes.</p>

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<p>1 Q. So transposed to our case, it would mean that if it's</p> <p>2 couplers with a ductility requirement, then the strength</p> <p>3 to be achieved would not be 529 but 529 times 1.25; yes?</p> <p>4 A. Yes.</p> <p>5 Q. Which would be 575; correct?</p> <p>6 A. Yes, correct.</p> <p>7 Q. So the difference between a test limit or a minimum</p> <p>8 strength of 529, on the one hand, and 575 on the other,</p> <p>9 is whether the coupler in question is subject to</p> <p>10 a ductility requirement; correct?</p> <p>11 A. I agree.</p> <p>12 Q. Because I think in cross-examination of Mr Southward,</p> <p>13 certain figures were put to him on the basis of a test</p> <p>14 limit of 575, but we have now looked at the documents.</p> <p>15 575 is the limit. The higher strength requirement only</p> <p>16 applies if the couplers are subject to a ductility</p> <p>17 requirement; do you accept that?</p> <p>18 A. I agree.</p> <p>19 MR KHAW: Sorry, just one clarification. I think 575 is not</p> <p>20 529 times 1.25; it's 460 times 1.25.</p> <p>21 MR SHIEH: Sorry, yes.</p> <p>22 A. Yes, that's right.</p> <p>23 Q. Of the characteristic strength, I'm sorry.</p> <p>24 A. That's right.</p> <p>25 Q. But it's the higher --</p>	<p>1 by whatever design drawings he is given --</p> <p>2 A. Okay.</p> <p>3 Q. -- by whatever consultant who is responsible; correct?</p> <p>4 Do you accept that?</p> <p>5 A. I thought the drawing showed ductile couplers,</p> <p>6 am I right, when I looked at the drawings?</p> <p>7 Q. I'm not going to go through the tedious process of going</p> <p>8 through all the drawings, because we can all see the</p> <p>9 drawings by ourselves.</p> <p>10 A. Okay.</p> <p>11 Q. But there are one or two big principles that I want to</p> <p>12 put to you. Within the EWL slab, none of the couplers</p> <p>13 were subject to a ductility requirement, do you accept</p> <p>14 that, within the EWL slab?</p> <p>15 A. You mean according to the drawing or --</p> <p>16 Q. According to the drawings.</p> <p>17 A. According to the drawings, it seems to be the case, yes.</p> <p>18 Q. So if that is the case, it would follow that couplers</p> <p>19 installed in the EWL slab only needed to fulfil the load</p> <p>20 requirement of 529 megapascals?</p> <p>21 A. If there is no requirement for moment redistribution,</p> <p>22 yes, I agree.</p> <p>23 Q. No, if there is no requirement of ductility, then</p> <p>24 according to the documents we have seen from the BD</p> <p>25 perspective, the test to be reached is 529?</p>
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<p>1 A. I know what you mean.</p> <p>2 Q. It's higher than 529 --</p> <p>3 A. I know what you mean anyway.</p> <p>4 Q. Thank you, Mr Khaw, for correcting me.</p> <p>5 Whether or not certain couplers or assemblies are</p> <p>6 subject to a ductility requirement is a different</p> <p>7 question from whether in fact ductile couplers were</p> <p>8 used; correct?</p> <p>9 A. Okay.</p> <p>10 Q. You accept that?</p> <p>11 A. I accept that.</p> <p>12 Q. Because there may or may not be -- there may be no</p> <p>13 requirement but people for whatever reason may choose to</p> <p>14 use ductile couplers; do you accept that?</p> <p>15 A. I agree.</p> <p>16 Q. Whether or not there is a requirement for using ductile</p> <p>17 couplers is a matter pre-determined by looking at the</p> <p>18 drawing, design drawing; correct?</p> <p>19 A. Okay. You can say that. But it depends on the design</p> <p>20 principle. The principle is more important. For</p> <p>21 example, here, if there is no moment redistribution,</p> <p>22 there may not be any requirement for ductile couplers.</p> <p>23 Anyway, I take your point, yes.</p> <p>24 Q. Because when a contractor builds a structure, he has to</p> <p>25 ask himself what are the requirements, and he's dictated</p>	<p>1 A. I agree. When it was originally designed, there was no</p> <p>2 anticipation of moment redistribution in the original</p> <p>3 design. It's only in the updated design that moment</p> <p>4 redistribution was required.</p> <p>5 Q. I was told it's not the case under the 2004 Code.</p> <p>6 A. The 2004 Code, I tell you --</p> <p>7 Q. By reference to which it was designed.</p> <p>8 A. Anyway, that's a long story. According to the 2004</p> <p>9 Code, you are not supposed to have coupler located in</p> <p>10 front of the diaphragm wall. You have to be 1.5d away;</p> <p>11 right? Because of that, that's why if you use the 2004</p> <p>12 Concrete Code, BD always give you an additional letter;</p> <p>13 "If you want to place the coupler within the 1.5d, you</p> <p>14 need ductile coupler." So in the 2013 Code, this has</p> <p>15 been put correct. This is all I want to say. Normally,</p> <p>16 if you use 2004 Code, if you want to put the coupler</p> <p>17 right in the diaphragm wall, BD always give you</p> <p>18 an additional requirement in the form of a letter. But</p> <p>19 nowadays this is formalised in the 2013 Code.</p> <p>20 I can tell you this because I was involved in the</p> <p>21 drafting of the first edition of the code.</p> <p>22 Q. So you are saying -- can I remind you that we are</p> <p>23 talking about suitable measures being proposed for</p> <p>24 area A of EWL slab.</p> <p>25 A. Yes. Okay. You are talking about now?</p>

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<p>1 Q. Yes.</p> <p>2 A. Okay.</p> <p>3 Q. Because the only suitable measures recommended,</p> <p>4 resulting from problems with couplers, are confined to</p> <p>5 EWL slab area A?</p> <p>6 A. Agree. I totally agree.</p> <p>7 Q. You say BD always gives you an additional letter that if</p> <p>8 you want to place whatever, you need ductile coupler.</p> <p>9 A. They always give you an additional letter.</p> <p>10 Q. So it is all dependent upon -- so whether there is</p> <p>11 ductility requirement depends on whether there is or is</p> <p>12 not this BD letter saying you should use ductile</p> <p>13 coupler?</p> <p>14 A. Because BD will look at the location of your coupler.</p> <p>15 If it is placed within the 1.5d area, then they give you</p> <p>16 an additional letter. This is the practice in</p> <p>17 Hong Kong. This is the practice in Hong Kong.</p> <p>18 Q. So if BD has not written such a letter, then there's no</p> <p>19 such requirement?</p> <p>20 A. Agree.</p> <p>21 Q. I probably don't need to take you to the underlying</p> <p>22 opening-up results, but do you accept that adopting</p> <p>23 529 megapascals, that is the no ductility requirement</p> <p>24 limit --</p> <p>25 A. Okay.</p>	<p>1 that you have raised it.</p> <p>2 A. Yes.</p> <p>3 Q. Can I show you what Prof McQuillan said in COI 1,</p> <p>4 transcript Day 44, page 106. That's Prof McQuillan</p> <p>5 giving evidence, commenting on the relevance of</p> <p>6 elongation tests.</p> <p>7 A. Okay.</p> <p>8 Q. Starting from line 11. I don't know whether you've read</p> <p>9 it, but --</p> <p>10 A. I did not.</p> <p>11 Q. Let's have a look at what Prof McQuillan said. It's</p> <p>12 Day 44, page 106, line 22. This is what Prof McQuillan</p> <p>13 said:</p> <p>14 "The point I'm simply making is that to perform that</p> <p>15 test, you stress the bar to a fairly high level, and</p> <p>16 because of the utilisation values in this job, the bars</p> <p>17 will never be subjected to that level of stress, so they</p> <p>18 are never going to strain to 0.1 of a millimetre."</p> <p>19 Then he moved on:</p> <p>20 "... Dr Glover has explained that the tests are done</p> <p>21 in the open. When the couplers are encapsulated in</p> <p>22 concrete, they don't actually behave that way, but even</p> <p>23 if 0.1 millimetre were to occur, that cracking would be</p> <p>24 evident, and you've heard from the other experts that</p> <p>25 they have inspected the structure ... I have seen no</p>
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<p>1 Q. -- 529 megapascals, coupler assemblies with six threads</p> <p>2 passed this test?</p> <p>3 A. I know.</p> <p>4 Q. You know?</p> <p>5 A. I know. You don't have to take me to it. I know.</p> <p>6 Q. Whereas even if you were to adopt 575 megapascals as the</p> <p>7 test limit, all six thread assemblies, except one,</p> <p>8 passed the 575 megapascal test.</p> <p>9 A. I know. You don't have to show me. I know that.</p> <p>10 Q. So do you accept that on a 529 megapascal basis, six</p> <p>11 thread coupler assemblies were enough for the purpose of</p> <p>12 carrying load, because it passed --</p> <p>13 A. Strength-wise.</p> <p>14 Q. -- strength-wise; you accept that, yes?</p> <p>15 A. Yes.</p> <p>16 Q. You have no dispute with that?</p> <p>17 A. No dispute.</p> <p>18 Q. Can I now then move on to -- in which case, at the</p> <p>19 stage 3 analysis, structural analysis, there's no basis</p> <p>20 to disregard partially engaged coupler assemblies as if</p> <p>21 they have no contribution to load bearing; correct?</p> <p>22 A. But as I said in my report, we want strength as well as</p> <p>23 permanent elongation, and this is for durability</p> <p>24 purposes or serviceability requirement.</p> <p>25 Q. Can I deal with permanent elongation immediately, now</p>	<p>1 evidence ..."</p> <p>2 If you move on:</p> <p>3 "... if cracking did occur, it's in a dry</p> <p>4 environment, and so it doesn't become a durability or a</p> <p>5 serviceability issue. Might I say, every structure,</p> <p>6 every house has cracks. It doesn't mean that they give</p> <p>7 [rise to any] concern whatsoever.</p> <p>8 So I'm suggesting that elongation testing and</p> <p>9 partially threaded coupler assemblies is not really</p> <p>10 relevant in context."</p> <p>11 Have you seen this?</p> <p>12 A. Yes.</p> <p>13 Q. So I'm suggesting to you that because of the reason</p> <p>14 given by Prof McQuillan, permanent elongation test is</p> <p>15 not relevant in the context of where these couplers are</p> <p>16 going to be encapsulated.</p> <p>17 A. I disagree. I disagree.</p> <p>18 Q. Because?</p> <p>19 A. First of all, even at very low stress, the coupler has</p> <p>20 already got the elongation because of the slack we are</p> <p>21 talking about, and this elongation is sufficient to</p> <p>22 crack the concrete. So I cannot understand why</p> <p>23 Dr Glover said if they are enclosed in the concrete</p> <p>24 nothing would happen. On the contrary, because they are</p> <p>25 enclosed in the concrete, the elongation in the coupler</p>

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<p>1 will cause a lot of cracks in the concrete. That's what 2 we are worrying about. And the cracks will accumulate. 3 They will not go away, they will accumulate for the rest 4 of the life of the structure, because this sort of 5 elongation we are talking about, they occur at very low 6 stress level. They are not occurring at the 0.6fy 7 level, they are occurring at the low level, because they 8 are slack of fit. 9 Q. Now, there's one more element in play and let me try to 10 describe it verbally. It's tempting to use gestures but 11 in order to make it, you know, on record, let me try to 12 explain the matter verbally. 13 A. Yes. 14 Q. These rebars are very long. 15 A. Okay. 16 Q. You accept that? 17 A. I accept that. 18 Q. Each rebar is I think 6 metres long? 19 A. Yes. 20 Q. Plus lapping, it could be obviously longer than 21 6 metres? 22 A. I agree. 23 Q. If they are attached on one end onto a coupler -- 24 A. Agree. 25 Q. -- the risk of an incompletely attached coupler assembly</p>	<p>1 So I disagree with what the professor said here. 2 Q. But this scenario is what I am putting to you, because 3 elongation presupposes ease of movement sideways, 4 laterally; right? 5 A. Along the bar. 6 Q. Along the bar. Basically, there's a tendency to be able 7 to pull it out because if it's not locked properly, you 8 would be able to pull it out easily, relatively easily; 9 right? 10 A. They will not pull out but just -- 11 Q. There will be movement, sorry, slight movement, if it's 12 not locked properly; correct? That's the idea behind 13 it? 14 A. And the coupler is located at the joint; right? So that 15 means, at that particular joint, there would be a lot of 16 deformation because of this movement of the coupler, and 17 the deformation will cause cracks at the joint. This is 18 what we are worried about. 19 Q. The point I'm putting to you is there won't be that kind 20 of slight sideways movement -- 21 A. What do you mean by "sideways"? Longitudinal movement? 22 Q. Longitudinal movement, yes. There won't be that slight 23 longitudinal movement in the context of the present 24 case -- 25 A. Why?</p>
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<p>1 would be there would be lateral movement. If it's not 2 locked in properly, there will be movements laterally; 3 right? 4 A. Yes. 5 Q. Moving in and out. But in reality, imagine one end 6 being screwed in to the extent of 44/48 millimetres, but 7 on the other hand you have a gigantic raft of mass, 8 6 millimetres worth of metal or even more, pressing 9 down, there is simply not going to be that ease of 10 movement for an incompletely attached coupler connection 11 to laterally move around -- 12 A. I disagree with you. 13 Q. You disagree? 14 A. Because now you have the reinforcing bar inside. 15 Suppose there's no coupler. You load the beam, there 16 would be tension in the bar, and the bar will elongate, 17 and when it elongates, it will cause cracks in the 18 concrete. Some cracks in the concrete anyway. Suppose 19 you have a coupler inside the beam, in the bar. When 20 you load the beam again, a lot more deformation will 21 occur at the location of the coupler, as in our case 22 here, and this elongation will cause a lot of cracks at 23 that particular location with the coupler. And this 24 sort of crack will accumulate for the rest of the life 25 of the structure.</p>	<p>1 Q. -- where you have one end screwed in to the extent of 2 48 millimetres, let's say, but the other end with 3 a 6 metre long bar pressing downwards? 4 A. What do you mean by pressing downwards? 5 Q. The weight of it plus the concrete around it. 6 A. No, no, no. You totally misunderstand. It's 7 a reinforced concrete structure, at the joint, when you 8 apply bending moment to it -- we are talking about 9 bending moment to the joint -- the bar will be subjected 10 to tension, and that tension will try to move the bar 11 out of the coupler, and that means at that particular 12 joint there are a lot of tension, tensile strain and 13 stress, in the joint, causing cracks in the joint. This 14 is what I'm worried about in the long term. 15 Q. If there are to be cracks, the cracks would have shown 16 themselves already; correct? 17 A. Actually, you cannot see it now because it's inside the 18 concrete at the moment, they are inside the concrete at 19 the moment. 20 Q. What is there to dictate that the cracks must appear 21 inside the concrete? 22 A. Because they are placed inside the concrete. The 23 couplers are placed inside the concrete at the moment. 24 Q. They wouldn't manifest themselves by -- 25 A. Eventually, yes, but not now.</p>

Page 161	<p>1 Q. Let me just test you further about the classification of</p> <p>2 the environment inside that concrete structure.</p> <p>3 A. Okay.</p> <p>4 Q. 1, 2 or 3. Mr Pennicott debated this with you. I'm not</p> <p>5 going to revisit the definition of conditions 1, 2</p> <p>6 and 3, but can I just take you to that drawing that you</p> <p>7 have looked at with Mr Pennicott.</p> <p>8 A. Okay.</p> <p>9 Q. In the OU bundle, page 8590.</p> <p>10 A. Yes.</p> <p>11 Q. Can you zoom in. Just now, you looked at this drawing</p> <p>12 with Mr Pennicott; remember?</p> <p>13 A. Yes.</p> <p>14 Q. You see the EWL slab?</p> <p>15 A. Yes.</p> <p>16 Q. The green, and you see capping beams?</p> <p>17 A. Yes.</p> <p>18 Q. You see that arrow pointing all the way towards the</p> <p>19 left?</p> <p>20 A. Yes.</p> <p>21 Q. That is where the couplers were located; right?</p> <p>22 A. Yes.</p> <p>23 Q. But you can see from this drawing that the EWL slab was</p> <p>24 above sea level?</p> <p>25 A. Yes, okay. Above, you should be saying above the</p>	Page 163	<p>1 level as the groundwater. They were above the</p> <p>2 groundwater.</p> <p>3 A. You have fill, and the fill is wet just below the</p> <p>4 capping beam. That means the environment is good enough</p> <p>5 to cause corrosion of the reinforcement inside the slab</p> <p>6 in the long term.</p> <p>7 Q. But there's no air inside. Where is the air?</p> <p>8 A. Of course there is air. How come there's no air?</p> <p>9 Of course there is air. What do you mean by "no air"?</p> <p>10 What do you mean by "no air"?</p> <p>11 Q. That's soil inside.</p> <p>12 A. Soil has air.</p> <p>13 Q. Compacted. It's compacted soil.</p> <p>14 A. Even though it's compacted soil -- well, if that's the</p> <p>15 case, there's no need to have thick concrete for the</p> <p>16 diaphragm wall or the concrete cover, nor thick concrete</p> <p>17 cover for the pile.</p> <p>18 Q. Can I look at the definition of condition 1 with you.</p> <p>19 A. Okay.</p> <p>20 Q. Look at bundle H9 at 2857. This is the 2004 version of</p> <p>21 the code.</p> <p>22 A. Yes.</p> <p>23 Q. You have said that you would have classified that area</p> <p>24 as between 2 and 3?</p> <p>25 A. Yes.</p>
Page 162	<p>1 groundwater table, rather than sea level.</p> <p>2 Q. Above the ground, yes.</p> <p>3 A. Groundwater level.</p> <p>4 Q. Above groundwater level.</p> <p>5 A. Okay.</p> <p>6 Q. Just now, when you gave evidence, you talked about the</p> <p>7 D-wall inside would be wet and all the rest of it, but</p> <p>8 if we are talking about the EWL slab, it's above</p> <p>9 groundwater level, so where would -- there's no way in</p> <p>10 which the wetness could have got to the EWL slab.</p> <p>11 A. Even if the wetness goes into the fill below, it can</p> <p>12 still affect the structure. When we talk about the</p> <p>13 so-called environment, we are talking about the effect</p> <p>14 of environment on the concrete and the reinforcing bar</p> <p>15 inside the concrete. This is what we are talking about.</p> <p>16 The diaphragm wall itself is not continuous. It's</p> <p>17 discrete. Water and seepage and moisture can go inside</p> <p>18 the building through the diaphragm wall joint; right?</p> <p>19 And if the water -- well, even though it is clean water,</p> <p>20 groundwater, it still affects the quality -- the</p> <p>21 durability of the concrete in the long term. They are</p> <p>22 permanently underwater. The diaphragm wall is</p> <p>23 permanently underwater.</p> <p>24 Q. I ask one more time: the EWL slab and in particular the</p> <p>25 capping beams inside the EWL slab are not on the same</p>	Page 164	<p>1 Q. 2 would be internal concrete surfaces exposed to high</p> <p>2 humidity, for example bathrooms and kitchens.</p> <p>3 A. Yes.</p> <p>4 Q. So that gives you an example of the kind of exposure --</p> <p>5 A. Yes.</p> <p>6 Q. -- needed. But on the drawing that we have seen, you</p> <p>7 are seriously suggesting that the EWL slab face is</p> <p>8 similar in its exposure to humidity --</p> <p>9 A. On the outside. On the outside I'm talking about.</p> <p>10 Q. EWL slab, we are talking about the EWL slab.</p> <p>11 A. Yes, on the outside.</p> <p>12 Q. That's what you say.</p> <p>13 A. On the joint. The side in contact with the soil as far</p> <p>14 as the diaphragm wall is concerned has all the cracks,</p> <p>15 as demonstrated by the finite element model.</p> <p>16 Q. But the suitable measures are conducted on the inside.</p> <p>17 A. It's conducted on the inside in order to reduce the</p> <p>18 stress level in the joint, at the joint, because in the</p> <p>19 long term we have to consider whether the reinforcement</p> <p>20 will be corroded in the long term. I'm not talking</p> <p>21 about five years, ten years. I'm talking about the long</p> <p>22 term. If the reinforcement is corroded in the long</p> <p>23 term, the reinforcement will expand and cause spalling</p> <p>24 of the concrete. And you cannot inspect the outside of</p> <p>25 the diaphragm wall. You cannot inspect, nor can you</p>

Page 165	<p>1 inspect the top of the diaphragm wall -- you cannot</p> <p>2 inspect them, because on the inside they are always in</p> <p>3 compression. Even if there's cracks, you can't see it,</p> <p>4 because it's in -- this is the joint (demonstrating with</p> <p>5 hands)), we try to bend it this way, on the outside we</p> <p>6 have all the cracks.</p> <p>7 Draw? Okay.</p> <p>8 (Drawing on the whiteboard) This the joint. You are</p> <p>9 trying to bend the joint this way. We have all the</p> <p>10 cracks on the outside, but compression here. On the</p> <p>11 inside, there are compression.</p> <p>12 So you are telling me that to inspect the crack on</p> <p>13 the inside, you cannot see it. Of course you cannot see</p> <p>14 it. But if you are on the outside, you can see all the</p> <p>15 cracks, but you cannot see it here, because it's soil,</p> <p>16 and here (indicating), it's covered by the track</p> <p>17 concrete.</p> <p>18 So, in the long term, there's a worry, because as</p> <p>19 demonstrated by all the finite element models, by OAP</p> <p>20 and also by Atkins, we have all the cracks on the</p> <p>21 outside, not inside, and if you have all the cracks on</p> <p>22 the outside, we have durability problem in the long</p> <p>23 term.</p> <p>24 I can sit down.</p> <p>25 Q. Coming back to the question -- yes, please be seated --</p>	Page 167	<p>1 "... there comes a point when all of a sudden it</p> <p>2 snaps. That's called fatigue failure. It occurs when</p> <p>3 the specimen is subjected to first of all compression</p> <p>4 and then tension, compression/tension, so it's not that</p> <p>5 the stress is fluctuating, it's actually reversing.</p> <p>6 Again, it needs to be highlighted that for the</p> <p>7 3 metre thick slab ... I'm just under 2 metres tall, so</p> <p>8 put another half of me on top, that's 3 metres. It's a</p> <p>9 huge, enormous slab. To experience that sort of load</p> <p>10 reversal, that huge, thick slab has to bend upwards</p> <p>11 against its own self-weight, and that simply will never</p> <p>12 happen."</p> <p>13 Now, you've seen how Prof McQuillan describes this</p> <p>14 concept about cyclic tension test.</p> <p>15 A. Yes.</p> <p>16 Q. I am suggesting to you that on the basis of what</p> <p>17 Prof McQuillan has said, this test is irrelevant in the</p> <p>18 context of the structure that we are talking about here?</p> <p>19 A. I'm not worried about cyclic test either.</p> <p>20 Q. You are not worried about that?</p> <p>21 A. I'm not worried about that. I'm only worried about the</p> <p>22 permanent elongation test.</p> <p>23 Q. Okay. Can I then now move on to the question of shear</p> <p>24 links.</p> <p>25 A. Okay.</p>
Page 166	<p>1 of strength, do you accept, having seen all the</p> <p>2 consultants' reports and calculations, that the</p> <p>3 structure is typically utilised to the extent of only</p> <p>4 about 50 per cent?</p> <p>5 A. In general, yes. In general.</p> <p>6 Q. Cyclic tension tests. If I ask you to look at what</p> <p>7 Prof McQuillan said on Day 44 of COI 1, page 107.</p> <p>8 Day 44, line 21. He said:</p> <p>9 "That brings us to the issue of the cyclic loading</p> <p>10 test, and I think there has been a good deal of</p> <p>11 misunderstanding ... It's not a matter of subjecting the</p> <p>12 coupler assembly to a fluctuating load, as occurs with</p> <p>13 any structure and which will occur with the passage of</p> <p>14 trains. Rather, it's very important to point out that</p> <p>15 it involves load reversal. So it's not a matter of the</p> <p>16 stress going from A to B and up to C and down to A</p> <p>17 again. What we are talking about here is the bar is</p> <p>18 being subjected to alternate cycles of compression and</p> <p>19 then tension. So you are pulling the bar, then you are</p> <p>20 squeezing it, and then you are pulling it again and then</p> <p>21 squeezing it again, and then you take it to destruction.</p> <p>22 So, you know ... as I understand it, this is a test</p> <p>23 against fatigue failure."</p> <p>24 Then Prof McQuillan talked about a wire coat hanger,</p> <p>25 the example, and bending it back and forth:</p>	Page 168	<p>1 Q. You would accept that the opening-up and the inspections</p> <p>2 did show the presence of shear links?</p> <p>3 A. Whose? You mean Leighton's or the MTRC's?</p> <p>4 Q. MTR's and Leighton's. Both showed the presence of shear</p> <p>5 links in the opening-up exercise?</p> <p>6 A. Anyway, 16 of the 40 openings showed no shear links.</p> <p>7 Q. 16?</p> <p>8 A. 16, in MTR's investigation, they have carried out</p> <p>9 altogether 40 openings, and of the 40 openings, 16 of</p> <p>10 them show no shear links; okay?</p> <p>11 Q. Yes. The others do?</p> <p>12 A. The others do. But some of them the space is too wide,</p> <p>13 some of them the diameter is too small, some of them --</p> <p>14 but I'm not worried about the anchorage thing either.</p> <p>15 I agree with Mr Southward there will be strength in the</p> <p>16 shear link.</p> <p>17 Q. Now, we have seen a number of drawings and photos over</p> <p>18 the course of Friday and today.</p> <p>19 A. Yes.</p> <p>20 Q. Before we look at those drawings, can I just put to you</p> <p>21 a basic proposition, and that is opening up merely</p> <p>22 an L shape as opposed to a 1 metre by 1 metre square</p> <p>23 shape is necessarily exposing less; correct? If you</p> <p>24 open up 1 metre times 1 metre, obviously you reveal more</p> <p>25 than merely an L shape; okay? You accept that?</p>

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<p>1 A. Yes.</p> <p>2 Q. But what you are saying is that opening it in an L shape</p> <p>3 of the dimensions that you have described would be</p> <p>4 enough to expose shear links if they were there?</p> <p>5 A. Okay.</p> <p>6 Q. That's what you say; right?</p> <p>7 A. That's what I say. But of course -- let me put this</p> <p>8 way -- it will be better if it is 1 metre by 1 metre,</p> <p>9 but this is something done. There's nothing we can do</p> <p>10 about that. But even based on 1 metre by 1 metre</p> <p>11 L shape, if the shear links were there, we can still see</p> <p>12 it.</p> <p>13 Q. Mm-hmm. Following on your answer, if the shear links</p> <p>14 were there, you would see it?</p> <p>15 A. We would see it.</p> <p>16 Q. But that is at the mercy of the precision of where the</p> <p>17 shear links were placed, because you cut the L shape in</p> <p>18 a particular way, it's based on a particular assumption</p> <p>19 as to where the shear links were actually located;</p> <p>20 correct?</p> <p>21 A. But the shear link --</p> <p>22 Q. If there's a tolerance, an imprecision in locating the</p> <p>23 shear links, there would be a risk of missing them. As</p> <p>24 a big-picture observation, do you accept that?</p> <p>25 A. Yes and no, because the spacing of the shear link is</p>	<p>1 your own report, appendix JL1-E at page 4. This is</p> <p>2 a photograph of an MTR --</p> <p>3 A. Yes.</p> <p>4 Q. -- opening-up --</p> <p>5 A. Yes.</p> <p>6 Q. -- in an L shape, and this was an attempt to</p> <p>7 demonstrate -- or this is relied upon as showing that</p> <p>8 there was no shear links on this opening-up?</p> <p>9 A. Yes.</p> <p>10 Q. But, you see, the focus of this photograph was on the</p> <p>11 rebars on what I would call the top layer.</p> <p>12 A. Okay. Yes.</p> <p>13 Q. If, as a matter of fact, the shear links were not hooked</p> <p>14 onto the rebars of the top layer but on the bottom</p> <p>15 layer, then this method of opening-up would have missed</p> <p>16 it, or there's a possibility or likelihood that this</p> <p>17 form of limited opening-up would have missed the shear</p> <p>18 links on the layer below; do you accept that?</p> <p>19 A. It's impossible to open up because -- it's nothing to do</p> <p>20 with the size. It's the depth you were talking about;</p> <p>21 am I right? You want -- you are not -- are you</p> <p>22 concerned about the size or the depth?</p> <p>23 Q. The size.</p> <p>24 A. As far as size is concerned, I think this is good</p> <p>25 enough. If you are worried about the depth, maybe I can</p>
Page 170	Page 172
<p>1 150 millimetres. We are bound to see some.</p> <p>2 Q. I was told it is 300.</p> <p>3 A. Well, it depends. 75, 150 to 300. There were three</p> <p>4 types. So, if it is 150, we are bound to see some of</p> <p>5 them. If it is 75, we are also bound to see some of</p> <p>6 them. But if 300, I think we should still be able to</p> <p>7 see some of them. But don't forget that on the</p> <p>8 honeycombed underside, on the honeycombed area, there's</p> <p>9 a big area we did not see any shear links, as far as the</p> <p>10 photograph is concerned. So there's a concern that</p> <p>11 there's no shear link in the right position.</p> <p>12 Q. Can I take you to your slide number 33.</p> <p>13 A. Yes.</p> <p>14 Q. The red shape is what was shown in Mr Southward's slides</p> <p>15 or report.</p> <p>16 A. This opening is the Leighton opening. This is not the</p> <p>17 MTR opening; right? First of all. Leighton only do one</p> <p>18 opening and that's the only one. Mr Southward tried to</p> <p>19 show, using the red line, that it's possible to miss the</p> <p>20 shear links, and I tried my best to show that if there</p> <p>21 are shear links there, you can see them. That's all.</p> <p>22 Q. So this is an example where shear links were there and</p> <p>23 where you were able to see the shear links; yes?</p> <p>24 A. Yes.</p> <p>25 Q. Okay. But can I then ask you to look at your report,</p>	<p>1 understand, because I think Mr Southward said the depth</p> <p>2 is not deep enough to expose the shear links;</p> <p>3 am I right?</p> <p>4 Q. Well, let's leave the depth to one side, because the</p> <p>5 depth would show you what's there at the next layer</p> <p>6 down. But the width of the vertical column, if you make</p> <p>7 it wider, you could be able to see what, for example, is</p> <p>8 to the right of the second vertical bar on the</p> <p>9 photograph.</p> <p>10 Do you follow what I'm saying?</p> <p>11 A. I follow what you are talking about. This is --</p> <p>12 Q. There are two vertical bars facing us, but to the right</p> <p>13 of the bar on the right-hand side or to the left of the</p> <p>14 bar on the left-hand side, there could very well be</p> <p>15 shear links attached to the rebars in the layer below.</p> <p>16 A. If it was hooked onto the main bar, we should see it;</p> <p>17 right?</p> <p>18 Q. The main bar meaning the top two bars?</p> <p>19 A. Yes, because they are supposed to be hooked onto the</p> <p>20 main bar.</p> <p>21 Q. You are assuming, as a matter of fact, that if shear</p> <p>22 links are attached at all, they would be attached to the</p> <p>23 top, what you call the main bar?</p> <p>24 A. It's supposed to be, anyway.</p> <p>25 Q. We will deal with it, but if the hooks are in fact</p>

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<p>1 hooked onto the layer of bars below?</p> <p>2 A. "Below" means the next layer?</p> <p>3 Q. Next layer, yes -- then this form of opening-up stands</p> <p>4 a risk of not revealing them; do you accept that?</p> <p>5 A. Well, possibility, but unlikely, because the whole</p> <p>6 purpose of the investigation is to find the shear links.</p> <p>7 That's the purpose of this. Of course, I was not</p> <p>8 involved, but this is done by the MTR. They try their</p> <p>9 best to locate the shear links, and if you look at the</p> <p>10 comments, the third column says, "Is shear links found",</p> <p>11 they said "No", and I have to accept the investigation</p> <p>12 by MTR. I don't think I can doubt their investigation.</p> <p>13 Q. The reason why the shear links could not be hooked onto</p> <p>14 what you call the main bar is because there is a cover</p> <p>15 zone on top of that which had to be filled with</p> <p>16 concrete, a cover zone.</p> <p>17 A. I don't understand. Why?</p> <p>18 Q. The shear links cannot be hooked onto the main bar on</p> <p>19 top, because there is a requirement of a cover zone on</p> <p>20 top of the main bar?</p> <p>21 A. No, no, no. In all construction work, the shear link</p> <p>22 must be hooked onto the main bar.</p> <p>23 Q. Not in a slab, I was told.</p> <p>24 A. This is another reason why I have a bit of concern. If</p> <p>25 the shear link was tied onto the main bar, we should be</p>	<p>1 but onto the bar in the next layer, as you can see.</p> <p>2 A. Yes, this is true.</p> <p>3 Q. Never mind whether or not it is correct practice or good</p> <p>4 practice or condemnable practice, or you say you would</p> <p>5 not condemn it, as a matter of fact you accept that this</p> <p>6 phenomenon of shear links being attached not on the top</p> <p>7 main bar but on the bar --</p> <p>8 A. Okay.</p> <p>9 Q. -- on the underneath layer did exist; do you accept</p> <p>10 that?</p> <p>11 A. Yes, I accept that.</p> <p>12 MR CHEUK: I stand to be corrected, but according to</p> <p>13 Dr Lau's report, if we look at what we call</p> <p>14 exhibit JL1-E3 -- yes -- we see actually the opening,</p> <p>15 according to my understanding, the title line says</p> <p>16 "Opening at the slab soffit", which means we are looking</p> <p>17 towards above rather than below, and that's why all the</p> <p>18 confusion arises.</p> <p>19 A. I think you now understand, because you are looking up</p> <p>20 on the soffit.</p> <p>21 COMMISSIONER HANSFORD: Thank you. I had understood that</p> <p>22 Thanks. That's helpful.</p> <p>23 MR SHIEH: It may change the language a bit because we are</p> <p>24 no longer talking about whether it's top or whatever,</p> <p>25 but my point --</p>
Page 174	Page 176
<p>1 able to see the shear link. It was not -- so I don't</p> <p>2 understand why the shear link disappeared.</p> <p>3 Q. Can we look at your slide 33.</p> <p>4 A. Okay. This investigation was done -- if you look at</p> <p>5 this, this is done by Leighton; right?</p> <p>6 Q. Yes, but those shear links were hooked onto the layer</p> <p>7 below, not on the top layer.</p> <p>8 A. I can accept that. In fact, they should be hooked onto</p> <p>9 the top layer, but even if it is not hooked on the top</p> <p>10 layer, I can still accept it. I will not condemn it.</p> <p>11 It's not good, but still I will not condemn it.</p> <p>12 But the thing is, this is not a good practice.</p> <p>13 First of all, the hook should be hooked onto the main</p> <p>14 bar. That means it should be turned 90 degrees, but in</p> <p>15 this case it is not. In many situations, when I look at</p> <p>16 the shear links, the reason why they can move around is</p> <p>17 they were not tied by steel wires onto the bar. You can</p> <p>18 look at it. There's no steel wires.</p> <p>19 Q. You have raised two distinct issues. One is whether</p> <p>20 they are tied or not tied. Let's leave that to one side</p> <p>21 for the time being; right?</p> <p>22 A. Okay.</p> <p>23 Q. But you said that on the basis of what you see in your</p> <p>24 slide 33, as you can see, as a matter of fact, shear</p> <p>25 links were indeed hooked not onto the main bar on top</p>	<p>1 COMMISSIONER HANSFORD: All we are saying is: is it tied on</p> <p>2 the outer bar or the next one in?</p> <p>3 MR SHIEH: Correct. Is it tied to the first bar you see or</p> <p>4 the bar in the level after that first layer?</p> <p>5 COMMISSIONER HANSFORD: Yes, and I recognise that in all</p> <p>6 these, we are looking upwards from the soffit.</p> <p>7 MR SHIEH: So when I say below, it's actually above.</p> <p>8 COMMISSIONER HANSFORD: Understood.</p> <p>9 A. I understand. Don't worry.</p> <p>10 MR SHIEH: But leaving aside whether or not it is called</p> <p>11 correct or good practice to hook the shear links onto</p> <p>12 the very first main bar or the next layer, as a matter</p> <p>13 of fact we could see that it happened that these shear</p> <p>14 links were actually not hooked onto the first layer but</p> <p>15 the next layer?</p> <p>16 A. I agree.</p> <p>17 Q. You agree that? Therefore, given this phenomenon, to</p> <p>18 shape the opening in the L shape that we have seen</p> <p>19 stands the risk of missing out on shear links that were</p> <p>20 hooked on the next layer; do you accept that?</p> <p>21 A. That's a possibility, yes.</p> <p>22 Q. Thank you.</p> <p>23 A. That's a possibility. But the conclusion from MTR is</p> <p>24 not based on one or two photographs. They are based on</p> <p>25 40 openings, and quite a lot of the openings are in the</p>

<p style="text-align: right;">Page 177</p> <p>1 honeycomb area, and they are much bigger than 1 metre by 2 1 metre, and they are much deeper. Some of them are 3 358, more than 300 millimetre deep into the concrete. 4 They did not find any shear links. 5 So it is prudent to assume that they are not there 6 in the assessment, and this is the conclusion by MTR; 7 it's not the conclusion by me, it's the conclusion by 8 MTR. 9 MR SHIEH: There are one or two small points that I may wish 10 to pick up, but given the time, perhaps it would be 11 an appropriate time to take the break. 12 CHAIRMAN: Do you have the one or two small points ready or 13 would you like to think about them? 14 MR SHIEH: I need to think about them and maybe I don't need 15 to ask them and maybe to ask them now would be 16 counter-productive. 17 CHAIRMAN: Very good. 18 Doctor, we are sorry we are going to have to ask you 19 to come back tomorrow morning but we will have to do 20 that. 21 WITNESS: No problem. I'm happy to help, if I can. 22 CHAIRMAN: So we will adjourn until tomorrow morning at 23 10 am. Thank you. 24 (5.05 pm) 25 (The hearing adjourned until 10.00 am the following day)</p>																																																	
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