IN THE HIGH COURT OF THE REPUBLIC OF SINGAPORE

[1994] SGHC 141

S704/1991

Between

Transit-Mixed Concrete Pte Ltd

… *Plaintiff*

And

Primeview Enterprise Pte Ltd

… *Defendant*

GROUNDS OF DECISION

Version No 1: 29 Oct 2026 (23:45 hrs)

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Transit-Mixed Concrete Pte Ltd v Primeview Enterprise Pte Ltd

[1994] SGHC 141

S704/1991
Kan Ting Chiu J
13 May 1994

1 **Judgment:**

2 Coram: Kan Ting Chiu J

3 JUDGMENT

4 The Plaintiff's claim is for $52,686.75 being the balance of the price of ready-mixed concrete supplied by it to the Defendant for the construction of a factory at Senoko Loop. The Defendant admitted buying the concrete. It denied liability to pay the sum claimed because it alleged that some of the concrete supplied was of inferior quality. It said that the defective concrete was used to cast some columns which had to be rectified at a cost of $16,971. The Defendant raised a set off and counter-claim against the Plaintiff for that sum.

5 Agreed facts There is a sub-stratum of agreed facts. The characteristic strength of the concrete in question was specified at 30N/mm2. The concrete was delivered to the work site between 19 October 1990 and 11 February 1991. Random cube tests carried out of the concrete delivered showed that all the

cubes tested exceeded the specified strength.1 On 5 Dec 1990, two truckloads of concrete were delivered on site at 9.55am and 11.35am.2 Cube tests were carried out of the first load, and which was found to be satisfactory. The second load was not tested, and this was the centre of the dispute between the parties.

6 The dispute On 18 December 1990, the consultant engineer of the project Mr Liew Kian Heng wrote to Mr Johnny Sng Yew Huat, the Defendant's project manager stating - Upon inspecting of the above on 16 December 1990 after stripping the formwork, we observed some irregularities on the column surfaces. Surfaces were found to be devoid of sufficient cement and were porous. The exposed surfaces revealed very definite separation of two separate pours. In view of this which may have effect on the quality of concrete, you shall submit a report on the following:- (a) Information on the fresh concrete used - from the supplier, (b) conditions of concreting, (c) verification on the strength and durability of the concrete by proper tests, (d) Any other information to justify for the acceptance of this work.3

7 On 21 December 1990 Mr Johnny Sng wrote to the Plaintiff saying - We spoke recently about the inspection carried out by the consultant the irregularities of concrete especially at top parts of columns situated at office 1st storey. Therefore, we would appreciate if tests can be conducted to justify the quality of concrete.4

8 When the Plaintiff failed to respond, the Defendant instructed CAST Laboratories Pte Ltd to undertake core tests and Ultrasonic Pulse Velocity (UPV) tests on the ground beams and columns constructed. On the 9 January 1991, CAST Laboratories conducted core tests on three ground beams and UPV tests on seven columns.5 Further core tests and UPV tests were conducted on three ground beams and three columns on 1 March 1991.6 The relevant results

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of the tests were that the in- situ cube strength of the concrete in the three columns were - Column 10 D - 21.5N/mm2, Column 11 B - 16N/mm2, Column 10 B - 9.5N/mm2.

9 The tests were carried out on the upper portions of the columns.7 CAST Laboratories added a rider in their report that "Estimated in-situ cube strength cannot be equated to standard cube strength"8. This is an important factor to keep in mind because the Plaintiff's obligation was only to deliver and discharge concrete of the specified strength to the Defendant. The placement of the concrete was the responsibility of the Defendant, and it was agreed that the in-situ strength (the strength of the concrete in a structure) would be lower than its specified strength, and the reduction in strength would be greater if the concrete is not properly handled. All the technical witnesses agreed that insufficient core tests were done for a proper co-relation of the UPV and core test results to be made.

10 The consultant engineer's complaint The Defendant took the position that the consultant engineer Mr Liew Kian Heng had complained of poor concrete at the top of the columns. This was continued by Mr Sng and reflected in his letter of 21 December 19909 and the instructions to CAST Laboratories to carry out tests on the upper portions of the columns. The focus on the upper portions of the columns was important in this dispute because the Defendant's case was that the first load of satisfactory concrete was used to cast to lower portions of fourteen columns and the second load of disputed quality was used to cast the top portions of those columns.

11 Only one column, column 11B, was available for inspection by the Plaintiff's experts and this was the only column to have been photographed. The photographs taken by the Plaintiff's experts showed that rough concrete at the

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bottom as well as top portions of the column.10 The Plaintiff contended that there were doubts over the top as well as the bottom portions of the columns. This matter was clarified by the consultant engineer Liew Kian Heng. He said that when he inspected the columns after the formwork was stripped, he found that the surface was devoid of sufficient cement, that there were gaps in between, and he saw on one column a separation line of two pours.11 He added that he did not inform the Defendant that only the upper portions of the columns were devoid of concrete12 that he did not mark the parts of the columns to be tested and that he left it to the company which did the tests to select the areas for testing.13 He confirmed that the column 11B showed honeycombing at the base14 and that it was within his contemplation15 when he gave the instructions to the Defendant on 18 December 199016. (Honeycombing refers to pitted concrete which visually resembles a honeycomb. The Plaintiff's expert, Lim Beng Sun defined it as the presence of voids in concrete17. The Defendant's expert, Dr C K Murthy described it as the interconnected voids in concrete arising from inadequate compaction or lack of mortar.18) It was clear from Mr Liew's evidence that poor concrete was seen at the top and bottom portions of the columns. The significance of this is that doubts were raised about the concrete cast from the first load which was tested and found satisfactory, suggesting the deficiency of the cast concrete may not originate from any deficiency in the concrete supplied.

12 Mr Liew's evidence also raised doubts over Mr Johnny Sng's evidence. Mr Sng had testified that the consultant engineer had pointed out to him that the top parts of the columns were of inferior concrete19 and that the consultant engineer had marked the spots for the core tests20. Mr Liew's evidence was interposed with Mr Sng's evidence. When Mr Sng continued with his evidence after Mr Liew, he modified his evidence that it was the clerk of works who

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informed him that the coring was to be done on the upper parts of the columns.21 He identified the clerk of works as Bobby Liew Kian Huat who worked under the instructions of the consultant engineer.22 Counsel for the Defendant did not dispute Mr Liew's evidence that the test areas were selected by the company that did the tests23 and did not call Bobby Liew Kian Huat as a witness to contradict him or corroborate Mr Sng.

13 The disputed evidence The CAST Laboratories core tests on the three columns were purported to have been carried out in accordance to the standards set in Singapore Standard 78: Part A 20: 1987 - Method for Determination of the Compressive Strength of Concrete Cores.24 The standards stipulate that specimens must be examined for voids, honeycombing and cracks25 and that test reports specify the condition of specimens when received and the classification of voids and presence of cracks26. These requirements were not complied with by CAST Laboratories. Mr Teo Yong Pheng from the laboratories said that he did not test for voids or record the state of voidage27 because there was no formula for discounting strength for voidage and there was no co-relation between voidage and strength28. (This may be explained by the fact that the standards are for determining the compressive strength of concrete cores rather than the strength of the concrete itself.) On this issue of strength and voids, the experts engaged by the Plaintiff, Mr Paul Mundell and Mr Lim Beng Sun submitted two joint reports of 14 June 1991 and 10 August 1993.29 In the first report, they analysed the available test cube results statistically and arrived at the result that 99% of all the concrete delivered would have a strength greater than 35N/mm2 30 if the same mix was used31. With reference to the tested in-situ strength of the concrete in the top portions of the three columns, they contended that the presence of voids reduced the density and strength of concrete. As authority, they referred to a practice sheet on

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Placement and Compacting Concrete by George Blackledge32 where it was stated that it is important to remove entrapped air during concreting because air voids reduce the strength of concrete to the extent that for every 1% entrapped air or voids, the strength falls by 5 to 6%. The positions taken by Mr Teo and M/s Mundell and Lim do not really conflict. Mr Teo was saying is that a core test can be carried out on a specimen with voids, and the presence of voids in the specimen does not influence the test results, ie, if the tested strength is 20N/mm2, the result is just as accurate whether the specimen tested has voids or not. On the other hand, what the other two experts were saying was that the presence of voids lowers the strength of a specimen, as compared to that of a void- free or less void-affected specimen from the same concrete. In other words, if there are two core specimens, one with and one without voids, both with a tested strength of 20N/mm2, the concrete in the specimen with voids would be greater than 20N/mm2 for the ultimate strength to be reduced strength to 20N/mm2 by the voids, whereas the concrete in the specimen without voids would be weaker than that in the first specimen as the measured strength of 20N/mm2 had not been reduced by voids. As Mr Liew the consultant engineer and Mr Sng the project manager agreed that there were voids in the top portions of the columns tested, the core test results are acceptable indications of concrete strength with voids. As the voids were not measured, the concrete strength free of voids cannot be ascertained. Mr Mundell in his evidence referred to the photograph of the column 11B that he was able to inspect. Like Mr Liew, he referred to the line separating the pours of the two batches of concrete and said that there should not be such a line if the concrete was compacted properly during pouring.33 He also found signs of segregation at the bottom of the column34 and honeycombing resulting from under compaction.35 Mr Lim Beng Sun, who also inspected the column, found that there was segregation, honeycombing and grout loss at the top and bottom of column 11B which he

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attributed to segregation, poor compaction36 and poor workmanship in pouring the concrete37. The Defendant appointed Dr C K Murthy to give his opinion on the reports of CAST Laboratories and M/s Mundell and Lim. Dr Murthy also gave evidence on behalf of the Defendant. He also found honeycombing at the base of the column, which he attributed to lack of mortar and segregation. He hypothesised that grout had separated from the concrete, leaving stones and sand in place, which is segregation due to improper grading or too much vibration (over-compaction).38 He discounted the second possibility as very unlikely because in practice the problem with compaction is under compaction rather than over compaction.39 He also said that the chances of segregation during concreting is very low unless there is over compaction. He disagreed with M/s Mundell and Lim and asserted that segregation does not occur with under compaction40 and stated in his report41 that the variation of the in-situ cube strengths of the upper portions of the three columns tested was too high for concrete of the same batch unless the concrete was segregated in transit and before discharge. With regard to the lower portions of the columns, there was no dispute that they were cast from the good concrete delivered in the first load. This eliminated improper grading as a cause of the honeycombing and left the other factor, segregation, as the cause. Under cross- examination Dr Murthy said that the honeycombing was caused by over compaction42 despite his earlier evidence that over compaction is "very unlikely"43 and that if concrete is well graded and cohesive, honeycombing may occur with inadequate compaction.44 The net position on the honeycombing on the lower portion of column 11B was that it did not result from bad concrete. The experts agree that improper compaction was the cause - whether it was under compaction as suggested by the Plaintiff's experts, or over compaction as Dr Murthy concluded. Whichever view is taken, no blame can be put on the Plaintiff as it was not responsible for compacting the concrete. The Defendant had control over that and must bear

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responsibility for the honeycombing. There were other manifestations of poor workmanship. Mr Liew and Mr Mundell referred to the separate line between the two pours.45 Mr Mundell said that this line showed that the concrete had not been properly compacted. He explained that compaction can be done by vibrating each layer of poured concrete with immersion type poker vibrators46 which would remove any separation line because any difference in colour of the two pours will be phased in the transition when the concrete is compacted.47 His evidence on this point was not challenged by counsel for the Defendant. Dr Murthy also referred to the line in his evidence, and said that it was due to a difference in cement content between two pours48, but he did not comment on Mr Mundell's point that if the concrete was properly compacted, there should be no line. The records maintained by the consultant engineer's clerk of works also showed poor workmanship on the part of the Defendant's workers. The record of 5 Dec 1990 read in part "No protective measures are taken whilst concreting the columns during wet weather".49 Mr Liew went on to explain that steps should be taken to protect the columns by placing canvas or plastic sheets to cover them because if water got in, it may affect the quality of the concrete.50 There was another point in Dr Murthy's evidence about the strength of the top portions of the three columns tested. He was asked whether in a situation where the concrete mix is so bad as to have a strength of only 9.5N/mm2 (as tested by CAST Laboratories), it will be noticed by an experienced contractor, and he replied that the contractor would be able to tell from its colour and composition.51 When Mr Sng was questioned on this, he confirmed that he was present when the concrete was discharged. He did not notice any segregation or difference in colour although he had twelve years experience in the construction industry.52 This raised a doubt whether the second load of concrete had segregated upon delivery as hypothesised by Dr Murthy.

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14 Evaluation of the evidence The Defendant had relied on the consultant engineer's complaint and the CAST Laboratories report as evidence that the second truckload of concrete used for casting the top portions of the columns were under-strength. Mr Liew's note53 showed that he was unhappy about the column surfaces. He was seeking information generally on the concrete used, conditions of concreting and was asking for the concrete to be tested. In court, he clarified that his concern was not limited to the top portions of the column, and that he had in mind the honeycombing at the base of the column as well. Mr Liew had not formed any opinion that the concrete used was defective. The CAST Laboratories tests were flawed in that the experts agreed that insufficient core tests were done to allow a proper co-relation of the core test and UPV results. Even in respect of the core tests themselves, two criticisms can be made. Firstly, there were no void tests or record of voids although the concrete in those areas were the consultant engineer's words, "devoid of sufficient cement and were porous". Secondly, no tests were done to the lower portions of the columns where there was honeycombing which would have afforded a basis for comparison between the cast strengths of the first load and the second load of concrete. I accept the evidence of the Plaintiff's experts that voids reduce the strength of cast concrete, and that weakness of cast concrete may be attributable to defects of the concrete as well as presence of voids. I also take into consideration the poor workmanship resulting in the honeycombing at the base of column 11 B, the failure to provide protection from the rain, the separation line in the column showing the lack of compaction, and the fact that no segregation was noticed when the concrete was discharged which would have been apparent if the concrete was so segregated that its strength was reduced to 9.5N/mm2. On the other hand, there was the evidence that all the cubes taken and tested were found satisfactory, and that working statistically on the test cube results, 99% of the concrete delivered would be stronger than 35N/mm2 barring

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any accidental change in mixture. In the final analysis, the issue has to be proved on a balance of probability, and I find that the Defendant has not proved that the second load of concrete was deficient. There was clear evidence that the Defendant's standard of workmanship was wanting, and little evidence of any defect in the concrete discharged in the second truckload except for the inconclusive core test results and the poor surfaces of the columns which may be caused by bad workmanship or bad concrete. In the circumstances, I reject the Defendant's defence. Judgment is entered for the Plaintiff in the sum of $52,686.75 with interest at 8% per annum from the date of the writ, ie 8 April 1991, to the date of payment and costs. The costs will include the costs of Mr Mundell and Mr Lim for preparing their joint reports and for their attendance in court. I dismiss the counterclaim with costs. I would add that even if I had found that the second truckload of concrete was deficient, I would not have allowed the counterclaim of $2,430.00 for the vermiculite boards because the Defendant has not shown that these expenses were related to the alleged poor concrete.54

Kan Ting Chiu J

Yap Boh Lim (Yap & Yap) for the plaintiff
Kumar Monoj Roy (Hilborne & Co) for the defendant

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