IN THE HIGH COURT OF THE REPUBLIC OF SINGAPORE

[1999] SGHC 54

Suit 883/1993

Between

Chuang Uming (Pte) Ltd

… *Plaintiff*

And

Setron Limited

… *Defendant*

And

Lee Sian Teck Chartered Architects

… *Third Party*

GROUNDS OF DECISION

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Chuang Uming (Pte) Ltd v Setron Limited (Lee Sian Teck Chartered Architects, Third Party)

[1999] SGHC 54

Suit 883/1993
MPH Rubin J
27 February 1999

Judgment :

Cur Adv Vult

Background

1 Setron Limited, the defendants herein, one of the subsidiaries of Haw Par International Ltd ('HPIL') are the owner- developers of a seven-storey light industrial building known as Haw Par Technocentre at Tanglin Halt Close, Singapore. On 30 October 1980, the plaintiffs, Chuang Uming (Pte) Ltd were awarded the main building contract to construct the said building. To this end a building contract was entered into between the plaintiffs and the defendants on 8 February 1991 to the value of $20,673,191.26, the terms of which followed the Articles and Conditions of Building Contract (3rd Edn) published by the Singapore Institute of Architects.

2 In the course of 1988, well before the plaintiffs were engaged to construct the building, a firm of architects known as Lee Sian Teck Chartered Architects, the

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third party herein were appointed by HPIL as architects for the project space. The terms of engagement between HPIL and the third party are evidenced in a letter dated 9 May 1988 from the third party to HPIL under which the terms and conditions of the third party's appointment are governed by the SIA's Conditions of Appointment and Scale of Professional Charges 1985 ('SIA Conditions').

3 In addition to the third party's appointment as architects, the following were also appointed as consultants to the project: Langdon Every & Seah (now known as Davis Langdon & Seah) as the quantity surveyors; T H Chuah & Associate Pte Ltd (now known as T H Chuah & Partners) as the structural engineers; and J M Pang & Seah (Pte) Ltd as the mechanical and electrical engineers.

4 The contract period was 50 weeks effective 14 November 1990. The works were practically completed on 20 March 1992 and a certificate of practical completion dated 28 April 1992 issued by the third party confirmed the same.

5 Unhappily, the matter did not terminate with a picture- book conclusion. Shortly after the issue of the certificate of practical completion, a number of tiles bonded to the external facade of the building started to disconnect and fall off from the wall. Such debonding process was first noticed in May 1992 and it would seem that initially, this occurrence was somewhat sporadic. But the debonding of the tiles progressively worsened and became a cause of great concern.

6 In the result, the defendants being dissatisfied with the tile finish of the external wall of the building declined to make payments to the plaintiffs, of the

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initially certified amount of $580,933.10 as being the first release of the retention monies under Certificate No C18 dated 19 February 1993.

7 The parties from then on were in a state of flux and having consulted their respective legal counsel and obtained expert reports as to what could have caused the debonding, started pointing fingers at each other, the plaintiffs blaming the third party for the poor design and the third party maintaining that it was poor workmanship by the plaintiffs that had brought about the fiasco.

8 The defendants in the meantime, after receiving advice, engaged a different firm of contractors to replace the entire tile facade with a new spray finish.

9 In the end, the plaintiffs are now claiming against the defendants either for a sum of $580,933.10 as was originally certified by the third party under Interim Certificate No C18 or for a sum of $531,433.10 under a revised Interim Certificate No C19 issued by the third party on 31 March 1993. The plaintiffs also dispute the third party's rights to issue certificate Nos C19, C20 and C21, the combined effect of such certificates was that the plaintiffs now owe the defendants a sum of $40,259.40.

10 The defendants' position is that they are entitled to an acceptable wall finish devoid of defects and free from danger to users of the building. As the tiles had started to peel off from the wall due to defects in installation, they maintain that the plaintiffs are not entitled to any further payment. On the contrary either the plaintiffs or the third party is liable to recompense the defendants the damages suffered by them on account of the defective tile facade and consequential losses which they quantify as amounting to $2,046,893.86 ($2,627,826.96 being the sum claimed less $580,933.10 being the amount earlier certified under Interim

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Certificate No C18). Inasmuch as the plaintiffs by their reply and defence to counterclaim endeavour to affix liability to the third party, the defendants have joined the third party for the purposes of indemnity as well as for their share of the liability.

11 The major issue between the parties centres on the debonding of the external wall tiles; however there is one side issue between the plaintiffs and the defendants as respects the replacement of some floor tiles at main lobby B1 and the second lobby B1 of the building, for which the defendants claim against the plaintiffs a sum of $67,367.68. The plaintiffs, in principle, appear to concede liability for this item save that they suggest that the claim under this head cannot exceed a sum of about $17,000 (para 58 of Sebastian Kho's affidavit filed on 31 October 1995).

Pleadings

12 The allegations and counter allegations in this suit are multi-faceted. In order to comprehend their true purport and significance, it is necessary to recapitulate the essential segments of the pleadings inter se the litigants.

13 As mentioned earlier, the plaintiffs' claim in the main is founded on Interim Certificate No C18 issued by the third party for $580,933.10 (or alternatively, under protest, for a sum of $531,433.10 under certificate No C19).

14 In this connection, the plaintiffs rely on the following provisions of the SIA contract which govern the parties' obligations:

> 31. (1) On the dates or at the stages for issuing Interim Certificates named in the Appendix hereto the Architect shall (subject to the provision of adequate vouchers and information by the Contractor) issue interim Certificates for payment to the

Contractor, who shall be entitled to payment of any sum stated therein as due to the Contractor within the Period for Honouring Certificates stated in the Appendix following receipt of the Certificate or a copy of the Certificate by the Employer.

31. (4) The Architect shall have power to issue a further Interim Certificate at any time whether before or after completion, correcting any error in an earlier Interim Certificate (but not in any Delay, Termination of Delay, Further Delay or any certificate other than an Interim Certificate) or dealing with any matter of which he was not aware, or which should have been dealt with, at the time of an earlier Interim Certificate, or revising any decision or opinion on which that Certificate was based.

31. (7) Subject to clauses 25 and 26 of these Conditions in regard to Phased or Stage Completion or Partial Occupation, one-half of the Retention Monies not yet paid shall be certified as due to the Contractor on the issue of the Completion Certificate under clause 24(4) of these Conditions, less only a sum sufficiently reasonable to cover the cost of the outstanding work (if any) not yet completed pursuant to clause 24(4) of these Conditions at the date of the said Certificate. Any sum so deducted shall be released to the Contractor upon a further certificate of the Architect given as soon as such outstanding work has been completed.

31. (11) No certificate of the Architect under this Contract shall be final and binding in any dispute between the Employer and the Contractor, whether before an arbitrator or in the Courts, save only that, in the absence of fraud or improper pressure or interference by either party, full effect by way of Summary Judgment or Interim Award or otherwise shall, in the absence of express provision, be given to all decisions and certificates of the Architect (other than a Cost of Termination Certificate or Termination Delay Certificate under clause 32(8) of these Conditions), whether for payment or otherwise, until final judgement or award, as the case may be, and until such final judgement or award such decision or certificates shall (save as aforesaid and subject to sub-clause (4) of this Condition) be binding on the Employer and the Contractor in relation to any matter which, under the terms of the Contract, the Architect has as a fact taken into account or allowed or disallowed, or any disputed matter upon which under the terms of the Contract he has as a fact ruled, in his certificates or otherwise. The Architect shall in all matters certify strictly in accordance with the terms of the Contract. In any case of doubt the Architect shall, at the request of either party, state in writing within 28 days whether he has as a fact taken account of or

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> allowed or disallowed or ruled upon any matter in his certificates, if so identifying any certificate and indicating the amount (if any) taken into account or allowed or disallowed, or the nature of any ruling made by him, as the case may be.
>
> 24. (4) Subject to the provisions of sub-clause (3) of this Condition as to the effect of Termination of Delay Certificates, the liability of the Contractor to pay further liquidated damages under sub-clause (3) of this Condition shall cease, and the contract be deemed to be completed for this purpose, upon the issue by the Architect of his certificate under this sub-clause that the works have been completed. Such certificate is referred to in this Contract as a "Completion Certificate", and shall be issued by the Architect when the Works appear to be complete and to comply with the Contract in all respects.

15 As regards Interim Certificate No C19 issued by the architect on 31 March 1993 pursuant to cl 31(4) of the SIA Conditions revising the sum of $580,933.10 to $531,433.10, to take into account a deduction of a sum of $49,500 for defective works in respect of external wall tiling, the plaintiffs' averments as appear at paras 10, 11 and 12 of the Amended Statement of Claim read as follows:

> 10. However, the Plaintiffs aver that the Interim Certificate No. C18 ought or is deemed to have been issued by the architect pursuant to the aforesaid Clause 31(7) and not Clause 31(1) and that, therefore, the architect was not entitled or empowered to correct or revise Certificate No. C18 for the purpose of taking into account defective works. In the premises, the Plaintiffs aver that Interim Certificate No. C19 is and was at all material times null and void.
>
> 11. Even if (which is denied) the architect is entitled to correct or revise Certificate No. C18 for the purpose of taking into account defective works, the Plaintiffs aver that the architect did not act bona fide in issuing Certificate No. C19 and that Certificate No. C19 is therefore null and void.
>
> **PARTICULARS**
>
> (a) The problem with the external wall tiling works referred to by the architect in Certificate No. C19 was not caused by any negligence or breach of contract on the part of the Plaintiffs, their servants or agents, but was due to default in the design of and/or relating to the external walls of the building referred to

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> in paragraph 2 above, on the part of the architect or for which the architect is/was responsible; (b) The tiles selected for the said external walls were not fit or suited to be used for the said external walls; (c) The architect had a self-interest in issuing Certificate No. C19 since the architect was responsible for the faults in the design of or relating to the said external walls and/or the external wall tiles therefor. Consequently, the architect is disqualified from certifying the cause of the problems with the external wall tiles and from certifying who is responsible or liable for the said problems; (d) On or about the 9th day of March, 1993, vide a letter from the Defendant's solicitors, Messrs Wong Meng Meng & Partners, to the architect, the Defendants challenged the validity of Certificate No. C18 on the ground that the alleged defective works had not been taken into account by the architect when issuing Certificate No. C18. Vide the said letter, the Defendants requested the architect that the architect reconsider the architect's decision in issuing Certificate No. C18 and to issue a further certificate pursuant to the said Clause 31(4) to correct Certificate No. C18; (e) Subsequent to the aforesaid letter, the architect issued Certificate No. C19 to purportedly correct or revise Certificate No. C18 although the architect had acknowledged in Certificate No. C19 that when he issued Certificate No. C18, he had decided to the effect that the overall works were completed except for the works listed in the Schedule to the Completion Certificate and that the release of one-half of the retention monies was due, and despite the provisions of Clause 31(7).
>
> 12. Alternatively, even if Certificate No. C19 is valid (which is denied), by the said Clause 31(1), the Defendants are obliged to pay the Plaintiffs the sum of $531,433,10 certified therein.

16 The defendants by their Further Re Re-Amended Defence and Counterclaim ('Defence and Counterclaim') join issue with the plaintiffs and rely *inter alia,* on clauses 37(3)(h) and 37(3)(i) of the SIA Contract which read:

***Clause 37(3)(h)*:**

> Pursuant to clause 31(11) of these Conditions, temporary effect shall be given to all certificates (other than a Cost of Termination or Termination Delay Certificate under clause 32(8) of these Conditions), whether for payment or otherwise, granted (or refused) by the Architect, and to all rulings and decisions required of him for the purpose of issuing certificates under the terms of the Contract, until final award (or, where the

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> courts may for any reason be seised of a dispute, until final judgement), save only that in cases where no ruling or decision has been made or certificate given or refused by the Architect (as to which an arbitrator or the Courts may if necessary receive evidence from the Architect) or in the case of a Cost of Termination or Termination Delay Certificate, or of any matter in relation to which the Architect has no power to decide or certify under the terms of the Contract, an arbitrator or the Courts, as the case may be, may deal with a matter, whether in interlocutory proceedings or by way of Interim Award or in any other way, before final award or judgement.
>
> Clause 37(3)(i):
>
> The power of the Architect to issue a further certificate under clause 31(4) of the Conditions shall continue until his Final Certificate notwithstanding the prior commencement of proceedings by way of arbitration or in the Courts, to which further certificate full effect shall be given by the Courts or an arbitrator until final award or judgement.

17 The defendants then proceeded to articulate their set-off and counterclaim against the plaintiffs. Paragraphs 17 to 28 of the Defence and Counterclaim require reproduction and they are as follows:

> 17. The Contract was made in the standard form measurement contract type of building contract issued by the Singapore Institute of Architects. The Defendants will, at trial, refer to the Contract for its full term and effect. The relevant conditions of the Contract, for present purposes provide, inter alia:

(a) Clause 1(1):

> "The Contractor shall at all times carry out, bring to completion, and maintain the Works to in accordance with all requirements of the Contract and must (subject to sub-clause (8) of this Condition) comply with all written directions and instructions given in relation thereto by the Architect. ..."

(b) Clause 1(7)

> "If within 7 days after receipt of a written notice from the Architect requiring the Contractor to comply with a written direction or instruction the Contractor fails to do so, the Employer may employ other contractors to do so under the

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supervision of the Architect and may upon the certificate of the Architect deduct the extra cost (if any) of doing so from any monies otherwise due under the contract or recover the same from the Contractor. ..."

(c) Clause 11(1):

"Without prejudice to the Contractor's responsibilities under clause 3 of these Conditions, all materials, goods and workmanship comprised in the Works shall, save where otherwise expressly stated or required, be the best of their described kinds and shall in all cases be in exact conformity with any contractual description or specification and of good quality. Wherever it is practicable to do so the Contractor shall, at the request of the Architect, furnish him with any necessary supporting vouchers, evidence or information confirming that all materials and goods whether fixed or unfixed comply with the requirements of this sub-clause. Any unreasonable failure or refusal by the Contractor to furnish such vouchers, evidence or information shall entitle the Architect to give a direction for the removal of the materials or goods at the expense of the Contractor, and until replacement to deduct their value, if already paid, from the Contract Sum";

(d) Clause 21

"Following commencement of work under clause 10(1) of these conditions, the Contractor shall proceed with the Works diligently and with due expedition at all times until completion"; and

(e) Clause 27(1)

"Subject to clause 26 of these Conditions in the case of an Occupied Part of the Works, the Maintenance Period stated in the Appendix hereto shall commence upon the issue of a Completion Certificate under clause 24(4) or 25 of these Conditions. During such period:

(b) the Architect may at any time following the Completion Certificate give directions or instructions for the making good by the Contractor of any defects, omissions or other faults which may be or become apparent in the Works. If the cause of the same is due or found to be due to any breach by the Contractor of any of his obligations express or implied under the Contract or those of any sub-contractor or supplier, direct or indirect, and whether Designated, Nominated or otherwise, then the Contractor shall be responsible for repairing and making good the same or making arrangements therefor at his own expense on the direction of the Architect. If the said defects have occurred despite compliance with the contract in all

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respects by the Contractor or any such sub-contractors or suppliers he shall be entitled to payment on a reasonable price basis for compliance with any instruction of the Architect to make good the same". (The Maintenance Period commenced on 20 March 1992 and ended on 19 March 1993.)

(f) Clause 27(4)

"Provided that in lieu of requiring the Contractor to make good defects under sub-clause (1) or (2) or exercising the powers in sub-clause (3) hereof, the Architect may, in any case where the cause is a breach of contract by the Contractor or by any sub-contractor or supplier as aforesaid, give a direction that the defect not be remedied, and instead that there should be a reduction in the Contract Sum to be assessed by the Quantity Surveyor representing the reduced value of the work to the Employer, or any savings in costs to the Contractor which the defective work may have involved, whichever is the greater. ..."

18. Alternatively, it was an implied term of the Building Contract that the Plaintiffs would carry out the works with due and/or reasonable care and skill, that the goods and materials supplied would be of good quality and/or the best of their kind and that the Technocentre would be fit for human occupation upon completion of the Plaintiffs works.

19. The following clauses are also relevant to and deal with the question of the Architect's Interim Certificates relating to the work done, the corresponding payment thereon and the effect of the Interim Certificates:

(a) Clause 31(2)

Subject to sub-clauses (5) of this Condition, such Interim Certificates shall (expect where, pursuant to Article 2, interim payment is to be by stage instalments) be based on a retrospective re-valuation of all the work carried out under the Contract up to a date (which shall be named in the Certificate) not exceeding fourteen days before the date of issuing the Certificate itself. Such valuation (subject to the provision of adequate vouchers and information by the Contractor) shall be carried out in accordance with the following rules:-

(g) Deducted from the total of the preceding paragraphs, a fair allowance in respect of any defective or incomplete work for which the Contractor or any sub-contractor direct or indirect is responsible and of which the Architect is aware at the time of the certificate.

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(b) Clause 31(4)

> The Architect shall have power to issue a further Interim Certificate at any time whether before or after completion, correcting any error in an earlier Interim Certificate (but not in any Delay, Termination of Delay, Further Delay or any certificate other than an Interim Certificate) or dealing with any matter of which he was not aware, or which should have been dealt with, at the time of an earlier Interim Certificate, or revising any decisions or opinion on which that Certificate was based.

(c) Clause 31(11)

> No certificate of the Architect under this Contract shall be final and binding in any dispute between the Employer and the Contractor, whether before an arbitrator or in the Courts, save only that, in the absence of fraud or improper pressure or interference by either party, full effect by way of Summary Judgment or Interim Award or otherwise shall, in the absence of express provision, be given to all decisions and certificates of the Architect (other than a Cost of Termination Certificate or Termination Delay Certificate under clause 32(8) of these Conditions), whether for payment or otherwise, until final judgement or award, as the case may be, and until such final judgement or award such decision or certificates shall (save as aforesaid and subject to sub-clause (4) of this Condition) be binding on the Employer and the Contractor in relation to any matter which, under the terms of the Contract, the Architect has as a fact taken into account or allowed or disallowed, or any disputed matter upon which under the terms of the Contract he has as a fact ruled, in his certificates or otherwise. The Architect shall in all matters certify strictly in accordance with the terms of the Contract. In any case of doubt the Architect shall, at the request of either party, state in writing within 28 days whether he has as a fact taken account of or allowed or disallowed or ruled upon any matter in his certificates, if so identifying any certificate and indicating the amount (if any) taken in account or allowed or disallowed, or the nature of any ruling made by him, as the case may be.

20. Further or in the alternative the Plaintiffs owed a duty of care to the Defendants in carrying out the works and to ensure that their respective works were carried out in a professional, diligent, skilful or workmanlike manner so that the Technocentre would be fit for human occupation and free from defect.

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21. Pursuant to their engagement, the Plaintiffs in or about the month of November 1990 commenced their works and purportedly carried out and completed the same.

22. After the purported completion of the Plaintiffs' works, defects apparent in the Plaintiffs' works were noticed. A list of the said defects is attached hereto as Appendix 1. A copy of the said list of defects were made available to the Plaintiffs who were required to rectify the same. One of the defects in question was that of the tiles debonding from the surface of the Technocentre's facade and falling to the ground ("the debonding tile defect"). Particulars of the debonded tile defect was made known to the Plaintiffs in the architect's letter dated 27 July 1992 requesting the Plaintiffs to rectify the debonding tile defect. Subsequently, the architect sent a number of reminders and/or directions to the Plaintiffs to rectify and/or remedy the debonded tile defect. However, no attempt was made by the Plaintiffs to undertake any remedial or rectification works.

23. By their Directions dated 13 May 1993, which also served as a written notice, the architect directed that the Plaintiffs rectify the defective tile facade for the Technocentre as the tile facade was "not in accordance with the Contract" and which the architect found to be "unacceptable".

24. Despite the Directions of 13 May 1993 by the architect and the numerous reminders to the Plaintiffs by both the architects and the Defendants to remedy and/or rectify the defects in the Plaintiffs' works, the Plaintiffs, in breach of the contract, refused and/or failed and/or neglected to rectify or remedy the said defects.

25. In view of the Plaintiffs' failure and/or refusal and/or neglect in complying with their obligations under the Contract and in view of the grave danger posed to both persons and property by the debonded tile defect the Defendants then, pursuant to the Contract, employed other contractors to carry out the said rectification and/or remedial works in respect of the defective works executed by the Plaintiffs.

26. Given the extent, nature and danger posed by the defective tiling works carried out by the Plaintiffs, the whole of the tile facade to the Technocentre had to be replaced.

27. The Defendants will rely upon the Architects' Certificates C19 and C20 as evidence of the Plaintiffs' negligence and/or breach of their contractual duty and/or duty of care to the Plaintiffs to carry out their works properly and with all due care and skill. Further and in the alternative, the Defendants will rely upon the following particulars:

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(a) failed and/or neglected to use proper or suitable adhesive for the tiling works;

(b) failed and/or neglected to use any or sufficient adhesive for the tiling works;

(c) failed and/or neglected to ensure that the tiles were properly adhered to the wall of the Technocentre's facade;

(d) failed and/or neglected to lay the tiles with sufficient space and/or clearing between each tile so as to allow for thermal expansion of the tile;

(e) failed and/or neglected to ensure that moisture or water would not collect behind the tiles after the said tiles had been laid;

(f) failed and/or neglected to execute the tiling works with due diligence and/or proper care;

(g) failed and/or neglected to check with the architect and/or the architect's agents or representatives as to how the tiling works should be carried out especially with regard to the clearance space between tiles;

(h) fixed tiles to screed which was defective in that:

(i) it had not been properly cured/dried; (ii) the cement-sand-polymer mix was variable - at times too rich, at other times too lean; (iii) it was of excessive thickness, not properly applied in layers, and lacking in reinforcement.

28. The Plaintiffs have failed and/or refused and/or neglected to make good the defects, in particular the debonding tiles defect, inspite of the directions and numerous reminders from the architect and in breach of their duties and obligations to the Plaintiffs.

18 Thereafter the defendants proceeded to particularise the losses suffered by them under various heads as follows:

(1) Paragraphs 29 to 35 of the Counterclaim:

(a) Loss of rental for unit #01-01 of the building ... $232,893.76

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(b) Loss of rental for unit #01-02 ... $193,728.47

(c) Loss of rental for units #01-04/05 ... $490,911.42

$917,533.65

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(2) Paragraph 36 of the Counterclaim:

Payments by two tenants of the building due to damage caused to their fittings on account of water infiltration: ... $3,150.00

(a) $2,450 to Sony International (S) Pte Ltd; and

(b) $700 to AST (S) Pte Ltd.

(3) Paragraphs 37 and 38 of the Counterclaim:

Lost management time ... $40,692.79

(4) Paragraph 39 of the Counterclaim:

Loss due to defective tile facade:

(a) Supply and installation of external tiling works ... $587,192.50

(b) Cost of associated works (expansion joints) ... $ 34,000.00

(c) Protective/interior measures including reports, testing and removal of debonded tiles ... $287,600.00

(d) Works on new facade including consultant fees and preparation of new facade ... $690,290.34

(e) Replacement of tiles at certain lobbies ... $ 67,367.68

Total: $2,627,826.96

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19 From the foregoing sum of $2,627,826.96, the defendants say that the sum certified under Interim Certificate C18 amounting to $588,933.10 should be deducted so as to avoid double counting. In the result, the defendants' present claim amounts to $2,046,893.86.

20 The plaintiffs in their defence to the defendants' counterclaim deny that they were in any way responsible for the defective tile facade. Save for a general admission (paras 3 and 5 of their defence to the counterclaim) that they were required to exercise reasonable skill and care in the execution of the building works, ensure that the goods and materials supplied by them would be of good quality and carry out the work with due diligence, skill and in a workmanlike manner, they aver that the debonding took place as a result of a design fault on the part of the third party.

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21 In this connection the plaintiffs' averments as appear in paras 9, 10, 11, 12, 13 and 14 of their Re-Amended Reply and Defence to Counterclaim read as follows:

> 9. The Plaintiffs aver that the defect in the external tile facade of the technocentre was caused by the default in the Architect's design of the same.
>
> **PARTICULARS**
>
> (a) The Architect failed to ensure that there was adequate spacing between the expansion joints on the external tile facade; (b) The Architect failed to ensure that there was sufficient and/or adequate width of the joints between the tiles;
>
> 10. Further and/or in the alternative, the Plaintiffs aver that the tiles selected for the said external walls were not fit and/or suitable to be used for the said external walls.
>
> **PARTICULARS**
>
> (a) The said tiles were made of rigid ceramic which were not able to tolerate movement due to thermal expansion; (b) The said tiles failed to contain adequate adhesive and/or bonding material to ensure proper and/or adequate bonding of the said tiles onto the said external walls.
>
> 11. Paragraphs 25 and 26 of the Further Re-Re-Amended Defence and Counterclaim are not admitted.
>
> 12. Paragraphs 27 and 28 of the Further Re-Re-Amended Defence and Counterclaim are denied. The Plaintiffs repeat the matters pleaded at paragraphs 9 and 10 hereof and further aver that the screed was not defective in that:-
>
> (a) It was properly cured/dried in accordance with industry practices and standards in relation to climatic conditions; (b) The cement/sand polymer was mixed in accordance with the manufacturer's recommendation, contract conditions and within acceptable tolerances; (c) The screed was not of excessive thickness and given the characteristics of the background, neither application in layers nor reinforcement was required. Further the contract conditions did not call for layering or reinforcement but in any event, two (2) layers were applied; (d) The debonding of the tiles was not in any way caused by the alleged defect in the screed but was, inter alia, due to the Architect's and/or Defendants' failure to consider and/or take into account of the characteristics of the tiles selected.

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> 13. Paragraphs 29 to 39 of the Further Re-Re-Amended Defence and Counterclaim are not admitted.
>
> 14. Save as it is expressly admitted herein, the Plaintiffs deny each and every allegation set out in the Further Re-Re-Amended Defence and Counterclaim as if the same were each herein set out and specifically traversed.

22 Faced with the prospect that the blame may possibly lie elsewhere, the defendants included the architects as third party to the proceedings. By and large the defendants' claim against the third party is for indemnity as well as for all losses and damages, in the event that the defects in the tile facade are found to be attributable to any lapse or default on the part of the third party (paras 2 and 3 of the defendants' amended statement of claim against the third party).

23 In this respect paras 4, 5, 7, 8, 9, 10, 11 and 12 of the defendants' amended statement of claim against the third party read as follows:

> 4. On or about 9 May 1988, the Third Party agreed with the Defendants for reward to act as the architect in respect of the construction of the Technocentre and they further agreed to design the said Technocentre and to prepare all the necessary drawings in respect of the construction of the Technocentre (the "Works"). The terms and conditions of the engagement of the Third Party by the Defendants are as per the guidelines prescribed by the Singapore Institute of Architects ("SIA") ie. the SIA Conditions of Appointment and Scale of Professional Charges 1985 ("SIA Agreement"). The relevant terms of the SIA Agreement provide, inter alia:
>
> (a) by Clause 1.3 thereof that the Architect in providing the services to the Client must exercise a reasonable standard of skill and diligence normally expected of and accepted by the profession of architects.
>
> The Defendants will at trial refer to the said guidelines for their full effect.
>
> 5. Alternatively, it was an implied term of the engagement between the Defendants and the Third Party that the Third Party would use all reasonable care and skill in executing their work.

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7. Further or in the alternative the Third Party owed a duty of care to the Defendants in supervising the works and to ensure that the works were carried out in a professional or workmanlike manner so that the Technocentre would be fit for human occupation and free from defect.

8. Pursuant to their engagement, the Third Party purported to design and prepare contract drawings showing and describing the said Works, and the Plaintiffs in or about the month of November 1990 started the said Works and purportedly carried out and completed the same.

A. THE DEBONDING TILE DEFECT

9. Completion of the Works took place on 20 March 1992 when the Third Party issued the Completion Certificate. Thereafter defects apparent in the Works were noticed. A list of the said defects is attached hereto as Appendix 1. One of the defects in question was that of the tiles debonding ("the debonding tile defect") from the surface of the Technocentre's facade and falling to the ground. Particulars of the debonded tiles were made known to the Plaintiffs in the Third Party's letter dated 27 July 1992 requesting the Plaintiffs to rectify the debonding tile defect. Subsequently, the Third Party sent several other reminders and/or instructions and/or directions including Directions dated 13 May 1993 to the Plaintiffs to rectify the debonding tile defect. However, no attempt was made by the Plaintiffs to undertake any remedial or rectification works.

10. In view of the grave danger posed to both persons and property by the debonding tile defect the Defendants then, pursuant to the Contract, employed other contractors to carry out the said rectification and/or remedial works in respect of the defective works designed and supervised by the Third Party.

11. Given the extent, nature and danger posed by the defective tiling works designed and supervised by the Third Party, the whole of the tile facade to the Technocentre had to be replaced.

12. Further, or in the alternative, if and in so far as the Plaintiffs may prove that the debonding tile defect was not solely attributable to their want of due care and skill, and in any event, the Defendants will contend that the Third Party was negligent and/or in breach of the terms set out in paragraphs 4 and 5 hereof, and of the duty set out in paragraph 7 in that they

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(a) failed and/or neglected to design the said tile facade with due care, consideration and/or diligence in that they did not specify the appropriate clearance between the tiles;

(b) failed to provide proper and/or adequate spacing between the vertical expansion joints on the external walls of the building which resulted in inadequate thermal movement of the joints;

(c) failed to provide proper and/or adequate spacing between the horizontal expansion joints which resulted in inadequate thermal movement of the joints;

(d) failed to provide proper and/or adequate width for the joints between the tiles on the external walls which resulted in the ingress of moisture through the joints;

(e) failed to provide for the nosing of the horizontal sill tile to overhang the cladding tiles to prevent water ingress;

(f) failed to properly and/or adequately detail the window sills on the external walls which led to the deterioration of the debonding of the tiles;

(g) failed and/or neglected to exercise any or any adequate supervision of the tiling works;

(h) failed and/or neglected to ensure that the clearance between the tiles provided by the Plaintiffs was adequate and/or sufficient;

(i) failed and/or neglected to instruct the Plaintiffs to remedy the inadequacy of the clearance between the tiles;

(j) failed and/or neglected to ensure that the tiles used were able to tolerate movement due to thermal expansion;

(k) failed and/or neglected to ensure that the tiles used contained adequate adhesive and/or bonding material to ensure proper and/or adequate bonding of the said tiles onto the external walls;

(l) failed and/or neglected to heed, observe and/or notice the defects and/or faults in the tiling works;

(m) approving the inappropriate choice of tiles; and

(n) approving the tiling works, including the said defects and/or faults.

Third party's defence

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24 The third party denies that the defendants are entitled to any indemnity or to claim any loss and damages from them. It further denies that the defects in the tile facade were attributable to any fault on its part. It particularly denies (paras 2 and 3 of their defence) that the third party is responsible for the design, as opposed to the aesthetic qualities of the external tiling and in this regard rely on the following clauses of the SIA Conditions of Appointment (of Architects), 1985:

> 1.6 The Client will employ a main contractor under a separate agreement to undertake construction or other works relating to the Project. The Client will hold the contractor, and not the Architect, responsible for the contractor's operations and methods and for proper execution of the works.
>
> 1.8 Included as part of the basic services the Architect shall inspect the works at such periodic intervals as the Architect may consider necessary to satisfy the Architect that the works are being executed in accordance generally with the building contract and to enable the Architect to certify in accordance with statutory and other requirements the completion of various stages of the works.
>
> 1.11 Where frequent or constant supervision of the Works is required, a Clerk-of-Works may be employed either directly by the Client or the Architect. Where a Clerk-of-Works is to be employed directly by the Client, the Clerk-of-Works shall be nominated or approved by the Architect and be under the Architect's direction or control. If the Architect appoints the Clerk-of Works, the Client shall nevertheless pay for the services of and all incidental expenses connected with such Clerk-of-Works in accordance with Section 5.3.5 of these Conditions. The Clerk-of-Works may be employed on conditions recommended by the Architect.

25 It goes on to allege that the debonding effect was as a result of the plaintiffs' breach of conditions of the building contract. The third party's averments against the plaintiffs appear at para 12 of its defence and it reads:

> 12. The Third Party avers that the debonding tile defect was caused by the Plaintiff's breach of Conditions 3(1) and/or 11(1) of the building contract and/or the implied term which is set out in paragraph 5(7) above.

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PARTICULARS OF BREACH OF CONTRACT

(1) the tile adhesive contained cement rich polymer modified adhesive with no sand in its mix, contrary to the manufacturer's (Laporte) recommendations, as a result of which it cracked due to drying shrinkage thereby allowing the tiles to debond from the external facade.

(2) the tile adhesive was only applied in patches as opposed to uniformly over the surface to which the tiles were to be fixed in consequence of which a substantial number of the tiles were not properly fixed to the external facade.

(3) The external render onto which the tiles were fixed had a substantial thickness in excess of 20 mm contrary to the requirements of British Standard 5385 : Part 2 : 1978. Further, the composition of the render was very variable. By reason of its substantial thickness and variable composition, the render debonded taking with it parts of the external tile facade.

(4) the tiles were inadequately tapped and/or pressed into the adhesive and were therefore inadequately fixed.

(5) the adhesive contained a significant number of voids caused by notching/ribbing and insufficient tapping and/or pressing of the tiles into the layer of adhesive in consequence of which a substantial number of the tiles were not properly fixed to the external facade.

(6) the tile adhesive was left too long before the tiles were tapped and/or pressed into it whereby it 'skinned' and in consequence of which a substantial number of tiles were inadequately fixed to the external facade.

(7) the tiles were fixed so that the notching/ribbing went in several directions whereby the strength of the bond between the adhesive and the tiles were substantially reduced.

(8) the grout used between the tiles comprised cement only, with no polymer or sand used in the pointing. In consequence the grout cracked and detached itself from the tile joints thereby allowing water penetration which caused weakening of the bond between the tile and the adhesive and/or render.

(9) the joints between the tiles were inadequately grouted/pointed with the result that water was able to get behind the tiles and thereby weaken the bond between the tiles and the adhesive whereby debonding ultimately occurred.

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26 The third party also laid the blame on the Architectural Clerk-of-Works who was then in the employment of the defendants. Paragraph 13 of the third party's defence reads:

> 13. Further or in the alternative, if (which is denied) the Defendant contends that the Third Party ought to have discovered all or any of the Plaintiff's breaches of contract which are particularised in paragraph 12 above during the course of its periodic inspections of the works, the Third Party will contend that the debonding tile defect was also caused and/or contributed to by the Defendant's contributory negligence.
>
> PARTICULARS OF CONTRIBUTORY NEGLIGENCE
>
> The Defendant directly employed and paid a Clerk of Works to carry out frequent and constant supervision of the Plaintiff's works, including the laying of the tiles on the external facade. The Clerk of Works carried out his supervisory role negligently and/or without reasonable skill and care whereby the Plaintiff was permitted to breach its contract in the respects particularised in paragraph 12 above. The Defendant is vicariously liable for the Clerk of Works' negligence.

27 By and large, by their defence the third party contended that it is not to be held liable for the defects alluded to; that the certificates issued by it was in order and that at all times it acted professionally and correctly both as to its several responsibilities and in relation to the issue of the Interim Certificates. Particularly as regards the defendants' averments that in the event Interim Certificate Nos C18 and C19 were to be held valid, the third party should be liable to compensate the defendants for any monies that the defendants are liable to pay under those certificates and for any costs payable thereon in defending the action (paras 24 and 35 of the defendants' claim against the third party), the third party's reply as it appears in para 17 of its defence, reads:

> 17. It is denied that the Defendant is entitled to an indemnity against the Third Party as alleged in paragraph 24. The Third Party avers that insofar as the Plaintiff is held entitled to any money under the Certificates which are the subject matter of the Plaintiff's Statement of Claim the Defendant will not have to

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> pay the same and/or will not have suffered any loss in that it will be entitled to set-off against any monies which are found to be due the costs of remedying the Plaintiff's breaches of contract which are particularised in paragraph 12 above.

Plaintiffs' evidence - factual aspects

28 There were altogether three witnesses of fact for the plaintiffs. They were Sebastian Kho Seng Fatt ('Sebastian Kho') who was at the material time the project manager of the plaintiffs; Lim Chwee Hock, who was at the relevant period the sales manager of Laporte Industries (Pte) Ltd, who supplied chemical additives known as Laporte SAC22 and SAC23 which were used as an admixture to the screed and the bonding matter to the external tiles of the project; and Toh Kim Boon, the sole proprietor of Siwahin Decoration Contractors who undertook the tiling work in relation to the building. There was a fourth witness, Goh Chong Chia, a registered architect and past president of the Singapore Institute of Architects who was produced by the plaintiffs to speak on the architectural practice in Singapore. Insofar as material, their evidence can be summarised as follows.

Evidence of Sebastian Kho

29 He is currently the general manager of the plaintiffs. Between October 1990 and March 1992 he was employed by the plaintiffs as their project manager for the building works in question.

30 Following the award of the main contract for the construction of the building on 30 September 1990, the building works commenced on 16 November 1990 and the practical completion of which took place on 20 March 1992. According

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to Sebastian Kho, the defects-liability period which commenced on 20 March 1992 ended on 19 March 1993.

Problem of the debonded tiles on the external facade

31 One of the works that came under the purview of the main contract was the tiling of the external facade of the building. The original requirement under the tender documents was that the external walls were to be tiled with ceramic tiles measuring either 240 x 52 x 8mm thick or 240 x 160 x 12mm thick. These tiles were to be laid with joints of 3mm on a thin set mortar bed. However, the tile size was changed as a result of instructions from the third party on 2 May 1991, to one measuring 245 x 300 x 8mm. These tiles were also to be laid with joints of 3mm in width.

32 At various site meetings held between the period December 1990 and April 1991, Sebastian Kho voiced his objections on the suitability of the tiles selected, to the architects and the defendants' representatives and his objections, as he testified, were based on the following:

> (a) The size, consequent weight and shallow key of the tiles meant that they will not bond onto the mortar regardless of the strength of the bonding material used. I had indicated to the Defendants and the Architects that, in the Plaintiffs' opinion, the selected tiles were more suitable for floor tiling rather than for wall tiling. This objection was minuted in the Minutes of the Main Contract Site Meeting Nos. 7 and 22 dated 26th December 1990 and 17th April 1991 respectively.
>
> (b) There was a good tendency of the tiles "warping" due to their size which will ultimately affect the bonding of the tiles to the mortar bed;
>
> (c) The tile joint of 3mm width as specified by the Architect was not suitable because it did not cater for the movement of the tiles caused by constant exposure to the sun;

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> (d) The expansion joints of 16mm width at a column spacing of 10.8 metres was not suitable since it did not, again, cater for the movement between the joints caused by constant exposure to the sun. This fact was pointed out to the Defendants by World Tiger Industries (Pte) Ltd, the suppliers of the polysulphite sealant. The Plaintiffs also wrote to the Architects on 28th September 1991 informing them of the same. Both Mr Chuang Shaw Boon of the Plaintiffs and I had suggested to the Architect to specify a width of 16 to 20 mm at an interval of 5 to 6 metres but this was rejected.

33 Despite the plaintiffs' objections, the third party and the defendants still proceeded to confirm the selection of the tiles objected to. Instead of engaging the tile suppliers, King Loong Pte Ltd ('King Loong') as a nominated sub-contractor - which appointment might well have relieved the plaintiffs of certain obligations - the third party and the defendants insisted that King Loong be appointed the plaintiffs' own direct sub-contractor for the supply of tiles. The plaintiffs, with a view to ensuring progress of works without any let or hindrance, gave in to the demand and appointed King Loong as their director sub-contractors.

34 The adhesive to be used for the bonding of the tiles was approved and selected by the third party. The original specification was for use of a brand known as 'Laticrete'. However, upon the recommendation of the plaintiffs, the use of alternative adhesives known as SAC22 and SAC23, supplied by Laporte Industries Pte Ltd were chosen by the third party after some mock-up tests had been carried out.

35 Sebastian Kho further claimed that during the mock-up tests, tiles were affixed to the wall, some with 3mm width tile joints and some with 6mm joints to enable the defendants and the third party to decide on an aesthetically pleasing finish. The defendants subsequently settled for the 3mm wide tile joints. The plaintiffs in the process also suggested to the third party and the

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defendants to seal the tile gaps with a polysulphide sealant. The estimated cost of such a sealant would result in an outlay of between $60,000 and $70,000. The defendants, however, opted for an inexpensive alternative of an ordinary cement sealant for the tile joints except for the expansion joints, which were located at 10.8 metre intervals, to be sealed with polysulphide sealant.

36 The installation of the external wall tiles commenced sometime in September 1991 and was completed by 19 February 1992. The tiling work was undertaken by the plaintiffs' own sub-contractor, Siwahin Decoration Contractors. The installation of external tiles was done in accordance with the shop drawings approved by the third party and were supervised at all material times by Mr Tan Deng Wee, the Architectural Clerk-of-Works and also by the architect during his regular site visits.

37 It should be mentioned presently that Sebastian Kho had initially claimed that the shop drawings were prepared by the tile suppliers, King Loong and submitted by them to the third party through the plaintiffs. However after making an application through his counsel requiring the defendants or the third party to produce the shop drawings, he gave the court a somewhat confused account including the assertion that the shop drawings were prepared by the plaintiffs' own quantity surveyor, one Zoe Tan (page 1259 of NE). But ultimately, his evidence was that no shop drawings were prepared by King Loong and those which were referred by him as shop drawings were in fact those provided by the third party.

38 Sometime in mid-May 1992, Tan Deng Wee telephoned Sebastian Kho and informed him that some of the external wall tiles between grids two and four at the fourth and fifth storeys of the front facade of the building facing

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Commonwealth Avenue had buckled and were 'popping out'. Immediately Sebastian Kho proceeded to the site to inspect the complaint since the debonding had taken place during the defects-liability period. His inspection revealed that some of the debonded tiles had fallen to the ground and that the keys at the back of the tiles contained little or no remnants of adhesive and the adhesive was still bonded to the mortar or screed on the wall. About a week after the initial complaint, the plaintiffs removed the debonded tiles and adhesive completely from the affected areas and replaced them with new tiles of the same specification and adhesive.

39 On 16 July 1992 more tiles debonded. Mr Anson Ho of the third party instructed Sebastian Kho to investigate the matter and report the findings to him.

40 Representatives from Laporte, the adhesive suppliers, were asked to attend at the site to investigate the problem. As more tiles from the external facade facing Commonwealth Avenue appeared to part company with the adhesive, the plaintiffs were advised by Lim Chwee Hock to consult a firm of specialists, RAK Materials Consultants ('RAK') to carry out tests to determine the cause of the problem. Subsequently, Sebastian Kho liaised with a Mr Paul Mundell of RAK on this.

41 On 31 July 1992, a meeting was held to discuss the problem of the debonded tiles. Present were Sebastian Kho, C G Tan (plaintiffs' quantity surveyor), Lim Chwee Hock (of Laporte), Wong Fook Yuen (of the defendants), Anson Ho (the architect) and Tan Deng Wee (the Architectural Clerk-of-Works). The plaintiffs informed the third party at this meeting that the problem could have arisen either through differential movement in the structure or due to the movement of the tiles from constant exposure to the sun.

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42 It was then decided by all parties that an expert opinion be sought and the third party instructed the plaintiffs to obtain quotations from RAK for the following:

> (a) a visual inspection and report on the probable cause of the debonding tiles;
>
> (b) the tests which have to be carried out to ascertain the actual cause of the problem and a report on this; and
>
> (c) The proposals for remedial action.

43 There then ensued a meeting of the representatives of all parties except Laporte, on 1 August 1992 when Mr Paul Mundell of RAK conducted a visual inspection of the affected areas and expressed his view that the cause of the debonding was due to thermal differential movement of the tiles.

44 Mr Mundell suggested at the meeting that in order to ascertain the total area affected, a thermographic survey at an estimated cost of between $50,000 and $60,000 be carried out. Another suggestion by him was a more economical method of manually tapping individual tiles to ascertain whether they were hollow, at an estimated cost of $8,000. Mr Mundell also recommended additional tests such as: (a) whether the adhesive used for the bonding of tiles to the mortar complied with the British Standards (BS) 5350; (b) whether the tiles used complied with BS 643 in respect of its absorption qualities and thermal properties; (c) whether the workmanship complied with BS 5385; and (d) whether there was any building movement due to settlement or otherwise.

45 The foregoing recommendations which were contained in Mr Paul Mundell's letter dated 3 August 1992 were forwarded to the third party for further instructions. However, the plaintiffs learnt from Mr Mundell, sometime in August 1992, that the defendants had commissioned RAK to carry out manual

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tapping of the tiles to ascertain the extent of the affected area and to investigate the cause of the debonding.

46 Amidst all this, on 12 August 1992, the third party instructed the plaintiffs, in writing, to provide safety nets to cover the external facade of the affected areas. On 14 August 1992, the plaintiffs were further instructed to remove the debonded tiles from the affected areas. As it was the plaintiffs' view that the cause of the debonding was due not to any shortcoming in the workmanship but as a result of the third party's faulty design, they informed the third party by their letter dated 18 August 1992, that they would carry out the works demanded only if they were allowed to claim for the additional works. Since no response was forthcoming from the third party, the plaintiffs did not execute the third party's instructions.

47 Subsequently on 20 and 22 August 1992 respectively, the third party forwarded to the plaintiffs, lists of defects to be rectified. The lists referred to two specific areas where the external tiles had debonded at the PUB station rear door and staircase 4 on the eighth storey. Sebastian Kho again informed Mr Anson Ho that as the debonding of the tiles was not due to the plaintiffs' fault, they were not obliged to carry out rectification works during the defects-liability period. They were however prepared to carry out the rectification if the said works were to be treated as additional works. As there was no response from the third party, no such works were carried out.

48 On three occasions between the period commencing 30 October 1992 and ending 16 November 1992, the third party and the defendants wrote to the plaintiffs on the rectification works to the external facade tiling, threatening to engage other contractors to carry out the works. On 30 November 1992, the

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third party again informed the plaintiffs that the falling tiles constituted a hazard to occupiers and visitors to the building and that it was the plaintiffs' responsibility to remove the debonded tiles during the defects liability period. To find a solution to the problem, on a goodwill basis and without prejudice to the plaintiffs' stated position on the cause of the debonded tiles, the plaintiffs wrote to the third party on 4 December 1992 requesting an urgent meeting between the defendants, the third party and the quantity surveyors to review the problem. The upshot was a letter from the defendants' solicitors to the plaintiffs on 9 December 1992 demanding immediate removal of the debonded tiles which the plaintiffs duly passed on to their solicitors for reply.

49 Sebastian Kho claimed that between 4 and 16 December 1992, he had tried to arrange a meeting with the defendants' Wong Fook Yuen but the latter was either on leave or not available during that period. On 16 December 1992, however, Mr Anson Ho, with reference to the plaintiffs' request on 4 December 1992, telephoned Sebastian Kho to attend a meeting at the third party's office on 17 December 1992. The plaintiffs did not attend the said meeting since they were given less than 24 hours' notice for the meeting but in turn proposed alternative dates on either 21 December 1992 at 4.10pm or 22 December 1992 at 2.30pm. No reply to this proposal was received either from the third party or the defendants. The plaintiffs' solicitors by their letter dated 24 March 1993 reiterated the plaintiffs' position that the debonding of the external wall tiles was due to no fault of theirs but instead due to the third party's design of the same.

50 There followed an exchange of correspondence between the third party and the plaintiffs. On 5 May 1993 the third party wrote to the plaintiffs instructing them pursuant to cll 27(3) and 11(2) of the contract to carry out tests on the

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adhesive used and to conduct certain pull-out tests for the tiles. The plaintiffs replied on 12 May 1993 requesting an urgent without prejudice meeting on the instructions given by the third party. Sebastian Kho asserted that the plaintiffs were keen to resolve the problem of the debonded tiles and were anxious to have a meeting particularly in the light of the third party's revision of Interim Certificate No C18 on 31 March 1993.

51 However, instead of arranging a meeting, the third party, on 13 May 1993 issued a formal instruction to the plaintiffs under cl 1(7) of the contract requiring the plaintiffs to make good the whole of the external tiling works. The instruction further contained a warning that the plaintiffs' failure to comply with the instructions would result in the defendants appointing other contractors to carry out the works and look to the plaintiffs for costs incurred.

52 Again on 24 May 1993, the third party wrote to the plaintiffs instructing the plaintiffs to appoint a firm known as Setsco to carry out the pull-out tests. No mention however was made by the third party on the plaintiffs' proposal to have a without prejudice meeting.

53 Finally on 25 May 1993, the third party wrote to the plaintiffs informing them that the meeting requested will be held in the week commencing 31 May 1993. On 27 May 1993, the third party confirmed that the said meeting would be held at their office on 2 June 1993.

54 The plaintiffs by then were rather disenchanted with the stand taken by the third party. They felt that the third party was being unreasonable in insisting that the plaintiffs carry out the rectification of the external facade. Feeling that no useful purpose would be served by carrying out the pull-out tests or in holding

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any meeting between them, the plaintiffs wrote to the third party and advised the latter accordingly.

55 On 3 June 1993, the third party wrote to the plaintiffs stating that since the plaintiffs had failed to comply with the third party's instructions issued on 5 May 1993, the third party would be advising the defendants to exercise whatever rights they had under the contract.

56 There were no further communications between the third party and the plaintiffs in regard to the external wall facade until 17 December 1993. On that day, the third party wrote to the plaintiffs pursuant to cl 27(4) of the contract informing them not to carry out the rectification works to the external tile facade. The plaintiffs were told that there would be a reduction in the contract sum, as assessed by the project's quantity surveyors and such sum would be deducted from the retention monies owing to the plaintiffs.

Defects other than the debonded tile facade

57 Upon the issuance of the certificate of practical completion on 28 April 1992, the third party forwarded to the plaintiffs a list of defective works with instructions that they be rectified. The said defects were all rectified by September 1992 or thereabouts with the exception of the toilets. According to the plaintiffs the defects to the toilets were not due to poor workmanship but instead due to wear and tear or vandalism.

58 Further tests followed. On 22 October 1992 and 23 December 1992, the third party issued further lists of defective works. On 19 March 1993, the defects liability period expired. On 29 March 1993, pursuant to cl 27(2) of the contract, the third party sent to the plaintiffs a final schedule of allegedly defective works.

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On 16 April 1993, the plaintiffs wrote and advised the third party that several of the allegedly defective works were either additional works or caused by vandalism. In regard to genuine defective works, the plaintiffs undertook to rectify them within a time frame of eight weeks.

59 The third party's reply dated 23 April 1993 was to proceed with the rectification works pending the third party's advice on those items of work which were considered additional or due to vandalism. However on 13 August 1993, pursuant to cl 27(4) of the contract, the third party instructed the plaintiffs, not to carry out the rectification works. The third party stated that they would instead be reducing from the contract sum, the value of the defective works which value was to be assessed by the quantity surveyors and would be taken into account by the third party in the final certificate. By their letter dated 25 August 1993, the plaintiffs protested against the proposed course of action.

60 The plaintiffs' position since then, was that they were prepared to give the defendants credit for the sum of S$16,442.12 being the cost of rectifying some of the items of the works that were properly considered to be defects within the contract. The plaintiffs maintained that save for the sum of $16,442.12, no sum was due to the defendants as respects the defective works.

61 The remainder of the evidence of Sebastian Kho during examination-in-chief concerned the issuance of Interim Certificate Nos C18, C19, C20 and C21. According to Sebastian Kho, under certificate No C18 the third party had certified payment to the plaintiffs of a sum of $580,933.10. Certificate No C18 was issued pursuant to cl 31(1) of the contract. When the plaintiffs realised that the payment so certified represented the first release of the retention monies, they wrote to the third party pointing out that the governing clause is cl 31(7)

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and that the third party correct certificate No C18 accordingly. In the meantime on 29 March 1993, Sebastian Kho learnt from Anson Ho that the third party intended to deduct a sum of $49,500 from certificate No C18 for alleged defective works on the external facades. The plaintiffs objected and reiterated that since certificate No C18 was purportedly issued under cl 31(7) of the contract any such deduction would not be permissible under the provisions of the said contract.

62 All the same, the third party issued a further Interim Certificate No C19 whereby it had certified a new payment of $531,433.10 after deducting a sum of $49,500 on account of the alleged defective works in respect of the external wall tiles. Yet no payment was forthcoming from the defendants even as to the revised sum of $531,433.10 despite the plaintiffs' solicitors demand letter to the defendants dated 19 April 1993.

63 There were further revisions to the Interim Certificates. On 5 May 1993 the third party amended certificate No C19 and issued a further Interim Certificate No C20 under which the third party deducted a sum of $750,000 for making good the defective external tile facade. This certificate meant that the plaintiffs now owed the defendants a sum of $218,566.90. The third party's reason for issuing Interim Certificate No C20 was that in their expert's opinion, the entire external tiling work was unacceptable and should be treated as defective works for which the plaintiffs were responsible.

64 Then on 13 May 1993, the third party issued yet another amended Interim Certificate No C21 in which it had admitted that their earlier deduction of the sum of $750,000 was erroneous and the amount owing by the plaintiffs to the defendants was in fact $40,259.40. On 27 May 1993, the plaintiffs, pursuant to

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cl 31(11) of the contract sought clarifications from the third party on Interim Certificates C20 and C21 and were advised by the third party in their reply dated 24 June 1993 that the debonding of the tiles was not due to a design problem but due instead to poor workmanship.

65 The foregoing was the recapitulation of Sebastian Kho's evidence-in-chief. In his *viva voce* evidence, Sebastian Kho added that as the project manager of the plaintiffs, he was present at the site during the progress of the works almost daily. He commended the experience and ability of their chief tiler, Toh Kim Boon. He highlighted amongst other things his earlier concern about the suitability of the Korzilius ceramic tiles selected by the defendants and the third party for the external tile facade particularly in relation to the size of the tile ie, 300 x 245 x 8mm. He added that the adhesive used for bonding the tiles onto the mortar was mixed on location near to the floor where the work was going on. He claimed that during a demonstration done on site by Laporte, the third party's architect in-charge, the tiler Toh Kim Boon and himself were present. As to the material to be used for grouting the tile joints, he mentioned that his suggestion to use polysulphide material was not accepted by the defendants on account of costs and neat cement, grey in colour, was instead suggested by the defendants. He added that the reason the tiles popped out was not due to workmanship.

66 During cross-examination he said that the space between the joints was achieved by the use of tooth picks as spacer lugs to obtain the 3mm each tile joint (pages 1225 and 1226E-F of the NE). He mentioned that the installation of the tiles was done by way of a square panel of 16 tiles (4 x 4) - (the 300mm length horizontally and the 245mm side vertically) (pages 1206 to 1210 of the NE).

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67 When questioned by counsel for the defendants that in the light of the tolerance of the tiles which could be plus minus 1%, whether it was clear to him that laying the tiles in panels of 16 tiles each might lead to some of the tile joints measuring less than 3mm in size, Sebastian Kho's initial response was that: 'the tiler would adjust .. for that on the expansion joint area.' When questioned how this would be done when he had given a fixed area for the panel of 16 tiles, he replied that 'the end point, the 16mm wide expansion joint ... is sometimes less than 16(mm) because of the tile sizes.' (pages 1209F to 1210B-C of the NE - 28 October 1996 at 12.30pm).

68 The next day ie, on 29 October 1996 (pages 1284 and 1290 of the NE), he modified his evidence and said that whatever adjustments required were obtained through the cut tiles placed at the two ends adjoining the expansion joints.

69 As regards the suitability of the Korzilius tiles which were selected and used as external wall tiles, Sebastian Kho said that leaving aside the aspect of the provision for the 3mm tile joints and the expansion joints as designed, the tiles were suitable for external wall applications (page 1212 of the NE).

70 As regards the shop drawings for the external wall tiles, his replies during cross-examination (page 1257 of the NE) were somewhat mangled. His final position was that no shop drawings were prepared by either King Loong or the plaintiffs and whatever that were called shop drawings in the proceedings herein (enclosures to exhibit TP-3) came from the third party.

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71 The next witness for the plaintiffs was Mr Lim Chwee Hock who was at the relevant period the sales manager of Laporte. His evidence insofar as material is as follows.

72 Laporte specialises in the supply of chemical additives for use in the construction industry, two of which were known as SAC-22 and SAC-23. These products are cement based admixtures employed to improve the strength of the tile mortar bed and the render mortar bed. Tests carried out by Setsco in Singapore and by test laboratories overseas showed that both SAC-22 and SAC-23 achieved a high standard in improving the mortar bonding and even surpassed the requirements for such additives imposed by the British and Australian construction standards.

73 The additives are cement based. They will have to be mixed with portland cement according to manufacturers' specifications. The compressive strength for the mortar mixed with the SAC-22 is 39.5N/mm2 and for the shear bond strength of mortar mixed with SAC-23 is 3.81N/mm2. If the tiles are of an uncommon nature, the types of adhesives need to be changed.

74 Laporte supplied to the plaintiffs SAC22 and SAC23 in June 1991 and to the best of his knowledge, there was a demonstration on the use of the said adhesives on site.

75 Sometime between 16 and 27 July 1992, Mr Lim Chwee Hock was informed by Sebastian Kho that some of the tiles on the external wall had debonded. Subsequently, he visited the site and noticed there that some tiles were vertically warping out; he also noticed cracks on the floor around the columns. He

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recommended that tests be carried out to ascertain the cause of debonding and suggested that the plaintiffs approach RAK to carry out such tests.

76 In his *viva voce* evidence, Mr Lim Chwee Hock added that for the tile adhesive, Laporte recommended SAC23 to be used with neat cement as a thin-set bond. This was done upon observing that the tiles selected had shallow keys. Mixing with sand was not recommended as it will build up body and this will be more appropriate for tiles with deep keys instead. He added that the open time for the SAC23 mix was 25 minutes in Singapore and the pot life for it was between one and two hours. According to him, SAC23 was well established in the United States and had been used in Singapore since 1983. He mentioned that SAC23 should be mixed on site and if the mixture was thick it could not be spread and if thin, would slump. Laporte also recommended a notched trowel with notches measuring 6 x 6mm to spread the mixed adhesive. They did not however recommend buttering, that is, the application of the adhesive on the back of the tiles. Mr Lim Chwee Hock added that in regard to the project under reference he recommended the alternative mix that is, one pail of cement to 19 litres of SAC23 (page 1854 of the NE). As regards the thick bed-setting screed, Laporte recommended SAC22.

Evidence of the chief tiler

77 Toh Kim Boon (PW-3), the sole-proprietor of Siwahin Decoration Contractors, the tiling sub-contractor for the project testified for the plaintiffs. His evidence as gathered from his affidavit of evidence-in-chief could be summarised as follows.

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78 His principal business is that of a contractor for floor and wall tiling works for over 31 years. He had been personally engaged in the installation of external wall tiles in four large construction projects undertaken by the Jurong Town Corporation and several other minor projects in Singapore.

79 In or about March 1991, he was appointed by the plaintiffs to instal internal and external wall tiles for the building. In or about August 1991, he was issued with a shop drawing by the plaintiffs' site foreman, Richard Wang in respect of the tiling works, which he followed. He later clarified (pages 2004 to 2006 of the NE) that what he had actually meant by shop drawing was the sketch given to him by the plaintiffs' site foreman.

80 He and his team of tilers commenced tiling works for the project in or about September 1991 and completed the said works in or about February 1992. The procedure adopted by him for the installation of the external wall tiles was as follows.

> (a) Firstly, the external facade wall was "plumbed" to ascertain the true plain face of the wall so as to ensure that an even application of the mortar can be achieved;
>
> (b) Once an even surface was determined, the mortar was applied accordingly to achieve an even smooth surface for the installation of the tiles;
>
> (c) The dry mortared surface was then marked to set out the layout of the tiles as required in the shop drawing. After the marking was completed, he checked with the site supervisor, Mr Richard Wang and the Clerk of Works, Mr Tan Deng Wee to ensure that the layout had been properly done. The Clerk of Works then checked the marked layout as against the shop drawings to ensure that the markings were consistent with the drawings;
>
> (d) After obtaining the approval from the Clerk of Works, the tiles were laid. The adhesive was first applied onto the mortar base. It was mixed on site according to the specifications and instructions issued by the adhesive suppliers. After mixing the

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> adhesive, it was immediately applied by the tilers on to the mortar and soon thereafter, the tiles were installed onto the wall.

81 Mr Toh personally supervised the installation of the external wall tiles in this project along with the defendants' Clerk-of-Works, who was present at every stage of the works. He also saw the architect in-charge on site, on several occasions making visual inspection of the installation of the tiles onto the external walls. He did not receive any complaints either from Tan Deng Wee or from the architect.

82 In his *viva voce* evidence, Toh Kim Boon testified, amongst other things, the following:

> (i) *Shop drawing* (pages 1919 to 1924 of the NE): It is more or less a plan but personally he did not really understand what the drawing was all about. He merely complied with the instructions given to him (page 1919D-E of the NE);
>
> (ii) *Application of SAC22 and SAC23*: He has had experience in employing them for tile installation elsewhere. SAC22 was used for the screed whereas SAC23 was used on tiles. For this project he used SAC22 mixed with sand and cement for the screed. But for the tile he had used SAC22 only with neat cement. He used a dog-toothed trowel in the installation process, that is, by floating the adhesive using trowels with a horizontal swipe and sometimes with a semi-circular swipe;
>
> (iii) *The setting out lines* (pages 1934 to 1940 of the NE): First of all, the tilers would mark out the lines as shown in the drawing by the Clerk-of-Works. Starting from the centre of columns 7 and 6 as shown in TP-3 (page 5), the tilers would mark out the horizontal lines and the position of the tiles to be laid. The position of the tiles would then be divided into panels of 16 tiles that is, four tiles horizontally and four tiles vertically with the left and right edges of the panels aligned to the window mullions (page 1937B-D of the NE). However, as the width of the tile panel would probably be slightly wider than the width of the window panel, the tilers were told, as far as possible, to align the edge of the panel with the window mullions and for the two panels nearing the edge of the columns, the tilers were required

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to cut the tile so that the width would correspond with the width of the column (see exhibits P-3, P-8 and TP-3 - page 5);

(iv) *Mixing of the adhesive SAC23* (pages 1944 to 1966 of NE): SAC23 came in a container. The persons charged with the mixing would pour the contents into 20 litre receptacles and then into five buckets with the use of a device. Thereafter, they would put in some cement and by the use of a device the adhesive was mixed with the cement to a certain consistency. The resultant mixture would be left in the bucket for about 10 minutes before the installation works commenced (pages 1944 to 1947B and 1957 of the NE). The pouring and the mixing of the adhesive were carried out at the particular level where the installation work was taking place. He disagreed that the mixing was done at the ground level or that the mixed material was hoisted up to the work level by means of ropes and buckets (page 1958);

(v) *Installation of tiles* (pages 1967 to 1972 of the NE): Toh Kim Boon was shown a diagram marked P-3 which appears thus:

13	14	15	16
9	10	11	12
5	6	7	8
1	2	3	4

Step 1: Level, alignment and fixing of wooden batten Step 2: Notch trowel adhesive to the panel of mortar screed Step 3: Sliding, twisting, positioning and tamping of tiles in row (1) commencing in sequence of number (1) to (4) Step 4: Upon completion of step (3), fix spacer lugs between the tile joints both horizontally and vertically; alignment and final tamping of tiles Step 5: Repeat step (3) and step (4) for 2nd row of tiles in sequence of numbering (5) to (8) Step 6: Repeat step (3) and step (4) for both 3rd row and 4th row of tiles numbering (9) to (16). NB: The total duration for the above sequence of laying for one panel of 16 tiles is approximately 10 to 12 minutes.

83 The sequence in which the tilers laid the 16 tiles in the panel was according to the numerical sequence as shown in the diagram. Prior to that they would sort out the tiles, since in the industry, it is normal to have tiles of different measurements ranging from 0.5mm to 1mm difference (page 1960 of the NE). The tilers were instructed to maintain a space of not more than 3mm between

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the tiles and for this the tilers made use of tooth picks as spacer lugs. They placed these tooth picks on the horizontal lines and only sometimes along the vertical lines (page 1972 of the NE).

84 Returning to exhibit P-3 and its enclosure ie, elevation sketches which were sometimes referred to during the proceedings as architectural drawings or shop drawings, Toh Kim Boon made it known that they were not the types given to him by the Clerk-of-Works (page 1980D-E of the NE).

85 Mr Goh Chong Chia, a registered architect for over 22 years and a past president of the Singapore Institute of Architects was also called by the plaintiffs to testify on their behalf. His evidence both oral and by affidavit was more in the nature of expert opinion.

86 In his evidence-in-chief, Mr Goh mentioned that it had always been the practice of architects in Singapore to follow as closely as possible the British Standards Code of Practice. In relation to the present case, Mr Goh expressed his view that the architect must comply closely as possible with British Standards Code of Practice No 5385 in the design of the external tile facade. He added that the architect of the project, in addition to complying with the said British Standard, should also make cross-reference to the equivalent Australian Standards Code of Practice No 3958 in the design of the external tiling, given the similiarity in the weather conditions between Australia and Singapore. During his oral testimony, Mr Goh disclosed that he had not seen or inspected the Haw Par Technocentre Building.

87 Under cross-examination by defendants' counsel, Mr Goh agreed that the design of the external tile facade was the project architect's responsibility and

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not that of the owner. When cross-examined by the third party's counsel, Mr Goh conceded that he had not had the opportunity of looking at any of the minutes of the site meetings or any correspondence between the parties. He agreed that a master tiler employed as a sub-contractor carried out specialised work.

Defendants' evidence

88 Tan Deng Wee, the Architectural Clerk-of-Works and Property Executive of the defendants said in his affidavit of evidence-in-chief as well as in his *viva voce* evidence as follows.

89 He had been in the employment of the defendants from March 1988, initially as a property executive and later as a Clerk-of-Works from 27 November 1990 (that was the date of the main contract site meeting No 3). He left the defendants' employment on 1 August 1994. As Clerk-of-Works he reported directly to the architect (page 2420 of the NE).

90 The plaintiffs also had their site foreman, Richard Wee conducting checks on the site. Tan Deng Wee would sometimes accompany Richard Wee and inform the latter of areas which required rectification.

91 Tan Deng Wee was the person in-charge of the worksite and the workers. His duties included the observation of the workers as they were performing their specific tasks which included the mixing of adhesive, floating the adhesive on the screed, soaking of the tiles in water, putting up the tiles and tamping the tiles into place with a mallet.

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92 He carried out spot checks on the workers as the installation of tiles was in progress. On such occasions, he gauged the width of the spacing between the tiles by using a PVC strip of 3mm thickness placed between the tiles as it was too time consuming to measure each and every tile spacing. He conducted these checks mainly in those areas which could be reached by him easily such as the space near the windows.

93 During such spot checks, he had discovered areas where the spacing was less than 3mm and these defects were randomly located throughout the building. He did not conduct a thorough search but believed that these defects amounted to about 20% of the areas where he had carried out his checks.

94 From the best of his recollection, the falling of tiles came to his attention sometime in May 1992 after the issuance of the completion certificate on 20 March 1992. It was during one night when the night security guard informed him of falling tiles in the front part of the building facing Commonwealth Avenue. This was the portion of the building where most tiles debonded. Upon being notified, he had arranged for those dislodged tiles to be cleared. He was then unable to determine the cause of the debonding. The adhesive applied on the wall was still in place and there were no remnants of the adhesive at the back of the debonded tiles.

95 Strong winds on the night of 4 November 1992 resulted in pieces of tiles falling on several glass panels on the space-frame skylight above the main lobby entrance. The plaintiffs did nothing to rectify the defects and as a result sub-contractors were engaged by the defendants to perform rectification work.

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96 At about this period, there were ongoing water leakage problems beginning as early as June 1992, mainly after downpours. The defendants received several complaints from the tenants in this regard. One such complaint was that there was water seeping into the tenant's premises from the top window sills and the brick walls below the windows but he was unable to ascertain the actual cause of the problem. Upon instructions, the plaintiffs did finally rectify the water leakage and choking problems.

97 A few months after the tiles started debonding, the defendants caused netting, mounted on a wooden scaffolding around the building to be set up to ensure that the tiles debonding did not cause injuries to visitors and property.

98 Tan Deng Wee was later assigned to work in another project at Toa Payoh and upon his transfer, Cheng Heng Sin (DW-3) was appointed by the defendants to keep a look out for the debonding tiles.

99 Under cross-examination Tan Deng Wee testified amongst other things, as follows.

100 The drawings in relation to the external tiling layout were to the best of his recollection, supplied by the project's first architect, Angela Tseng. The drawings contained vertical and horizontal expansion joints; they did not however contain the setting out lines. The tile joint space of 3mm was specified in the architectural drawings.

101 The architect visited the site usually after the weekly site meetings and sometimes on other occasions. As regards the mixing of the adhesive, this was initially done at the ground level (see page 2575C of the NE) and the mixture was sent up to the level where the tiling work was in progress by means of ropes

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and buckets. Tan Deng Wee later mentioned that he was not sure whether it was the screed or the adhesive mixture which was transported to the work level. Whenever he had observed that some of the vertical joints were not of 3mm width, he would point this out to the contractor especially to the plaintiffs' site foreman Richard Wang and the contractor took steps to rectify about 80 to 90% of the deficient portions. He did not deem it fit to report this to the architect as he was of the view that the tile joint width could be less sometimes due to the 1% plus or minus, tile irregularities. He also revealed that at least 20% of the total area was found by him to have been tiled with unacceptable tile joint width and remedial work was carried out by the tilers.

102 Mr Wong Fook Yuen, the property manager of the defendants said in his affidavit of evidence-in-chief, as follows:

103 In the course of the progress of the works, he became aware that the plaintiffs were behind schedule and were rushing to complete the works. In the event the works were completed on or about 20 March 1992 and the completion certificate was issued by the third party. The work was however unsatisfactory. The defects became apparent and many complaints were received from the occupants and tenants of the building which included:

> (1) Tiles debonding from the surface of the external facade of the building and falling from about May 1992; and
>
> (2) Water seepage from the column beams and walls damaging carpets and furniture belonging to the tenants.

104 The complaints concerning the defects were duly made known to the plaintiffs. Since no remedial measures were taken by the plaintiffs, the defendants had to engage other contractors to undertake protective measures and remedial works. The defendants in this regard engaged a number of

contractors: Consafe Builders to carry out particularly replacement of floor tiles at the lobby area; Dokota Pte Ltd to clear the space surrounding the area of debonded tiles and put up protective netting and precautionary devices; and Brilliant General Building Construction (Pte) Ltd ('Brilliant') to replace the tile facade with a finish known as 'Eleganstone'.

105 The defendants also commissioned RAK to ascertain the cause of the debonding of tiles and the report submitted by RAK on or around 11 January 1993 revealed that the said defect was due to a combination of design faults and poor workmanship. RAK mentioned in its report that the primary cause was the lack of adequate provision for thermal movement attributable to poor workmanship and other factors.

106 Subsequently, on or about 21 December 1993 (sic) [22 January 1993], the third party engaged their own expert, Dr Henry Ong to look into the debonding effect. The report which was completed on 5 April 1993 (sic) [30 April 1993] had stated that the debonding tile defect was principally due to poor workmanship.

107 The defendants had no alternative but to make good the defects through other contractors for the following reasons:

> (i) the Plaintiffs had refused and/or failed and/or neglected to comply with their obligations under the said contract;
>
> (ii) there was grave danger posed to both persons and property by the said defects;
>
> (iii) on 17 May 1993, the Public Works Department directed the Defendants to repair the debonding tile defect;
>
> (iv) the damages suffered by the tenants of the Technocentre resulting from the said defects;

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> (v) loss of reputation by reason of the adverse press release on the debonding tile defect; and
>
> (vi) reliance on the Third Party's Interim Certificate No 21 declaring that "all of the external tiling work is now unacceptable".

108 He then quantified the damages suffered by the defendants under the various heads as $2,630,587.28 and also gave a sequence of the relevant Interim Certificates affecting their claim. His averments in regard to certificates C18, C19, C20 and C21 are as follows:

a. Certificate No. 18

> i To the best of my knowledge, the Third Party, as Project Architects was obliged to issue Interim Certificates. ii On or around 19 February 1993, the Third Party issued Certificate No. C18 for S$580,933.00 despite having notice of the debonded tiles effects and the expert report submitted by the Defendants, which tends to suggest the Plaintiffs lacked due care and skill in carrying out the said work. iii On 9 March 1993, the Defendants through their solicitors challenged Certificate No. C18 and drew the Third Party's attention to clause 31(4) of the SIA. I now produce and marked "WFY-27" a copy of the solicitor's letter.
>
> b. Revised Certificate No. C19
>
> i. On 31 March 1993, the Third Party issued a revised Interim Certificate No. C19 stating that "5% of the external tiling work is now unacceptable and is properly treated as defective works for which the contractors are responsible whereby the employers is entitled to deduct therefrom a fair allowance until satisfactory rectification is completed." Certificate No. C19 reduced C18 by $49,500.00. ii On 14 April 1993, the Defendants wrote to the Third Party challenging the Revised Certificate No. 19 and requested the Third Party to set out the basis in which they reached the decision that the 5% of the external tiling work is defective.
>
> c. Revised Certificate No. C20
>
> i On 5 May 1993, the Third Party issued Certificate No. C20 pursuant to Clause 31(4). The Third Party certified that the sum of $750,000 was deducted from Certificate No. C19. The deduction was to take into account the debonding tile defect.

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> As Certificate No. C19 was only for $531,433.10, the amount stated to be "owing this certificate" was $218,566.90.
>
> d. Revised Certificate No. C21
>
> i. On 13 May 1993, the Third Party issued a revised Certificate No. C21. It was certified that Certificate No. C20 was amended and that the sum of $571,692.50 was to be the amount to be deducted from Certificate No. C19. As a result, $40,259.40 was owing on this Certificate No. C21 to the Defendants. ii Accordingly, no payment was due from the Defendants to the Plaintiffs under Certificate No. C18 or Certificate No. C19.

109 Mr Wong's *viva voce* testimony (pages 2861 to 2935 of the NE) is largely in relation to the aftermath of the falling tiles. He recounted the several complaints and correspondence exchanged between the defendants and the building's tenants and prospective tenants. He also detailed the protective as well as safety measures undertaken by the plaintiffs to protect property and lives. He outlined the steps taken by the plaintiffs to provide safety netting and the rectification work undertaken by Brilliant as respects the external wall and Consafe Builders replacing the mismatched lift lobby tiles. He also narrated the events leading to the studies undertaken by RAK and as regards the costs involved in connection with the rectification work and the appointment of the third party to be their architect for the re-finish of the external wall surface. In connection with the foregoing, he made reference to various documents, correspondence, invoices and studies. He also recounted, *inter alia*, the losses suffered by the owners, including loss of rental and loss due to some tenants not taking up their leases, losses occasioned by lost management time, expenses incurred in providing safety netting, including charges incurred for gondolas to undertake the work. By and large, with a view to proving strictly the counterclaims of the defendants, he took the court through the entire terrain of the defendants' losses and expenses consequent upon the delamination of the

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external wall tiles of the building as well as alleged defective works by the plaintiffs.

110 When cross-examined, Mr Wong admitted that the quote by Consafe Builders for the rectification work was not the lowest. He denied the suggestion that the defendants were in league with the third party to pin the blame on the plaintiffs as respects the defective tile facade. He conceded that the choice of the tiles was made by his superior Mr Wee Ee Lim in consultation with the third party and that the plaintiffs had at the outset expressed their reservation as to its suitability. He also said that RAK was engaged by the defendants with the knowledge of the third party to do a study and report on the causes for the falling tiles. He agreed that the report submitted by RAK had stated that the main cause of delamination was the lack of expansion joints. He further agreed that it was the duty of the third party to provide for such expansion joints.

111 The evidence of Mr Chen Heng Sin, a property executive with the defendants, as contained in his affidavit of evidence-in-chief was to the following effect.

112 In or around December 1992, he was deployed by the defendants for managing certain technical aspects of the building, including security, maintenance and repairs. To the best of his knowledge, the tiles began to debond from the facade of the building from around May 1992. Although such debonding and other defects were brought to the plaintiffs' attention, the plaintiffs did not take any remedial action. Due to the failure on the part of the plaintiffs to take remedial action, the defendants undertook the task themselves. He also made a record of the tiles that were debonding and were debonded.

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113 After receiving many complaints from the tenants and occupants of the building, the defendants, as a precautionary measure, put up safety netting mounted on wooden scaffolding around the building. The affected areas were also barricaded and cordoned off so that the debonded tiles posed minimal risk to the occupants and tenants of the building.

114 After taking into account the following, namely, the nature, extent and danger posed by the debonded tiles, lack of response from the plaintiffs, the Interim Certificate from the third party under which all the external tiling work was found unacceptable, an order from the PWD on 17 May 1993 to remedy the debonding tiles and the loss of reputation and adverse news coverage, the defendants decided to replace the entire building facade. In the event, Brilliant were awarded the contract for the replacement of the facade and rectification works were completed in or around July 1994.

115 The plaintiffs also failed to rectify the other defects contained in the schedule of defects specified by the third party, despite reminders from the defendants and the third party. As a result, the rectification of the defects was undertaken by Consafe Builders and the said works were completed sometime in early 1994.

Third party evidence

116 The evidence of Mr Ho Ann Soon, an associate partner of the third party, as contained in his affidavit of evidence-in-chief can be summarised as follows.

117 He joined the third party in 1983 and had been a practising architect since 1986. He was made an associate partner of the third party since 1991. The third party was appointed by HPIL to act as the latter’s architects for the building and

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the terms of their appointment were evidenced in a letter dated 9 May 1988 from the third party to HPIL. Under para 5 of the said letter, the appointment was also subject to the Singapore Institute of Architects Conditions of Appointment and Scale of Professional Charges, 1985 ('SIA Conditions').

118 In addition to the third party's appointment as architects, HPIL also appointed the project's quantity surveyors (Langdon Every & Seah later known as Davis Langdon & Seah), the structural engineers (T H Chuah & Partners) and the mechanical and electrical engineers (J M Pang & Seah (Pte) Ltd).

119 Immediately after their appointment, the third party proceeded to take instructions on HPIL's requirements for the proposed project and prepare the design of the building for HPIL's approval. Thereafter the third party, obtained the necessary approvals from the authorities for the design of the proposed building.

120 After receiving approvals for the design of the proposed building, the defendants instructed the third party to award the main contract to the plaintiffs on 25 October 1990. The award was made to the plaintiffs by way of a letter dated 30 October 1990 from the third party and the building contract was signed between the defendants and the plaintiffs on 8 February 1991.

121 The contract value was S$20,673,191.26 with a construction period of 50 weeks. The contract commencement date was 14 November 1990, the terms of which followed the Articles and Conditions of Building Contract (third edition) published by the Singapore Institute of Architects. One of the requirements in the contract more specifically in the Bill of Quantities (B3.9/14 to B3.917), was

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that the external facade of the building was to be finished with external wall tiles.

122 He himself was not personally involved in this project when it first began in 1988. It was handled by another architect, Miss Angela Tseng, who was in-charge of the project until the end of May 1991 when she resigned from the employment of the third party. It was upon her resignation that he took over the project. By that time, the building was at the structural stage of construction.

External tile selection process

123 Sometime in April 1991 quotations were obtained for the supply and delivery of internal and external tiles for both the floor and wall. As regards the wall tiles, various specimens were considered. It could be gathered from the minutes of the site meetings that the defendants were initially considering a white ceramic tile measuring 300mm by 245mm by 8mm (Korzilius tiles) manufactured by a German company. Two tile suppliers namely Wing Tai Enterprises Pte Ltd ('Wing Tai') and King Lung Trading Pte Ltd ('King Lung') were asked to give their confirmation that the tiles selected were suitable for external wall tiles. Subsequently, the third party received letters from Wing Tai and King Lung stating that the Korzilius tiles were suitable for external wall applications. These letters were tabled at a main contract site meeting No 11 on 22 January 1991. The upshot was that the plaintiffs undertook at the meeting that they would write direct to the manufacturer in Germany to obtain confirmation on the suitability of the external wall tile. As it transpired, the plaintiffs did not write to the manufacturer as mentioned by the plaintiffs in the said meeting.

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124 On 24 April 1991, Haw Par Properties received a letter from the manufacturers of Korzilius tiles confirming that their tile was suitable for external wall applications. It would appear from the said letter that Mr Wee Ee Lim of Haw Par Properties had a telephone conversation with representatives of the manufacturers of Korzilius tiles who confirmed the suitability of their tiles for external cladding. Consequently on 2 May 1991, Architect's Instruction No 026 was issued to the plaintiffs to order, amongst other things, the Korzilius tiles for the external facade of the building.

External tile application works

125 The plaintiffs commenced work on the external facade sometime in late September 1991. At that point of time the plaintiffs had approximately only one month to complete the work since the contract completion date was 30 October 1991.

126 In accordance with established architectural practice, he carried out periodic inspections at the site where the plaintiffs were executing the external tile works. His inspections would usually take place immediately before or after each weekly main contract site meeting.

127 The site staff responsible for the day to day supervision of the external tiling works was the Architectural Clerk of Works, Tan Deng Wee. He was required to submit at every main contract site meeting a report on the progress of works by the plaintiffs. Similarly the plaintiffs were also required to submit a report on the progress of the works at every main contract site meeting and this was discussed at every such meeting.

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128 Throughout the period during the external wall application, neither the plaintiffs nor the Architectural Clerk of Works raised with him either verbally or in the weekly progress reports, any problems or difficulties encountered by them during the progress of the plaintiffs' work on external facade of the building.

129 Tiling of the external facade of the building was completed in the middle of February 1992. All works were completed under cl 24(4) of the Building Contract on 20 March 1992. The completion certificate thus issued was dated 28 April 1992 and a copy thereof was sent to the plaintiffs by way of a letter from the third party dated 28 April 1992. In the said letter the plaintiffs were informed that the maintenance period was deemed to commence from the date of completion for a period of 12 months. In other words, the maintenance period was to expire on 19 March 1993. The third party also attached to their letter a list of remedial works (as at 20 March 1992) prepared by the Architectural Clerk of Works, which the plaintiffs had to carry out.

Debonding of external tiles

130 The third party received the first written complaint of 'popping out' tiles in mid-July 1992. Mr Ho had earlier received a complaint by way of a telephone call from Wong Fook Yuen of the defendants. At the material time, when he had first learnt of tiles falling from the building, he had told Sebastian Kho of the plaintiffs to look into the problem and to report to him.

131 A joint site meeting was held on 31 July 1992 to discuss the debonding tile problem. It was agreed at the meeting that the plaintiffs were to obtain quotations from RAK for: (a) visual inspection and report on the probable cause

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of the tile problem; (b) tests to ascertain the actual cause and report; and (c) proposals for remedial action. Following this, RAK set out in a fax message to the plaintiffs, their comments and an outline of their proposal of the tests and inspection required in order to ascertain the cause of the debonding tiles. Copies of RAK's comments and proposals were circulated by the plaintiffs to the defendants and the third party. Sebastian Kho had also discussed the contents of RAK's proposal and comments with Wong Fook Yuen of the defendants on 3 August 1992.

132 As both the defendants and the third party were concerned that safety measures be taken to avoid any accidents and injury to persons from falling tiles, directions were issued to the plaintiffs by the third party to remove tiles which had debonded from the building.

133 Since about October 1992 [sic], the plaintiffs had plainly refused to carry out any further work to remove the debonded tiles. As a result, the defendants had to employ other contractors, namely, Dokota Private Ltd ('Dokota'), to carry out the said works in November 1992. Additionally, the defendants also arranged for Dokota to place safety netting around the building as a precautionary measure.

134 On 30 November 1992, the third party wrote to the plaintiffs directing them to carry out rectification works, ie, removal and replacements of debonded tiles but the plaintiffs refused to carry out the said rectification. On 11 January 1993, the defendants forwarded to the third party two reports from RAK (Report No 11836 dated 9 September 1992 intituled 'Tiles Testing' and Report No 12032 dated 5 October 1992 containing RAK's comments and conclusions) and requested the third party's comments thereon. The highlight in the second report

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was that the main cause of the debonding problem was thermal movement. Parts of the comments and conclusions contained in para 5.0 of the second report read as follows:

> It is self-evident mainly from the location of the debonded tiles that the main cause is thermal movement.
>
> B.S. 5385:Pt 2:1978 "Code of practice for wall tiling" recommends in CL. 20.2. that vertical movement joints should be located 3 m - 4.5 m apart and horizontal joints should be at storey heights.
>
> In the case of the Technocentre, vertical joints are at 11.8 m centres and horizontal joints in window areas are at storey heights but at areas where there are no windows, horizontal joints are between 4.5 m to 6.0 m.
>
> In either case, the distance between joints is far greater than normally recommended.
>
> B.S. 5385 further states that the "area of jointing should be about 10% of the total tiled area", even with a joint width of 5 mm the joint area only constitutes less than 5% of the total tiled area. One of the main purposes of this is to allow free movement of water vapour from behind the tiles, though in practice the comentitious joint filler is not so rigid as the tiles and can help accommodate some of the thermal movements.
>
> The lack of correct nosing tiles over window sills is more likely to have an effect in the longer term and unlikely to have been a major influence on the current situation.
>
> Although some of the tiles from debonded areas were found not to be well bonded and bedded, we would suggest that the tiles would still have cracked and eventually fallen since the stresses induced by thermal movement can be very high in localized areas especially in a rigid tiled cladding.
>
> Any remedial action which is to be carried out must embrace the overall problem not only localised areas, it must also address the long and short term situation.
>
> Face C of the building has not as yet exhibited the same problems as the other faces, though we would suggest that as December approaches the sun will move into the southern hemisphere and the suns' rays shine directly on the surface of the tiles. When this occurs there will [be] much greater thermal movement of the tiles and we would expect that only then will tiles begin to visibly debond.

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135 A clarification contained in RAK's letter dated 21 December 1992 addressed to the defendants' solicitors, reads as follows:

> 21st December 1992 Wong Meng Meng & Partners ... Dear Sir HAW PAR TECHNOCENTRE Further to our report No. 12032 we would like to clarify what we consider to be the main causes of the falling tiles. In our report we identified four contributory factors i) Inadequate expansion joints ii) Joints between individual tiles too small iii) Poor bedding in some of the tiles iv) Poor detailing of the window sills The current spacing of the expansion joints is approximately 11.8m which we feel is the major reason for the failures. The joints have apparently been designed in this manner by the architect for aesthetic purposes, to give an appearance of continuity. The British Standard, B.S. 5385:Pt 2:1978 "Code of Practice for Wall Tiling" CL 20.2 states the considerations for locating movement joints as follows a) over existing movement joints; b) where cladding abuts other materials; c) at junctions between different background materials, when cladding is continuous cross varying types; d) at story heights horizontally and approximately 3m to 4.5m apart vertically ideally they should be located over movement joints in the structural background and at structural material changes, for example horizontal joint at bottom of floor slab, vertical joint at internal corners and at junctions with columns; e) at external angles vertically within 0.25m to 1.0m from the angle. Had the Code of Practice been followed the vast majority of tiles would not have fallen.
>
> The size of the joints between the tiles was found to be on average 2-3mm wide. CL 16.2.3 of BS5385 : Pt2 : 1978 recommends that "the area of jointing should be about 10% of the total tile area "in the case of the Technocentre this would require joints of 10mm wide. The larger joints would allow adequate evaporation of any moisture trapped behind the tiles and prevent any pressure build up, in addition (sic) it may also have allowed some thermal movement. At this stage we are not aware whether the joints were kept small at the request of the architect, or developer, or if it was simply the contractors workmanship.
>
> Less than 10% of the tiles found to be debonded were as a result of poor bedding of the tiles. The tiles which are badly bedded in are randomly located around the building and are usually found in ones and twos, and not in larger groups. Clearly those tiles found to be defective due to poor bedding are the responsibility of the tiling subcontractor.

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> The detailing of the window sills, is, at this stage not considered to be a major contributory factor in the debonding of the tiles. In the longer term however we would expect that the poor detailing will lead to a more rapid deterioration. Under normal circumstance we would expect the detailing of the sills to be specified by the architect but it is also possible that the contractor always details sill in this manner.
>
> In terms of apportionment of liability the prime cause of the problem is without doubt the lack of adequate provision for thermal movement, the problem may be exacerbated by the narrow tile joints, and poor bedding of tiles, but this does not distract from the prime cause.

136 The third party was not aware that the defendants had in fact asked RAK to submit a report on the matters dealt with in their reports. The defendants did not also seek the third party's assistance in regard to investigations carried out by RAK.

137 Since the third party was asked to comment on the cause of the falling tiles in reference to the reports by RAK, the third party proceeded to obtain an opinion from their expert, Dr Henry Ong dated 30 April 1993. Insofar as material the conclusion reached by Dr Henry Ong as stated by him in his report, reads as follows:

> In early March 1993, and after a few days of rain, a bulging tile appeared at the side of a 10.8m panel on the 6th level of the elevation B2. The bulging occurred at the bottom rather than at the side of the tile. This was later removed together with other tiles.
>
> On the 16th March 1993, and after several days of rain, four (4) tiles had dropped from the 6th level of elevation E at different times on the same day. Altogether, 70 tiles were removed subsequently from this area.
>
> These two episodes revealed the nature of the tile debonding problem found on the Haw Par Technocentre.
>
> If the causes were due to thermal and moisture movement, the tiles would have debonded explosively and a large section of the tiles would have come off together, and not one by one as was

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> found to be the case. Therefore, thermal expansion and moisture movement cannot be that important. This is substantiated by the low coefficient of linear thermal expansion of the tiles and the discontinuous adhesive layer found on the walls.
>
> The tiles, the adhesive and the tiling workmanship had all contributed primarily and equally to the poor adhesion, and hence to the tile debonding on the Haw Par Technocentre.
>
> Any suggestion of inadequacy of tile joints would at worst allow water penetration; and water may precipitate the tile debonding or cause further deterioration of the weak bond.
>
> The number and the spacing of the existing expansion joints in no way contributed to the tile debonding problem.

138 By their letter dated 5 May 1993, the third party issued instructions to the plaintiffs to carry out tests on the adhesive used for the external tiling on the facade (viz, Laporte SAC 23) and pull-out tests for the tiles. It also in that letter required the plaintiffs to engage Setsco to conduct the pull-out tests. The third party also by its direction No. 020 dated 13 May 1993 required the plaintiffs 'to make good the whole of the external tiling works which [were] not in accordance with the contract and ... found unacceptable and ... rejected.' The said direction also stipulated that if within 14 days of receipt of the said direction, the plaintiffs had not complied with it, the defendants might employ and pay other persons to execute any work which might be necessary to give effect to the direction. The plaintiffs, nonetheless refused to comply with the third party's instructions dated 5 May 1993 as well as the direction dated 13 May 1993.

139 Sometime on or about 26 June 1993, the third party was informed by the defendants that they wanted all the external tiles removed from the wall surface and to be replaced with a new external wall finish known as 'Eleganstone'. Consequently on 27 May 1994, the defendants entered into a contract with

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Brilliant to remove the whole of the external tile facade to the building and to replace them with the 'Eleganstone' finish. The contract sum for this project was S$1,020,000 and the works thereof completed on 6 July 1994.

Interim certificates

140 Amongst the Interim Certificates issued by the third party in respect of the building, certificate Nos C7 to C21 were issued by Mr Ho. The earlier certificates were issued by the project's previous architect, Angela Tseng. All the Interim Certificates were issued monthly to the plaintiffs.

141 On 19 February 1993, the third party issued Interim Certificate No C18 for the sum of $580,933.10. This amount represented the first retention monies and other interim payments as recommended by the project's quantity surveyors, Davis Langdon & Seah. At about the time of issuing this certificate, parties were still investigating the cause of the debonded tiles.

142 On 17 March 1993, the defendants sent the third party a letter stating that more external tiles had fallen from the building on 16 March 1993. Mr Ho thereupon visited the site and noted that more tiles had fallen from the building representing about 5% of the total tiles installed on the external faade. He then formed the opinion that Interim Certificate No C18 ought to be revised to take into account those external tiles which had debonded from the walls. He consequently consulted the project's quantity surveyors and thereafter issued Interim Certificate No C19 dated 31 March 1993, which reads as follows:

> INTERIM CERTIFICATE No: C19 099/LST/87 Project : Haw Par Technocentre Date : 31/3/93 Employer/Contractor : Setron Ltd./Chuang Uming (Pte) Ltd In my earlier Interim Certificate No. 18 dated 19/2/93, I certified that a sum of $580,933.10 was due to Chuang Uming (Pte) Ltd. In so doing I had decided to the effect that the overall works were completed except for the works listed in the Schedule to Completion Certificate and

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> the release of one-half of the Retention Monies further to the issuance of the Completion Certificate was due. Pursuant to Clause 31(4) of the Conditions of Contract I now revise Interim Certificate No. 18, having decided that 5% of the external tiling works is now unacceptable and is properly treated as defective works for which the contractor is responsible whereby the Employer is entitled to deduct therefrom a fair allowance until satisfactory rectification is completed and hereby certify that, allowing for all sums previously certified by me, and paid by the Employer, or deducted by him under the terms of the Contract, there is now due and owing as a consequence of my said revision from the Employer to the Contractor the sum of Singapore Dollars Five Hundred and and Thirty One Thousand Four Hundred and Thirty-Three And Cents Ten Only (S$531,433.10) calculated as follows: Amount due in Interim Certificate No. 18 $580,933.10 Less : Deduction for the defective works referred to above (cost of 5% of external tiling works) $49,500.00 _____ Amount Now Due/Owing $531,433.10 this Certificate ========== Certified By (signed) _____ Architect

143 He continued to make visits to the building from time to time to review the situation. Between 16 March 1993 and 20 May 1993, the debonding of the external tiles to the building continued unabated. After perusal of Dr Henry Ong's opinion and noting that the external facade of the building was wholly defective, he concluded that a further revision of the third party's Interim Certificate No C19 was necessary. Consequently, the third party wrote to the project's quantity surveyors on 27 April 1993 seeking their advice. Paragraph 3 of the third party's said letter reads as follows:

> We would also appreciate your advice as to whether we would be in a position to recover the costs of making good the rejected works. This would allow us to employ another party to carry out the said works and deduct the same from the Contractor should they refuse to take any action to rectify the situation. Obviously the value extracted from the BQ would be insufficient for this purpose. If the answer is "yes", please advise as to whether it can be reflected in our proposed Interim Certificate No. 20.

144 The quantity surveyors replied to the third party on 4 May 1993. The relevant segments of the said reply are reproduced hereunder:

…

Clause 31(4) of the Conditions of Contract provides for the correction of earlier interim certificates found to be erroneous by way of a further certificate which as provided for under Clause 31(5) may culminate in a resultant negative value.

Your decision to reject the whole of the completed facade now imposes on the Contractor not only an implied obligation but it is submitted, [also] the right to make good the works. Having another Contractor brought in without giving an opportunity to the Contractor to do the making good himself is, we believe, contractually and procedurally wrong.

If and only if the Contractor fails to comply with the direction ordering him to make good the rejected works after the expiration of the written notice served can the Employer invoke the provisions of Clause 1(7) of the Conditions of Contract and employ other contractors to give effect to the direction. The extra costs, if any, of doing so can then be deducted from any monies otherwise due under the Contract or the same be recovered from the Contractor.

While we may have expressed our comments in respect of the power of the Architect to issue a further corrective certificate, we must add emphatically that it merely represents an opinion. There is a lack of authority and legal principles decided upon under the particular circumstances. So as not to be challenged on a point of procedural technicality, we would suggest that you seek a legal opinion from your own expert advisers on whether the exercise of your power to issue a corrective certificate was not done ultra vires Clause 31(4).

Previous payments certified for the tiled facade amount to $571,692.50. We estimate the cost of rectification by other contractors engaged by the Employer in the event of the Contractor's non-compliance with the Architect's Direction on the due date served to be $750,000.00. The amount provides for the removal of the existing tiles and replacement with new tiles of the same type and material specification as that originally installed, temporary protection, temporary hoardings and general preliminary items. We must stress that the estimate can only be an indication of the probable cost at this initial stage. The actual remedial cost to be recovered from the Contractor will have to be based on the final claims of the contractor engaged by the Employer when these are submitted upon completion of the work.

…

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145 On 5 May 1993, the third party wrote to the plaintiffs informing them that in view of the third party's expert's report, it had reached the conclusion that the entire external tiling works were unacceptable. Accordingly, based on the recommendation and advice of the quantity surveyors as contained in their letter dated 4 May 1993, certificate No C20 was issued in the following terms:

> INTERIM CERTIFICATE No: C20 099/LST/87 Project : Haw Par Technocentre Date : 5/5/93 Employer/Contractor : Setron Ltd./Chuang Uming (Pte) Ltd In my earlier Interim Certificate No. 19 dated 31/3/93. I certified that a sum of $531,433.10 was due to Chuang Uming (Pte) Ltd. In so doing I had decided to the effect that the overall works were completed except for 5% of the external tiling works which are unacceptable and was properly treated as defective works for which the Contractor is responsible. Pursuant to Clause 31(4) of the Conditions of Contract I now revise Interim Certificate No. 19, having decided that all of the external tiling works is now unacceptable and is properly treated as defective works for which the contractor is responsible whereby the Employer is entitled to deduct therefrom a fair allowance until satisfactory rectification is completed and hereby certify that allowing for all sums previously certified by me, and paid by the Employer, or deducted by him under the terms of the Contract, there is now due and owing as a consequence of my said revision from the Contractor to the Employer the sum of Singapore Dollars Two Hundred and Eighteen Thousand Five Hundred and Sixty-Six And Cents Ninety Only (S$218,566.90) calculated as follows: Amount due in Interim Certificate No. 19 $531,433.10 Less : Deduction for the making good of the defective works referred to above $750.000.00 Amount Now Owing ($218,566.90) this Certificate Certified By (signed) _____ Architect

146 The third party also by its letter dated 5 May 1993 informed the plaintiffs, in accordance with cll 27 and 11 of the Building Contract, that they were required to carry out tests in respect of the debonding and that instructions for such tests would be issued shortly in a separate letter.

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147 On 5 May 1993, the third party received a letter from the quantity surveyors correcting the amount to be certified for deduction in respect of the rejection of the external tiling works. The said letter insofar as material, reads as follows:

> …
>
> 1. In our earlier letter ref. 2422/T dated 4th May 1993, we have advised that your decision to reject the whole tiled facade imposes on the Contractor the liability to make good the works. As such, we have also pointed out that it is contractually and procedurally wrong to bring in another contractor without giving him an opportunity to make good the works himself.
>
> 2. In view of the above, we are of the opinion that you can only deduct from the Contractor at this point in time, the contractual amount ($621,192.50) for the tiled facade and not the estimated total cost of rectification ($750,000/=).
>
> 3. As and until due notification has been served on to the Contractor and subsequent non-compliance with the Architect's Direction, then only can the Employer invoke the provisions of Clause 1(7) which gives him the contractual right to claim the extra cost of rectification from any monies otherwise due under the contract or the same be recovered from the Contractor.
>
> 4. In this instance, taking into account your total rejection of the tiled facade works, the previous payments certified to-date for the tiled facade shall be deducted in totality and is in the order of $571,692.50 as shown below.
>
> Total contract amount for tiled facade works $621,192.50
>
> Less Cost for making good 5% of defective tiling works which has been deducted in Revision Certificate No. C19 49,500.00
>
> Previous payments certified $571,692.50
>
> for tiled facade
>
> 5. Notwithstanding the above, you may wish to seek a legal opinion on our views pertaining to this issue.

148 Upon receipt of the letter dated 5 May 1993 from the quantity surveyors, the third party proceeded to amend the amount to be deducted under Interim

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Certificate No C20 and to this end issued Interim Certificate No C21 which reads:

> INTERIM CERTIFICATE
>
> No: C21 099/LST/87
>
> Project : Haw Par Technocentre Date : 13/5/93
>
> Employer/Contractor : Setron Ltd./Chuang Uming (Pte) Ltd
>
> In my earlier Interim Certificate No. 20 dated 5/5/93, I certified that a sum of Singapore Dollars Two Hundred and Eighteen Thousand Five Hundred and Sixty Six and Cents Ninety Only (S$218,566.90) was owing from Chuang Uming (Pte) Ltd. In so doing, I had decided to the effect that all of the external tiling works were unacceptable and therefore defective entitling the Employer to deduct a fair allowance for making good the said defective works.
>
> Pursuant to Clause 31(4) of the Conditions of Contract, I now revised my previous Certificate, having decided that the amount of S$750.000.00 deducted for making good the defective works was erroneous and should be corrected so that the value already certified for external tiling works was deducted only and hereby certify that, allowing for all sums previously certified by me, and paid by the Employer, or deducted by him under the terms of the Contract, there is now due and owing as a consequence of my said revision from the Contractor to the Employer the sum of Singapore Dollars Forty Thousand Two Hundred and Fifty Nine and Cents Forty Only (S$40,259.40) calculated as follows:-
>
> Amount owing in Interim Certificate
>
> No. 20 S$218,566.90
>
> Add: Amount erroneously
>
> deducted in Interim
>
> Certificate No. 20 for
>
> making good defective
>
> works S$750.000.00
>
> ----------
>
> S$531.433.10
>
> Deduct: Amount previously

certified for external

tiling works. S$571,692.50

Amount now owing S$ 40,259.40

this certificate: ==========

Certified By

(signed)

_____

Architect

149 In its letter dated 13 May 1993 which accompanied Interim Certificate No C21 as well as the Architect's Direction No Setron/LST/DN/020 - both also bearing the same date - the third party required the plaintiffs to make good the unacceptable work in compliance with the said direction. The third party's letter also contained a warning to the plaintiffs that failure by them to comply strictly with the said direction, after the expiration of the written notice served (ie, 14 days from the date of service of the direction) would result in the plaintiffs having to bear the extra costs of employing other contractors to carry out the work referred to.

150 Mr Ho in his supplemental affidavit of evidence-in-chief said that he had managed to locate the 'Alternative A' of the tile layout together with 'Alternative B' and produced them. He added that he could not, however, locate any shop drawings for the external tiles and believed that either the plaintiffs or King Lung, the tile suppliers should have a copy thereof. Mr Ho was cross-examined at length by plaintiffs' counsel. They are too long to be entered upon here but I shall refer to them, if necessary, later in these grounds except to add that Mr Ho had conceded that the technical specifications prepared by his

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predecessor did not follow certain time-tested standards in relation to the external tile facade (page 4006 of the NE).

151 The next witness for the third party was Mr Seah Choo Meng (TPW-2), a partner of Davis Langdon & Seah, a firm of quantity surveyors and construction cost consultants in Singapore. He testified that his firm were the quantity surveyors for the project. His affidavit evidence was formal in nature. It concerned Interim Certificates C18, 19, 20 and 21 issued by the project architects (the third party) and the recommendations made by his firm for the amounts to be certified in relation to the said Interim Certificates. Insofar as is material, the said Interim Certificates as well as the letters containing the quantity surveyors' recommendations appear from TPE-12 to 15 and TPE-17 to 27. Three of the letters sent by the quantity surveyors to the third party require mention: one dated 4 May 1993 (TPE-17-18) advises the third party amongst other things as follows:

> 4th May 1993 Lee Sian Teck Chartered Architects … Attention: Mr Anson Ho … HAW PAR TECHNOCENTRE EXTERNAL TILED FACADE We refer to your letter ref: 099/LST/87/302 dated 27th April 1993 and the issue of the external tiled facade which we noted has been rejected in totality. Clause 31(4) of the Conditions of Contract provides for the correction of earlier interim certificates found to be erroneous by way of a further certificate which as provided for under Clause 31(5) may culminate in a resultant negative value. Your decision to reject the whole of the completed facade now imposes on the Contractor not only an implied obligation but it is submitted, [also] the right to make good the works. Having another Contractor brought in without giving an opportunity to the Contractor to do the making good himself is, we believe, contractually and procedurally wrong. If and only if the Contractor fails to comply with the direction ordering him to make good the rejected works after the expiration of the written notice served can the Employer invoke the provisions of Clause 1(7) of the Conditions of Contract and employ other contractors to give effect to the direction. The extra costs, if any, of doing so can then be deducted from any monies otherwise due under the Contract or the same be recovered from the Contractor. While

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> we may have expressed our comments in respect of the power of the Architect to issue a further corrective certificate, we must add emphatically that it merely represents an opinion. There is a lack of authority and legal principles decided upon under the particular circumstances. So as not to be challenged on a point of procedural technicality, we would suggest that you seek a legal opinion from your own expert advisers on whether the exercise of your power to issue a corrective certificate was not done ultra vires Clause 31(4). Previous payments certified for the tiled facade amount to S$571,692.50. We estimate the cost of rectification by other contractors engaged by the Employer in the event of the Contractor's non-compliance with the Architect's Direction on the due date served to be $750,000.00. The amount provides for the removal of the existing tiles and replacement with new tiles of the same type and material specification as that originally installed, temporary protection, temporary hoardings and general preliminary items. We must stress that the estimate can only be an indication of the probable cost at this initial stage. The actual remedial cost to be recovered from the Contractor will have to be based on the final claims of the contractor engaged by the Employer when these are submitted upon completion of the work. … Yours faithfully, (signed) DAVIS LANGDON & SEAH

152 Another letter written by the quantity surveyors to the third party dated 5 May 1993 advises the third party in the following terms:

> 5th May 1993
>
> Lee Sian Teck Chartered Architects
>
> …
>
> Attention: Mr Anson Ho
>
> …
>
> HAW PAR TECHNOCENTRE
>
> EXTERNAL TILED FACAE
>
> In response to your letter ref. 009/LST/87/313 dated 5th May 1993 with regard to the above, our comments are as follows:-
>
> 1. In our earlier letter ref. 2422/T dated 4th May 1993, we have advised that your decision to reject the whole tiled facade imposes on the Contractor the liability to make good the works. As such, we have also pointed out that it is contractually and procedurally wrong to bring in another contractor without

> giving him an opportunity to make good the works himself. 2. In view of the above, we are of the opinion that you can only deduct from the Contractor at this point in time, the contractual amount ($621,192.50) for the tiled facade and not the estimated total cost of rectification ($750,000/=). 3. As and until due notification has been served on to the Contractor and subsequent non-compliance with the Architect's Direction, then only can the Employer invoke the provisions of Clause 1(7) which gives him the contractual right to claim the extra cost of rectification from any monies otherwise due under the contract or the same be recovered from the Contractor. 4. In this instance, taking into account your total rejection of the tiled facade works, the previous payments certified to-date for the tiled facade shall be deducted in totality and is in the order of $571,692.50 as shown below. Total contract amount for tiled facade works $621,192.50 Less Cost for making good 5% of defective tiling works which has been deducted in Revision Certificate No.C19 $ 49,500.00 _____ Previous payments certified for tiled facade $571,692.50 ========== 5. Notwithstanding the above, you may wish to seek a legal opinion on our views pertaining to this issue.
>
> Yours faithfully,
>
> (signed)
>
> DAVIS LANGDON & SEAH

153 On 12 May 1993, the quantity surveyors forwarded three drafts for the third party's consideration. The first one which was proposed to be sent to the plaintiffs reads as follows:

> Chuang Uming (Pte) Ltd … HAW PAR TECHNOCENTRE EXTERNAL TILED FACADE We refer to our Interim Certificate No 20 dated 5th May 1993 which was issued to correct the previous Certificate No 19 in respect of the unacceptable external tiling works. Having examined the said certificate which was found to be erroneous in that an amount of S$750,000.00 was deducted for making good the unacceptable works when it should only be the value of the tiling works already certified, we append herewith a revised Certificate No 21 dated (insert date) showing a sum of S$40,259.40 owing to the Employer, to correct the earlier certificate. In respect of the rejected tiled facade and pursuant to Clause 1(3) of the Conditions of Contract, we require you to make good the unacceptable works in compliance with our Architect's Direction No (insert reference) dated (insert date) enclosed.

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> Please note that failure to comply strictly with this Direction after the expiration of the written notice served will result in your having to bear the extra cost of employing other contractors to carry out the work. Yours faithfully LEE SIAN TECK CHARTERED ARCHITECTS

154 The next was a draft revised Interim Certificate C21 which reads:

Project: Haw Par Technocentre Certificate No: 21

Employer: Setron Ltd Date:

Contractor: Chuang Uming (Pte) Ltd

In my earlier Certificate No 20 dated 5th May 1993, I certified that a sum of Singapore Dollars Two Hundred and Eighteen Thousand Five Hundred and Sixty Six and Cents Ninety Only (S$218,566.90) was owing from Chuang Uming (Pte) Ltd. In so doing, I had decided to the effect that all of the external tiling works were unacceptable and therefore defective entitling the Employer to deduct a fair allowance for making good the said defective works.

Pursuant to Clause 31(4) of the Conditions of Contract, I now revise my previous Certificate, having decided that the amount of S$750,000.00 deducted for making good the defective works was erroneous and should be corrected so that the value already certified for the external tiling works was deducted only and hereby certify that, allowing for all sums previously certified by me, and paid by the Employer, or deducted by him under the terms of the Contract, there is now due and owing as a consequence of my said revision from the Contractor

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to the Employer the sum of Singapore Dollars Forty Thousand Two Hundred and Fifty Nine and Cents Forty Only (S$40,259.40) calculated as follows:

Amount owing in Interim Certificate

No 20 ... S$ 218,566.90

ADD

Amount erroneously deducted in Interim Certificate No 20 for making good defective works ... S$ 750,000.00

_____

S$ 531,433.10

DEDUCT

Amounts previously certified for external tiling works ... S$ 571,692.50

_____

Amount now owing this certificate S$ 40,259.40

==========

Certified By

_____

Architect

155 The other was a draft architect's direction. It reads:

Project: Haw Par Technocentre No:

Contractor: Chuang Uming (Pte) Ltd Date:

_____

In accordance with Clauses 1(1), 1(2) and 1(3) of the Conditions of Contract, I hereby direct you to make good the whole of the external tiling works which are not in accordance with the Contract and which I found unacceptable and have rejected.

Take this also as notice under Clause 1(7) of the Conditions of Contract that I require you to comply with this Direction.

If within fourteen (14) days of receipt of this notice you have not complied, the Employer may employ and pay other persons to execute any work whatsoever which may be necessary to give effect to this Direction. All costs incurred in connection with such employment will be deducted from money due or to become due to you under the Contract or will be recovered from you by the Employer as a debt.

_____

Architect

Expert evidence

156 The plaintiffs called Mr N Narendranathan ('Mr Nathan'), a civil engineer by training and reportedly a person with considerable experience within the construction industry in Singapore, Brunei and Sri Lanka, to give expert evidence on the plaintiffs' behalf. He submitted altogether two reports and insofar as is material, reproduced hereunder are some of the important segments of his opinion expressed in his first report dated 27 March 1996 (ER-1 to ER-51):

> 3.0 General Comments On External Wall Tiling Systems 3.1 Perspective Wall tiling system is a complex composite structure. … The components of an external wall tiling system consists of the external tile, the adhesive base, the levelling mortar, the background which could be concrete or brick work. In order to understand the short term and long term behaviour of such a composite system, it is necessary to first understand the various factors that affect the performance of each layer by itself and its combined form. The behaviour of the composite system will be influenced by the environment under which it is expected to perform. 3.2 Materials
>
> The performance of a tiling system is affected by the materials, namely tile, adhesive, mortar, the levelling coat and the background, and their compatibility with each other. It is essential for the Architect, Contractor and all parties involved to understand this issue. The construction and detailing of the whole composite system must seek to minimize or eliminate possible causes of non-performance of the whole system.
>
> In the case of the tile manufacturing process, (i.e. extruded type or dust pressed) firing, size of the tile, type of glazing used are some of the factors to be considered. The size of the tile is an important factor in determining its suitability for external wall tiling. The bigger the size, the more susceptible it would be to slip under self weight during installation.
>
> In the mixing and laying of the levelling mortar and adhesive bed, Codes of Practice or manufacturers' recommendations should be followed for the proportion of each material and types of material to be mixed.
>
> 3.3 Workmanship
>
> Here the important factors are the pattern of installation of the tile, the mix proportions, the application methods, and the evenness of the surfaces.

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In order to obtain a satisfactory workmanship, the recommendations given in Codes of Practice should be followed. In general, British or Australian Codes of Practice are normally consulted in Singapore. Codes of Practice embody good workmanship practices that have given rise to satisfactory installation. It would also be necessary to follow the recommendations of manufacturers if special products have been used.

3.4 Environment

The thermal temperature, gradients encountered across the tiled wall at different times of the day, the type of locations, orientations in relation to the sun, rainfall, humidity, the internal temperature and humidity changes within the building are some of the factors that can contribute or affect the behaviour of the external wall tiling system.

3.5 Detailing

Detailing by the project architect consists of initially understanding the whole system behaviour. This means understanding the individual elements of the system and their behaviour as well as the behaviour of the composite system under various conditions. In detailing considerations that need to be accounted for are the environmental conditions, the type of backgrounds or substrate on which the tiles are being fixed, the types of tiles that are being specified and their manufacturing processes. All these need detailed study as well as consultation with the manufacturers and Codes of Practices.

3.7 Codes of Practices/Standards

Historically, tiling has been a work of craftsmen. Tiles in various forms, such as manufactured tiles or naturally formed tiles have been in use for many thousands of years. The fixing methods have also varied.

In the past decades, tiling has been a craft and was passed on from the senior craftsmen to apprentices. As time went on and the use of tiles became more and more extensive, Codes of Practices were formulated for tiling. Since manufactured ceramic tiles were becoming common, Standards for the various tiles and tile adhesives were formulated. While Standards have laid down various quantitative values for acceptance of some of the tile system components, such as tiles, tile adhesive mortars and levelling mortars. It should be noted that there is no Standards that has been laid down for quantitative or even qualitative performance criteria of a complete composite system during or after construction.

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Despite numerous attempts to mathematically quantify or model the various complex interactions within the composite system, this has not been achieved or standardized successfully. This is mainly due to the fact that the various individual components of a tiling system, i.e. background, the levelling coat, the adhesive mortars and tiles are subjected to various thermal movements, creep movements and shrinkage movements during their initial construction stage, on a day-to-day basis as well as long term basis.

Hence tiling system design and installation should follow the recommendations laid down in codes for detailings, materials and workmanship.

Considering the complex nature of the issues, what Codes of Practices and Standards have attempted to do for issues such as detailing and installation is essentially record practices that have achieved successful results in the past. This means these Standards or Codes of Practices are very much empirical and have to be strictly followed in terms of their recommendations. If these recommendations are not followed at each of the various stages, unsatisfactory installation would result.

In short, the Codes of Practice recommendations are the "Bible" of tiling, since the whole process of tile detailing and installation embodies past experience.

Any experimentation "outside the scope of Code of Practices" is at the risk of the designer, the client and the contractor. Such experimentation could be attempted if there have been extensive studies done to substantiate the performance. All parties involved in tile installation, tile specification as well as tile failure study should have a very clear understanding of this. Here reference could be made to BS 5385 and AS 3958 in terms of Standards and Code of Practices.

The above is a general perspective of the current state-of-the art situation as far as tiles and tiling system are concerned.

4.0 Cause of Tile Debonding

The preceding section provided an outline of the various factors that influence tiling system performances. In studying the causes or cause of tile system failure, all these factors have to be considered and eliminated based on the available technical data.

Our report on the possible causes is based on evidence gleaned from various sources as mentioned in Section 1, several site visits made during the months of August/September 1993 and interviews with the contractor’s staff.

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4.1 Detailing of Joints

The Code specifies a minimum of 6 mm tile-tile joint and this has not been provided here. This would lead to excessive stress build up between the tile/adhesive interface causing debonding.

Even the manufacturer of the Korzelius tiles (see Appendix 1) indicates that the tiles were extruded tiles and recommends that the tile-tile joint should be a minimum of 6 mm.

The initial creep shrinkage of the concrete building should have been considered, especially when the concrete structure had no movement joints. The stresses built up due to initial creep shrinkage of the concrete structure has caused the tiles to pop out, as can be seen in Plates 7 and 8. The mechanism of tile popping out (or buckling) is shown in Figure 3.

Thus, with no movement joints in the concrete structure, it is even more important to provide the minimum 6 mm tile-tile joint. In this instance, the whole tiling system should have had joint spacing that are more liberal than the minimum recommendations in the codes, such as in the Australian Standards AS 3958.1 (see Appendix 3).

In the case of vertical movement joints, there is no basis to provide the 10.8m spacing when Codes recommend 3 m - 4.5m (AS 3958.1, see Appendix 4). This is a cause of the excessive thermal stress build up.

Provision of adequate movement joints would relieve the possible stresses built up in the tiling system. In the absence of adequate and sufficient movement joints, the stresses built up could only be relieved through cracking or delamination of the tiles.

Several photographs taken on site indicate that, there were several cracks that had occurred in the tiles, even prior to their removal, indicating the extremely high stresses that the tiles had been subjected to (see Plate Nos. 1 to 4).

In addition, the bulging of tiles in sheets and layers as shown in Plate Nos. 3 to 22 show the typical stress induced delamination.

Based on these observations and review of various documents, it is our opinion that the cause of tile debonding is due to insufficient tile-tile joints spacing and inadequate spacing of movement joints.

4.3 Workmanship

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> Based on interviews with the tiler and Affidavit Evidences reviewed, there is no basis to conclude that workmanship errors caused the debonding of tiles as evidenced in this project.
>
> Observations made on the delaminated surfaces at site showed that adhesive layer material was missing in small patches at some locations. Generally, it was found that the missing adhesive materials occupied only small areas in the whole tile surfaces. They were within the allowable limit set out in the code. Appendix 2 which is an extract from Clause 5.6.4 of Australian Standards 3958.1, shows how the back of satisfactory floor or wall tiling would look. It can be seen that the adhesive coverage need not be 100% to be acceptable.
>
> The observations at site on the mode of tile delamination, as shown in Plates 1 to 22 had also not shown any basis to conclude that workmanship caused the debonding.
>
> In actual fact, even with proper workmanship being adopted, the inadequate joint systems would have led to build up of excessive stresses between the tile/adhesive interface thus causing debonding.
>
> **4.4 Environment**
>
> The environment under which the tiling system has to perform cannot be normally controlled by the tile system designer. However the environment conditions and other special factors should be allowed for in detailing and specifying the work.
>
> Under the normal conditions in the tropics, had the spacings in the tiling system be adequately provided, the debonding of the tiles would not have happened.
>
> **5.0 Conclusions**
>
> The findings in our study are concluded as follows:
>
> - Insufficient tile-tile joint widths and inadequate spacing of movement joints had cause (sic) the debonding of the tiles. - There was no basis to conclude that workmanship errors caused the debonding of the tiles.

157 Mr Nathan's second affidavit of evidence-in-chief deals with the effect of the render (screed) in relation to the failure of the external wall tiles. In this connection Mr Nathan made reference to a report from a renowned expert on ceramic tiles, Mr Richard Bowman of the Commonwealth Standards and Industrial Research Organisation, (CSIRO) Australia. The said report was dated

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23 January 1997 and intituled "A consideration of the effect of the render on the differential movement failure of the ceramic tile facade on Haw Par Technocentre, Singapore". Conclusions drawn by Mr Bowman read as follows:

> Based on my experience of such tiling systems failures, and my understanding of the characteristics of the materials involved and the manner in which they interact under various environmental conditions with time, I can draw the following tentative conclusions with respect to the failure of the Haw Par Technocentre tiling, although it should be noted that since they are largely based on other people's observations and some dubious experimental results. Given further evidence, further conclusions could be drawn about other aspects of the failure, however, it is unlikely that there would be a significant change in position with respect to those below.
>
> 1. The failure is due to differential movement between the tile and the concrete substrate, where the adhesive, as applied, was incapable of withstanding the stresses due to moisture expansion of the tile, shrinkage of the concrete and applied render, shortening of the building and any other structural movements, in combination with any superimposed reversible thermal and moisture movements. 2. The tiling system was not designed to accommodate the above stresses in that there was a lack of expansion joints, the 1 to 3 mm wide joints were far too narrow, particularly given that an incompressible grout material was used. 3. Moisture expansion of the tile has significantly contributed to the failure, since the magnitude of the estimated expansion in the seven months service before the initial failure (0.025%) is considered unacceptable, particularly given the amount of additional irreversible expansion that would have occurred over the design life of the facade. 4. Thermal expansion of the tiles would have contributed to the failure of the tiling system. 5. There is no acceptable evidence to suggest that the render was the cause of the failure. 6. While anything less than perfect workmanship would contribute to the failure of the system, it is unlikely that the tiling workmanship has made a significant contribution to the failure. 7. Shrinkage and movement of the concrete substrate material and the applied render have possibly contributed to the failure. Although such movement would be expected, no report was made of any shrinkage cracking on the surface of the render. The magnitude of such movement, and its contribution to the failure, have not been determined.
>
> In the circumstances, it would be wrong to say that the render caused or initiated the failure.

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158 When cross-examined by defendants' counsel, Mr Nathan disagreed with the suggestion that the screed applied was defective. He said that he did consider the question of screed but had not found any conclusive or substantive evidence for the screed to be suspect (page 4600C-D of the NE). He disagreed with a finding by the defendants' expert, Mr Cyril Venning that the screed was lean, ie, high in sand content relative to cement (page 436D-E of the NE). He also disagreed with the report proffered by the third party that some samples of the screed were at the other end of the spectrum, ie, that they were too rich in cement content (pages 4636F and 4637B-C of the NE).

159 During cross-examination by third party's counsel, Mr Nathan maintained that though there were workmanship errors, those errors would not have caused the debonding (page 4752D-E of the NE). Elaborating, Mr Nathan said that there were areas on the wall where adhesive had not been fully - meaning 100% - applied and there were also a few joints which had not been fully grouted. But these were found on only a few locations (page 4754B-C of the NE). He confirmed that from his inspection the tile joints varied from 1mm to 3mm on the wall surface (page 4759C-D). He said that in order to obtain the joint space between the tiles, the tiler had used plastic spacer lugs (page 4763 of the NE) which were approximately 7mm in length (page 4764 of the NE) and these were placed on most corners of the tiles (pages 4767 to 4770 of the NE) to obtain the joint space. The spacer lugs shown to him were not toothpicks. Having opined that he had never seen any tiling expert using toothpicks as spacer lugs as they were bound to break-off (pages 4772E-F to 4773C-D of the NE), he said that if toothpicks were indeed used, it might well serve the functions provided that they were placed with caution (page 4774C-D of the NE). By and large the tenor of his evidence gave the impression that he was unwilling to fault his clients' tilers

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nor would he concede that there was any bad workmanship on their part (page 4774D of the NE).

160 In reply to a question by the court, Mr Nathan said that the main contributing factor for the tile failure was the lack of detailing and that blame lay squarely on the architects and the structural engineers (pages 4899 and 4900 of the NE).

161 Mr Paul Mundell, the regional manager of RAK was the other expert witness for the plaintiffs. His testimony was in relation to certain tests carried out by RAK and the reports (report No 11836 as appears from AB-1799 to AB-1810; report No 12032 as appears from AB-1819 to AB-1839; and a letter report as appears from AB-1852 to AB-1853) submitted by them on the debonding of the external tile facade at the request of the defendants. Mr Mundell said that he had been involved in material testing for the past 30 years in UK, Hong Kong, Singapore and the Far East and his primary field of work was especially in concrete and cementious materials.

162 According to RAK's first report, the investigation was basically carried out in two parts: the first was to examine the quality of the tiles and the second was a complete visual and tapping survey of all accessible exterior surfaces.

163 Following receipt of the first two reports, the solicitors for the defendants wrote to RAK on 9 December 1992 (AB-1851A) requesting them to state unequivocally as to whether the falling tiles were the result of poor workmanship, poor design or a combination of both, or as a result of other factors. The reply dated 21 December 1992 by RAK (AB-1852 to 1853) requires reproduction and it reads as follows:

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... 21st December 1992

Wong Meng Meng & Partners

...

Haw Par Technocentre

Further to our report No. 12032 we would like to clarify what we consider to be the main causes of the falling tiles.

In our report we identified four contributory factors

i) Inadequate expansion joints ii) Joints between individual tiles too small iii) Poor bedding in some of the tiles iv) Poor detailing of the window sills

The current spacing of the expansion joints is approximately 10.8m which we feel is the major reason for the failures. The joints have apparently been designed in this manner by the architect for aesthetic purposes, to give an appearance of continuity. The British Standard, B.S.5385:Pt2:1978 "Code of Practice for Wall Tiling" CL 20.2 states the considerations for locating movement joints as follows

a) over existing movement joints; b) where cladding abuts other materials; c) at junctions between different background materials, when cladding is continuous cross varying types; d) at story heights horizontally and approximately 3m to 4.5m apart vertically ideally they should be located over movement joints in the structural background and at structural material changes, for example horizontal joint at bottom of floor slab, vertical joint at internal corners and at junctions with columns; e) at external angles vertically within 0.25m to 1.0m from the angle. Had the Code of Practice been followed the vast majority of tiles would not have fallen.

The size of the joints between the tiles was found to be on average 2-3mm wide. CL 16.2.3 of BS5385:Pt2:1978 recommends that "the area of jointing should be about 10% of the total tile area" in the case of the Technocentre this would require joints of 10mm wide. The larger joints would allow adequate evaporation of any moisture trapped behind the tiles and prevent any pressure build up, in addition it may also have allowed some thermal movement. At this stage we are not aware whether the joints were kept small at the request of the architect, or developer, or if it was simply the contractors workmanship.

Less than 10% of the tiles found to be debonded were as a result of poor bedding of the tiles. The tiles which are badly bedded in

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> are randomly located around the building and are usually found in ones and twos, and not in larger groups. Clearly those tiles found to be defective due to poor bedding are the responsibility of the tiling subcontractor.
>
> The detailing of the window sills, is, at this stage not considered to be a major contributory factor in the debonding of the tiles. In the longer term however we would expect that the poor detailing will lead to a more rapid deterioration. Under normal circumstance we would expect the detailing of the sills to be specified by the architect but it is also possible that the contractor always details sill in this manner.
>
> In terms of apportionment of liability the prime cause of the problem is without doubt the lack of adequate provision for thermal movement, the problem may be exacerbated by the narrow tile joints, and poor bedding of tiles, but this does not distract from the prime cause.
>
> Your faithfully
>
> R.A.K. MATERIALS CONSULTANTS PTE LTD
>
> (signed)
>
> Paul Mundell
>
> Regional Manager

164 Mr Mundell was cross-examined by defendants' counsel on his observations that the tile joints were between 1 and 3mm and the average joint width was about 2mm. When asked whether he would consider such an average to be too narrow bearing in mind the contract specification was for a joint spacing of 3mm (pages 4952 to 4954 of the NE), he replied that if one were to specify a minimum of 3mm, one would hope to get joints of between 3 and 6mm (page 4954 of the NE). He ventured to say in reply to a question by the court that in apportioning blame, he would attribute 10% to poor workmanship and 90% to movement (page 5042C-D).

Defendants' expert

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165 The defendants produced Mr Cyril Venning as their expert. Mr Venning's bio-data summary produced to the court showed that he had considerable experience in the field of civil and structural engineering and had held senior positions in Singapore, Malaysia, Indonesia, United Kingdom and Australia. In his report on the debonding of external cladding tiles at the Haw Par Technocentre (ER-52 to ER-95) Mr Venning opined that the tile failure at the building resulted primarily from poor workmanship and that thermal expansion was not the prime cause of failure of the tiling and was not of any significance in such failure. The relevant segments of his report read as follows:

> 1. The Haw Par Technocentre was promoted in the Sales Brochure by Haw Par's subsidiary, Setron Ltd, as a "well designed light industrial building with quality finishes".
>
> 2. The building was designed to attract and satisfy the requirements of prestigious clients and succeeded in this aim from its completion in early 1992, until about six months later when the exterior tiles began to shed from a number of locations both exposed and sheltered.
>
> 3. The building was designed architecturally by Lee Sian Teck - Chartered Architects and built by M/s Chuang Uming - Building Contractor. Tiles were supplied by P.J. Korzilius Sohne Gmbh & Co, of West Germany and the adhesive by Laporte Industries (Singapore) Pte Ltd.
>
> 4. External tiling works commenced early in September 1991 and were completed in early February 1992, a period of approximately twenty-one weeks and which spanned the N.E. Monsoon season.
>
> 5. The start of tiling works externally was delayed by several weeks due to late finishing of the structural concrete works upon which the tiling depends. This fact is significant since it predicates that the Main Contractor may have been behind schedule and under pressure to reduce any further delays and if possible, to make up time during the ensuing finishing works.
>
> 6. Reference to the Contract Specifications and the architectural drawings indicates that the Main Contractor was to assume responsibility for the detailed fixing of the tiling. Infact, there is little complication in the tiling design of the building and any competent tiling contractor would not be

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unduly extended to produce a satisfactory tiling job given the quality of materials specified and provided.

7. The only change to specification for the tiling was noted in the Minutes of site progress meeting No. 46 of 1 October 1991 and for which an Architects Instruction was issued. This A.I. referred to a letter which confirmed that vertical expansion joints would be made at column centres (10.8m) instead of at a maximum of 4.5m, as specified originally. The reason for this permitted change was not given. Horizontal expansion joints were maintained at storey height of 5.4m and 4.8m.

…

(D) Inspection

10. The physical inspection was carried out by the present writer using a 5.0m temporary gondola suspended by brackets from the roof parapet. The writer was accompanied and assisted by the contractor employed by Setron for the removal of tiles which were in danger of falling.

11. Inspection commenced on Wednesday 13th October 1993, and continued for six non-consecutive days with interruptions due to rain.

…

13. Attention was paid to the expansion joints, tile joints, grouting and tile pattern and photographs were taken at relevant locations and are included in the Appendix 2 to this report.

(E) Interviews

14. Interviews were held with Mr Goh Choon Seng who was the Structural Resident Engineer during construction, Mr Tan Deng Wee, Clerk of Works for the building trades and with Mr Chen Heng Sin the present Building Services Manager for the building. All were able to contribute information which has a bearing on the problem.

…

(G) Debonding Due To Thermal Expansion

16. Several factors are involved in the above phenomenon. Materials of composition determine the coefficient of linear expansion which is a number that when used with the rise or fall in temperature of the material observed, will indicate the actual expansion or contraction of that material for a given unit length.

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17. The rise or fall in temperature of the tiling is caused by the radiant heat of the sun, cooling by rain, night time temperature-drops and wind. Heat absorption of the tile is affected by colour, reflectivity and intimacy with bedding and background. Heat is transferred in solids radiantly, by conduction to the bedding and background and by reflection. "Light-coloured cladding reflects and radiates heat; dark-coloured cladding mainly radiates heat only and therefore absorbs and conducts to the backing a high proportion of solar heat gain".

…

24. Reference to the photographs in Appendix 2 will demonstrate that the fall of tiles at the Technocentre is not related to excessive spacing of expansion joints but to other factors which will be dealt with later in the text.

25. First, the locations of tile falls are 'random', some occurring near to joints, some well between joints, others spanning completely over column and joint centres. In other cases, notably in the building entrance facing Commonwealth Drive, tiles have fallen from weather-sheltered locations; refer to photographs 5, 6 & 7.

26. Tiles have fallen from the soffits of overhangs on line 10 facing the car ramp and several tiles in similar locations were found hollow-sounding adjacent to column 'E' and marked for removal.

27. There are several locations (see photograph 1, 2, 8, 11, 13, 14, 15 & 16) where tiling panels are considerably less than 10.8m and some less than 4.5m and yet tiles have fallen.The only consistency noticed is in the inconsistency of fall-pattern.

28. It was noted in both reports (R.A.K. & Dr Ong) that the adhesive had not been compressed sufficiently to fill the raking-comb valleys or the frogs in the tiles.

29. There are a number of possible explanations for this, the most obvious being that insufficient pressure was applied by the fixers. It is also possible that the adhesive had begun to set and skin because of time delays in mixing to deposition at work location and/or in floating on to the screed and fixing the tiles. Whatever the reason it may be observed that there were voids behind the tiles that have already fallen or have been removed and this is due to poor workmanship. Any of the close-up photographs where tiles have been removed will show this situation.

30. What is quite incomprehensible is that when floating the adhesive on to the screed, first pencil-lines for setting-out small

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panels (12 Nos) of tiles were made on the face of the screed and then great care was taken not to spread adhesive over the pencil-lines and to about 25 mm on either side. This may be clearly seen in photographs No. 2, 6, 18, 22, 26, 27, 41 to 44. The result of this is to have a pattern of voids, approximately 3 mm x 50 mm in cross-sections, criss-crossing behind the total tiled surfaces.

...

(I) Interviews

41. The following is hearsay obtained from interviews with the Structural Resident Engineer, the Building Clerk of Works and the present Building Property Executive.

42. To come to an understanding of what went wrong it was necessary to find out what was happening during the "Construction" phase.

43. As mentioned earlier, it appears that the building programme was well behind schedule at the time the tiling/finishing works commenced and it appears that the Contractor may have tried to make up for lost time in the final stages.

44. It is desirable to begin tiling works from the highest point of a structure and work downwards. The reasons for this are concerned with the weather protection of completed tiling which would normally have a top seal beneath the parapet-coping to prevent water ingress. Also, if scaffolding is employed as the working platform, the scaffold tie-ins to the building may be progressively removed as work progresses downwards and scaffolding dismantled. Working upwards requires that anchoring to the building face be resorted to and windows are not always available. Such anchorages would mean leaving out tiles at their locations and placing when the scaffolding is finally dismantled.

...

45. In the case of the Technocentre, it appears that scaffolding was erected from bracket-cantilever supports, anchored to the face of the building at 2nd Storey level and work commenced up-wards. When scaffolded work was completed, overhang-faces were accessed by gondola and final clean-up of tiling by gondola.

46. It is recommended that tiling should commence not earlier than one week after screed has been plastered to the background and preferably, after two weeks. This is to allow for

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adequate drying-out of the cement/sand screed which would undergo most shrinkage during the first few days. The tiling appears to have been performed within three to four days of screening and sometimes after a lapse of only two days. It is normal to wet-down screed and concrete for the first four days after placing in order to mitigate the effects of shrinkage by slowing-down the drying-out. This is of particular importance in the tropics.

47. The adhesive used to retain the tiles on the screed is of vital importance to a successful job. It must be mixed in accordance with the makers instructions and applied as directed. Only the quantity which can be fixed in the space of ten to fifteen minutes from mixing should be mixed and then speedily transported to the tiling location.

48. It would appear that the adhesive was mixed at ground-level and then hauled by rope and bucket to the required working level and then floated-on to the drying-out screed in areas of approximately 0.8m2 to accommodate a tile covering of 0.9m2. The difference of 0.1m2 is the area of screed left vacant of adhesive as previously mentioned in all visible locations and remained void.

49. With adhesive being transported horizontally and vertically and to a largely porous and drying substrate in various locations it may be expected that the specified floating-on time is exceeded. This would result in "skinning" taking place on the adhesive which would prevent adhesion to the tile back. There was little evidence that "buttering" of tiles with adhesive had been used as recommended in the specification.

50. It was suggested that adhesive may have been transported internally in the building and then passed to the tilers through window openings. This is however, very unlikely since there is usually great worker congestion in a building nearing completion in a hurry and staircases are remote and tedious. Also, windows would have been installed and being top-hung are not convenient for the handling of buckets.

51. Significantly, tile falls are more common consequent on the increased vertical transportation time for adhesive and/or on the fact that the higher the elevation of work, the lower the level of supervision.

52. The Building Property Executive informed me that since the building was occupied in early 1992, he had received many complaints of damp penetration into sensitive areas such as computer rooms. He also noted that tile falls generally followed heavy rain. A reason for tiles popping and not mentioned in

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other reports, is "hydraulic pressure". This tends to push out poorly adhering tiles toward the bottom of a panel and as was glaringly obvious at Lobby 'B' roof, photographs 37 to 44.

53. The weight of water contained in the continuous vertical voids behind tile-joints would be more than enough to push-out at these joints. From then on, failure of the remaining surrounding tiles would be progressive.

54. At an early stage of the on-site investigation, samplings were taken from ten locations of the screed material where tiles had been removed, in an effort to determine if the composition of the screed had contributed in some way to the adhesion failure. Tests were made by Setsco to all the samples and the test report is included in Appendix 1.

55. The first determination from the samples is that all but one were outside of the specified mix for the screed of 1 part cement to 3 to 4 parts of sand and the one acceptable sample was exactly at the top-end of the range. Sample BC-4/2 (Photograph 21) was taken from a location where failure of the cladding was by internal-shear of the screed. The worst sample of the ten gave a result of 1 part cement to 8.9 parts of sand which is grossly at variance with specification.

56. The low limit of the cement/sand proportioning of 1:3 is set in the specifications to ensure high-strength without excessive shrinkage occurring. The top limit of 1:4 is required to prevent an over-lean mix being used with consequent loss of strength and excessive porosity. The mix is specified by volume and with due allowance being made for any water contained in the sand. This is important since the water/cement ratio is often the major strength determinant, the more water the weaker the resulting mortar. The specifications require that minimum water be used consistent with obtaining a workable mix. The test results indicate that the mix was lean but not necessarily dry. Such a lean-mix would require additional water to that normally used to hydrate the cement in order to obtain workability. In my opinion, all of the screed is suspect and may result in further failures of tiling accompanied by screed.

(J) Supervision

i. By Contractor

57. From the results of my inspections/observations and related tests, it appears that there was inadequate supervision on the part of the Contractor for the tiling works.

ii By Architect

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58. It appears that none of the members of the Architects' on-site team was given specific instructions to monitor the tiling and it appears that no one did any such monitoring. The Clerk of Works appears to have been overstretched to check on internal and external works simultaneously and he appears to have concentrated on the internal works. The size of the job and complexity in this final phase would have fully justified the employment of an assistant Clerk of Works to watch over the external works exclusively.

59. Normally, questions regarding the details to the window trims and other features by the Contractor to the Architect would be expected and also, in reverse, comments by the Architect as to the quality and acceptability of the work as performed should appear. However, in the present case this did not occur. Priority appears to have been that of securing rapid completion.

(K) Remedies

60. To repair the existing tiling by patching-up would be inadvisable as the tile falls will continue and the screed is entirely suspect.

61. Existing tiling and screed should be removed in its entirety and the background thoroughly cleansed of all adhesions and repaired.

62. Cladding systems in aluminium, fibre glass or other material should be considered or some intimate coating of sufficient body to cover blemishes applied. There are many proprietary systems on the market which have the properties of waterproofing and fungicidal resistance and are self-cleansing.

(L) In Summary

63. Tile failure resulted primarily from poor workmanship which introduced voids behind the tiles and allowed water penetration into these voids. The mortar supplied for screeding was of inferior quality in nine of ten locations checked and configurations of tiling trim to windows as installed was entirely unacceptable.

64. Supervision by the Contractor of his work-force appears to have been insufficient and inadequate. Supervision by the Architect of the Contractor may have been lax for the actual finishing work.

65. Thermal expansion was not the prime cause of failure of the tiling and was not of any significance in that failure. This can be seen from the fact that faces C.1 and C.2 mentioned on page

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> 2 of the R.A.K Report dated 5th October 1992 have not yet dropped tiles to the extent of other faces notwithstanding the sun having moved into the southern hemisphere as anticipated in that report. The tiles have begun to drop however, with the return of the rain.
>
> [Underlined parts abandoned by the author subsequently.]

166 It should be presently mentioned that Mr Venning had admittedly placed reliance on some hearsay material from interviews he had with the Structural Resident Engineer, the Building Clerk of Works and the Building Property Executive. His assumptions are set out in paras 41 to 56 of his report (ER-69 to 73). However, during cross-examination, Mr Venning readily conceded that some of these assertions were invalid and had consequently abandoned them. The portions abandoned by him are those underlined and highlighted in paras 45, 46, 48, 49, 50 and 51 of his report.

167 Mr Venning was subjected to some robust cross-examination by plaintiffs' counsel. Not all aspects traversed by counsel could be satisfactorily set forth in a summary fashion. The relevant segments of Mr Venning's answers would be referred to later in these grounds, if necessary. It should however be mentioned at this juncture that Mr Venning was not as dogmatic as some other experts who had testified at this trial; he conceded readily many a point when a sound proposition was put to him. His willingness to be flexible was apparent from his abandoning and conceding a number of assumptions which he had held and stated in his report as noted earlier in these grounds. In reply to questions by the court, Mr Venning commented that buttering of the tiles was necessary. He opined that for the tile failure 80% of the blame should be attributed to the workmen and the remaining 20% to the architects.

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168 There were two further witnesses for the defendants: Miss Joanne Soh Wan Kiaw ('Miss Soh') and Miss Elizabeth Lee Sweet Choong ('Miss Elizabeth Lee'). Both of them are officers from Setsco Services Pte Ltd ('Setsco'). Miss Soh, holder of a diploma in building management, testified that she had carried out certain tests in relation to the mix composition on ten samples of concrete render submitted by Haw Par Properties (S) Pte Ltd on 15 October 1993. The report subsequently prepared by Setsco appears at ER-75A to 75C. The results of the test as tabulated in the said report - which were no doubt relied on by Mr Venning - are as follows:

Results

:

Determination of Mix Composition

Sample Reference	BC 4	BC-4/2	BC-4/5	BC-4/6	C5-6/2	
* Approximate OrdinaryPortland Cement Content (calculated from Calcium Oxide Content)	% m/m	11.3	10.1	11.1	12.0	18.3
Approximate Fine Aggregate Content	% m/m	88.7	89.9	88.9	88.0	81.7
Approximate Weight Ratio of Cement and Fine Aggregate	1:7.8	1:8.9	1:8.0	1:7.3	1:4.5	

Remarks : i) * The cement content was calculated from the soluble Calcium Oxide constituent on the assumption that the sample did not contain substantial

amounts of other materials that yield soluble Calcium Oxide. The Calcium Oxide content of Ordinary Portland Cement was assumed to be 64.5% m/m.

Results:

Determination of Mix Composition

Sample Reference	C5-6/4	C5-6/7	E10/1	10E/5	E10/5b	
* Approximate OrdinaryPortland Cement Content (calculated from Calcium Oxide Content)	% m/m	20.2	18.7	15.1	11.5	11.6
Approximate Fine Aggregate Content	% m/m	79.8	81.3	84.9	88.5	88.4
Approximate Weight Ratio of Cement and Fine Aggregate	1:4.0	1:4.3	1:5.6	1:7.7	1:7.6	

Remarks : i) * The cement was calculated from the soluble Calcium Oxide constituent on the assumption that sample did not contain substantial amounts of other materials that yield soluble Calcium Oxide. The Calcium Oxide content of Ordinary Portland Cement was assumed to be 64.5% m/m.

169 Miss Soh was cross-examined by plaintiffs' counsel apparently with a view to casting doubts on her competence. She was unable to answer some of the technical questions put to her by counsel - such as whether she was familiar with 'varying degrees of hydration and carbonation in the samples' or what was meant by 'grout material' or 'polymer content'. She also admitted that she was not required to document or write down her physical observations of the

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samples provided to her. She maintained however that she had carried out the tests in compliance with British Standard 4551 of 1980. She also said in reply to a question by the court that in carrying out the chemical tests of the sample she had followed all the procedures set out in British Standard 4551 of 1980 (see AB-3681).

170 Miss Elizabeth Lee, Assistant Manager of the Chemical and Microbiological Technology department of Setsco confirmed that the Setsco report referred to by Miss Soh was on tests conducted for determining the mix composition of concrete render submitted for analysis. She was not cross-examined by counsel for the plaintiffs or by the third party.

Third party experts

171 The first expert witness for the third party was Dr Henry Ong Wah Kim ('Dr Ong'), a former Associate Professor in the Faculty of Science of the National University of Singapore. He was described to the court as a building consultant frequently engaged by the building industry to investigate work defects in buildings and oversee rectification work thereon. He holds a Bachelor of Science degree (first class honours) from the University of Singapore and a doctorate from Cambridge University. In his affidavit of evidence-in-chief, he said that on 22 January 1993, he was engaged by the third party to look into the problem of debonding external wall tiles at the Haw Par Technocentre. After several visits to the site and after visual inspection of the building and taking samples of the fallen tiles, he submitted his first report dated 30 April 1993 to the third party (ER-270 to ER-286).

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172 Dr Ong's first report has been divided into seven sections: Haw Par Technocentre (introduction); Debonded tiles; Bonded tiles; Tile quality; Tile and expansion joints; Tile adhesive; and Conclusion. Insofar as is material, the following segments of the report require highlighting:

> **Haw Par Technocentre**
>
> Haw Par Technocentre is a seven (7) storey light industrial building located at the junction of Commonwealth Avenue, Commonwealth Drive and Tanglin Halt Close. The owner of the building is Setron Limited.
>
> The building has seven tiled elevations. …
>
> Tiling began on or about the 20th September 1991 and completed around 7th February 1992. This period corresponded to the N-E monsoon season found in this part of the world.
>
> Tiles falling started in May 1992 or about 6 months after the tile application. A one to one replacement of the fallen tiles after hacking off the used adhesive was however not successful. The replaced tiles debonded again.
>
> Soon after, more tiles fell.
>
> By August 1992, [sic – see however para 133 herein] the owner had engaged an outside contractor to remove the bulging tiles, and also those in the surrounding areas.
>
> …
>
> **Debonded Tiles**
>
> A total of 1,649 tiles had fallen by the 16th March 1993. …
>
> The fallen tiles usually had no or little adhesive stuck on their backs when these tiles debonded. This is because the adhesive can be found intact on the external walls.
>
> …
>
> Where the tiles had debonded or removed, greyish horizontal and vertical patches were found. These patches were randomly located on the walls. Some tiles had ruptured when these tiles were debonded or were removed.
>
> It was noted that many patches were found adjacent to expansion joints and in sheltered areas. So far as the patches found adjacent to expansion joints are concerned it is fair to

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assume that the expansive movement (if any) would have been taken care of by the expansion joint. As far as the patches on the sheltered areas are concerned, the tiles were not subjected to the heat of the sun. Therefore the debonding of the tile as a result of expansive movement due to temperature cannot be a relevant factor. Therefore, expansive movement due to tile thermal expansion or relative moisture movement between the tiles and the adhesive cannot be too important.

Only one debonded patch was found near a building joint. Therefore, structural movement is minimal. This is confirmed by the fact that wall cracks were not detected or reported. This is further substantiated by the absence of micro-cracks on the bonded tiles.

Bonded Tiles

There were full and cut tiles bonded to the external walls. …

From the architectural drawing, the consultant understands that the panels to be tiled are 10.8m long and 4.8m high.

…

Other defects of the tiles and tiling were also detected or confirmed. These included:-

(1) hollow sound on the bonded tiles;

(2) chemical staining; and

(3) tile rupture.

These defects found on the bonded area were associated with poor workmanship … and removal by force …

From the RAK reports, less than 3,000 hollow sounding bonded tiles were detected. However, it has not been ascertained whether these tiles would remain bonded to the walls, and for how long.

…

Tile And Expansion Joints

The horizontal tile joint width was found to vary from 2 to 5mm with an average in excess of 3mm. Most of these horizontal tile joints measured were predominantly wider than the 3mm specified. However, a large variation in the vertical tile joint width was observed. These, varying from 1 to 3mm, had an average short of the 3mm required.

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The absence of tile grouts in several of the tile joints with widths varying from 3-4mm indicates that poor grouting or pointing workmanship might not be the only problem on the tile joints. Acid washing shown by chemical staining of the tiles could be another causative factor.

…

Tile Adhesive

The adhesive or bedding (3-6mm thick) was always found intact on the walls. Impression due to the combing with a 8 to 9mm notched trowel was clearly evident. But the combing was irregular, not always running from top to bottom, or from side to side.

The combing had resulted in the presence of voids 2-3mm deep in the adhesive layer. These voids caused the hollow sound when the tiles were struck.

This is poor tiling workmanship as the tiles were to have been applied with a twisting or sliding action, and tapped back firmly into the floated bedding to prevent the formation of these voids in the bedding adhesive. Otherwise, water would accumulate subsequently in these voids.

The adhesive bedding was found wet by the consultant. Hence, moisture movement of the bedding adhesive would be an important factor which could cause the tile debonding defect. This is provided that the bedding or the adhesive is a continuous layer, found below the tiles and on the wall panel.

However, discontinuous adhesive layers were found on the walls of the Haw Par Technocentre. This fact must eliminate therefore the serious expansive moisture movement of the adhesive as the prime cause of the tile debonding problem.

Therefore, the number of expansion joints and their distance apart in the panels (where the tiles had debonded) would not be critical. …

Furthermore, the faint or no depression of the tile keys or ribs on the adhesive meant that the contact of the tiles to the adhesive was poor. Hence, a weak bond between them would result. And the occurrence of the slipping or slumping of the tiles during their application can be inferred.

The adhesive on the walls appeared both light and dark grey. However, a cement/sand adhesive gauged with a latex would be light grey in colour. Hence, some adulteration with more cement was indicated.

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…

Conclusion

In early March 1993, and after a few days of rain, a bulging tile appeared at the side of a 10.8m panel on the 6th level … The bulging occurred at the bottom rather than at the side of the tile. This was later removed together with other tiles.

On the 16th March 1993, and after several days of rain, four (4) tiles had dropped from the 6th level … at different times on the same day. Altogether, 70 tiles were removed subsequently from this area.

These two episodes revealed the nature of the tile debonding problem found on the Haw Par Technocentre.

If the causes were due to thermal and moisture movement, the tiles would have debonded explosively and a large section of the tiles would have come off together, and not one by one as was found to be the case.

Therefore, thermal expansion and moisture movement cannot be that important. This is substantiated by the low coefficient of linear thermal expansion of the tiles and the discontinuous adhesive layer found on the walls.

The tiles, the adhesive and the tiling workmanship had all contributed primarily and equally to the poor adhesion, and hence to the tile debonding on the Haw Par Technocentre.

Any suggestion of inadequacy of tile joints would at worst allow water penetration; and water may precipitate the tile debonding or cause further deterioration of the weak bond.

The number and the spacing of the existing expansion joints in no way contributed to the tile debonding problem.

173 According to Dr Ong, he was instructed by the third party in January 1994 to carry out further investigations into the cause of the debonding tiles. This time, the third party, in consultation with Dr Ong, had engaged Setsco to carry out the following tests:

(a) Pull-out Tensile Bond Strength Test;

(b) Laboratory Analysis on Adhesive and Render from samples collected from the walls;

(c) Laboratory Simulation test;

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(d) Visual Examination test; and

(e) Tensile Bond with and without sand test.

174 Consequent upon receipt of reports from Setsco on the above tests, Dr Ong prepared his second report on the probable cause of the external tile problem. His second report dated 12 October 1995 appears at ER-288 to ER-453 together with the said Setsco reports.

175 The conclusion reached by Dr Ong following tests carried out by Setsco, as they appear in paras 90 to 110 of his second report (ER-318 to ER-322) are as follows:

3. Conclusion

> 90 The investigation had taken more than a year. Evidences were carefully collected and tests were planned and then conducted in the presence of parties concerned.
>
> 91 In tiling, the quality of the tiles is not determined by dimensional parameters alone; surface quality (eg. flatness, straightness of sides, warping etc) and other properties like modulus of rupture, craze resistance, chemical resistance and abrasion properties would altogether determine the final quality of the tiles.
>
> 92 The wall tiles used at the Haw Par Technocentre were not of inferior quality, except for the direction and depth of their back keys, grooves or ridges. The low keys were found by Setsco to have caused little or no significant effect on the tile bond development, except when the adhesive was ribbed vertically, and in line with the key direction of the tiles, a reduced tensile bond strength was obtained. Neither was the soaking of the tiles. Soaking of the tiles was only crucial in the application of very porous tiles.
>
> 93 The ribbed tile adhesive was found to have no sand. The adhesive consisting only of cement and proprietory polymer latex could have been mixed and applied in-situ by the applicators. More importantly, the adhesive was found to be between 3 to 6mm thick. In some instances their thickness had gone beyond 6mm to about 10mm. This was primarily because of inadequate tapping and pressing and/or wall uneveness.

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94 The 6mm mortar adhesive specified was intended to accommodate irregularities in the base or background. The surface of the adhesive was not required to be ribbed unless required to do so by the manufacturer (of the adhesive) or very lightly ribbed to assist application of the tile. If the application was improperly carried out, voids in the adhesive layer would form. To prevent void formation, pressing, sliding and tapping of the tiles into the adhesive were absolutely necessary.

95 The proprietory polymer latex manufacturer, Laporte, prescribed the following adhesive mix with their polymer latexes SAC 22 and SAC 23. These are :

Thin-Bed 3mm Thick-Bed 6mm

Portland cement 50 kg 50 kg

Sand 50 kg 150 kg

Polymer latex 19 litres (SAC 23) 19 litres (SAC 22)

96 It is evident that the tile adhesive was neither the thin-bed nor the thick-bed type (Appendix I).

97 Moreover, the adhesive was applied in small patches of about 1.5m x 1.5m in area. Re-working on the adhesive applied was perhaps found necessary due to the open-time problem. And, discontinuity between adhesive areas was also found. The discontinuity of the adhesive meant that any stresses developed under thermal or moisture movement could not extend throughout the entire length of 10.8m (or 4.8m) long. Any expansive or contractive forces between the adhesive and the render layer must therefore be localised.

98 But tiles in sheltered areas and areas located close to the expansion joints and at the edge of the walls where stresses were expected to be minimum had been found to have debonded. Therefore, positioning and size of the expansion joints were not important and was not the main cause of the tile debonding defect. Both the expansion and the tile joints would suffice inspite of any minor relative movement found subsequently, if the tiles were adequately bonded in the first instance.

99 The existence of any movement in the tiles or the walls was difficult to detect or prove, except for the bulging of some tiles. These tiles had bulged in ones and twos only; but most often at the top and at the bottom edge of the tiles. Stacking of the bulged tile on top of another would cause debonding of other adjacent tiles subsequently.

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100 If the tile-adhesive bonds were strong and the tiles were fully bonded, thermal and moisture movement would usually cause (1) cracking of the tiles and (2) an explosive, expansive tile debonding. Substantial number of these tiles would then come off altogether. The tiles on the Haw Par Technocentre walls hardly cracked, and there were no massive and/or explosive debonding reported.

101 There is no denying that water had penetrated into parts of the tiled facade and also that water could degrade the tile bond through leaching in the adhesive and perhaps also in the render. And that this deterioration of the bond could be quite drastic and a lowering of about 0.4 N/mm2 in the tensile bond strength could be anticipated under extreme conditions of weathering, exposure and/or water penetration.

102 But the samples extracted during the pull-out tests were generally dry in the adhesive and in the render except for the nine (9) out of a total of 44 samples mentioned earlier. Therefore water degradative process is not an important factor to have caused the tile debonding on the Haw Par Technocentre walls.

103 The only logical conclusion must be that bonding of the tile was inadequate. The adhesive and the workmanship had contributed to the tile debonding problem at the Haw Par Technocentre building.

104 It is also not unreasonable to expect that the adhesive mix, the workmanship and the water degradation would act synergistically and adversely on the tile bond. So water should not be permitted to find its way into the back of the tiles, and especially in between the tiles and the adhesive.

105 On render or plaster, BS 5385 : Part 2:1978 stated that it is not good practice to apply render having a total thickness in excess of 20mm without reinforcement. Moreover, poor, deteriorated and damaged plaster is known to have an adverse effect on the adhesion of the intermediate substrate or tiling or both. (BS 5385 : Part 1:1990; section 16.1.8).

106 But 90% of the render or plaster samples obtained from the Haw Par Technocentre were found by Setsco to be in excess of 20mm thick. Eighty percent (80%) of the render had thickness ranging from 25 to 40mm. Therefore, some wall render would also be expected to debond, if not reinforced, subsequently.

107 The question that should be asked was whether the tiles were bonded properly in the first place. If they did, then we must consider the continuity of the adhesive below the tiles.

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> 108 If the adhesive was everywhere discontinuous, then the disruptive relative thermal and moisture movement forces (if present) for the entire facade would not extend throughout the whole length of the panel.. The stresses when developed then would be localised between the tiles. The tile joints would become important, and the provision of 3 mm tile joints was sufficient.
>
> 109 Calculation has shown that a mere 2 - 3 mm width over a distance of 10.8 metre or 35 tiles altogether would only be required to allow for thermal expansion. This fact was confirmed by the RAK Consultants who had suggested that "the size of the joints should be generally between 3 - 6 mm; with the larger tiles, it is advisable to have joints nearer 6 mm" (see RAK Consultants' Report No. 12032, dated 5 October 1992, page 2, paragraph 2). Even the positioning of the much larger expansion joints located at junctions with columns would not also be critical if the tile joints were adequately provided, and filled.
>
> 110 The isolated bulging tile, the numerous hollow sound in the tile, the extensive adhesive voids, the common faint ridge impression and the exposed tile joints had reflected the kind of workmanship applied in the tiling. Workmanship problems referred to in this investigation included:
>
> (1) adhesive mix and mixing (2) long open-time before tile application (3) inadequate tapping and pressing (4) adhesive thickness; and (5) discontinuation of adhesive or method of application.

176 Dr Ong was also cross-examined vigorously by plaintiffs' counsel. As observed by me earlier, in relation to Mr Venning's cross-examination, aspects which emerged in the cross-examination of Dr Henry Ong will be referred to, if necessary, later in these grounds. It should, however, be observed at this stage that counsel for the plaintiffs endeavoured to introduce in evidence a previous conviction for an offence of corruption by Dr Ong, presumably as provided for under s 148 of the Evidence Act (Cap 97), with a view to discrediting him. Dr Ong readily admitted that he had been convicted and in this regard counsel for the third party placed before the court a newspaper clipping (exh P-59) which mentioned that Dr Ong was convicted on 16 November 1991 and was imposed

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a fine of S$19,000 for receiving gratification for recommending a painting contractor to a project he had once handled. The court was also informed by counsel for the third party that despite knowledge of this conviction, the plaintiffs' solicitors themselves had engaged Dr Ong's professional services in the course of 1994. In my opinion, the evidence pertaining to Dr Ong's previous conviction was no more than a red-herring, introduced unnecessarily and had little relevance to the issues at hand.

177 Besides the foregoing, in reply to a question by the court, Dr Ong expressed the view that liability for the tile failure should be attributed as to 85% to the plaintiffs and as to 15% to the third party and the defendants.

178 The third party also produced Mr Wong Chung Wan and Mr Teo Beng Chai, both from Setsco, who had carried out the tests mentioned by Dr Ong in his evidence.

179 Mr Wong Chung Wan said that Setsco is one of the pioneer laboratories accredited by the Singapore Institute of Standards and Industrial Research (SISIR) under the Singapore Laboratories Accreditation Scheme and is a leader in building material testing.

180 Of the five tests mentioned by Dr Ong, the first one being the pull-out tensile bond strength test was carried out by Mr Teo Beng Chai and the remaining tests were conducted by Mr Wong Chung Wan. Mr Teo's affidavit evidence (TP-18) appears from ER-116 to ER-180 whereas Mr Wong Chung Wan's affidavit evidence appears from ER-180A to ER-453. Their evidence, both in-chief and in cross-examination, inasmuch as they are technical in nature would be referred to, when necessary, later in these grounds.

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Arguments and conclusion

181 Comprehensive and lengthy submissions were made by counsel for each contestant. I do not propose to adumberate each and every aspect of counsel's submission. Suffice it if I said that all the arguments and learning referred to were considered by me and in this regard I must add that I also had the benefit of considerable technical assistance from Dr Y S Lau - a professional engineer of considerable repute in this region – who, being nominated by counsel for all the parties to the action herein, was appointed to assist the court.

182 It was clear from the way the evidence had been presented and arguments advanced, that the plaintiffs are attributing the tile failure squarely to faulty design by the third party. The third party, however, maintains that the failure was in the main due to poor workmanship by the plaintiffs and in the context of supervision of work, has raised the issue of contributory negligence on the part of the defendants, contending that the defendants are vicariously liable for the acts of the Clerk of Works who had been on the defendants' payroll. The plaintiffs have not raised contributory negligence against the defendants at all. Insofar as the defendants are concerned, their claim is plain and simple. They say that they had engaged the plaintiffs and the third party to provide them with a defect-free external wall faade but they were landed with a defective wall finish which they had not bargained for. By and large they blame the plaintiffs for the defects and in the alternative the third party for the tile failure and claim indemnity from them.

183 It may be useful at this stage to give a thumb-nail sketch of the points made by the respective parties as to the cause of the tile failure and their reliance as

well as criticism of the evidence adduced by the respective parties in the course of the trial.

Points highlighted by the plaintiffs

I *Third Party/Architects' Defaults*

(a) The defaults in the Architect's design of the external wall were:

(i) failure to provide proper spacing between vertical and horizontal expansion joints resulting in inadequate thermal movement provision;

(ii) inadequate width of the joints between the tiles, resulting in ingress of moisture through the joints;

(iii) omission of nosing of the horizontal sill tiles to overhang the cladding tiles to prevent water ingress; and

(iv) improperly detailed window sills leading to deterioration and debonding of the tiles.

(b) The debonding of the tiles occurred because the Architects:

(i) did not specify the appropriate clearance between tiles;

(ii) did not provide proper spacing between vertical and horizontal joints in the faade;

(iii) did not provide proper spacing between tiles, resulting in ingress of moisture through the joints;

(iv) did not provide for the nosing sill tiles to overhang the cladding tiles to prevent water ingress;

(v) did not properly detail the window sills, which led to the deterioration or debonding of the tiles;

(vi) did not exercise adequate supervision of the tiling works;

(vii) did not ensure that the provided clearance between tiles was adequate;

(viii) did not instruct the plaintiffs to remedy the inadequacy of the clearance between the tiles;

(ix) did not ensure that the tiles used were able to tolerate thermal expansion;

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(x) did not ensure that the tiles used contained adequate adhesive to ensure adequate bonding of the tiles to the walls;

(xi) did not heed, observe and/or notice the tiling defects;

(xii) approved the inappropriate choice of the tiles; and

(xiii) approved the tiling works, including the defects.

(c) The tiles were such that they were of rigid ceramic which could not accommodate thermal movement.

(d) The responsibility for the choice of tiles and design was the Architects' and the Defendants'.

(e) The Architect's design responsibility was not limited to aesthetics. According to Bowman, "*it is up to the Architects and the Structural Engineer to determine and make provision for likely movements in the facade*".

(f) According to Goh Chong Chia, past president of SIA, "the party responsible for the tiling design performance, durability and function were the Architects".

(g) Anson Ho conceded that choice of the tile, provision of the work method and sequence, specification of performance and durability, and specification of movement joints related to performance were design issues for which the Architect is responsible, and his role covered the specification of technical, material and work method.

(h) The Contract states that "the Contractor shall be under no responsibility for the design or suitability for their purpose after completion".

II *Movements and joints*

(a) In the opinion of Mundell of RAK, the defendants' expert:

(i) inadequate provision of tile and expansion joints to accommodate tile movement was the main cause of the debonding; and (ii) moisture expansion of the tiles could be significant, and the 10.8m spacing of the expansion joints was the major reason for the failures.

(b) Nathan was of the view that in addition to failing to provide inadequate joint width and expansion joints to accommodate both thermal and differential movement of the tiles especially

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as the building lacked structural movement joints, the tiles were irregular in size.

(c) The buckling/tenting patterns (the effect of thermal/compressive forces) were confirmed by the photographs.

(d) There was no evidence to show that water caused compressive failure. Moreover the tenting was vertical as well as horizontal, and the tiles moved upwards.

(e) There was inevitable thermal/differential movement in all the building facades which could have been, but were not allowed for in the design.

(f) The Architects had failed:

(i) to provide for sufficient tile joint width to accommodate thermal/moisture/differential movements (3mm tiled joint width was specified and affirmed by the Architects at a site meeting); and (ii) to provide adequate movement joints in the design of the tile facade to cater for stresses (the vertical expansion joints were 10-8m apart), deviating from British Standard BS 5385 Part 2 (1978) which recommends vertical expansion joints to be 3 to 4.5m apart.

(g) The specified 3mm joint width could only mean the nominal joint width since the Contract Specifications called for "straight unbroken lines". The Clerk of Works accepted that variable tile joint width was normal, given the tile irregularity.

(h) Extruded tiles have greater dimensional variability than pressed tiles and require wider joint widths to maintain a reasonable ratio between tile thicknesses and the grout. The British Standards specify that joints between extruded tiles are usually approximately 10mm wide to allow for size and tolerance. According to Dr Ong, the ratio should be 1:1.

(i) The tiles were 8mm thick and the joint width specified as 3mm. According to BS 5385 Part 2, "joints between extruded tiles are usually approximately 10mm wide to allow for the variation in size and tolerance" and "where it is necessary to provide for adequate release of water vapour to the atmosphere, such as where there is no permeable layer or ventilation cavity in the wall, the area of jointing should be about 10% of the total tile area". Also, "an adequate width of joint is necessary to enable the operative to insert the joint filling material thoroughly, that is, solidly to the full depth of the joint spaces to eliminate the danger of voids".

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(j) Singapore Standard SS301 allowed + 1% (3mm) tolerance in tile dimension which meant that each tile could be 297 to 300mm long and 242.55 mm to 247.55 mm wide. The tiles had a + 2 to 3mm tile irregularity in any event, which would encroach into the 3mm nominal joint width but still comply with SS301.

(k) At Bel-Air, cited by Venning, much smaller tiles were used and had 13mm to 15mm wide tile joints, which made expansion joints unnecessary.

(l) Lobby B had larger tiles than the external ones, but did not fail because there was no exposure to the sun and no moisture expansion from rain.

(m) According to Squinzi and Couillaird, 0.2mm to 0.3mm of differential movement would be sufficient to break the bond at the tile adhesive interface. The cumulative differential movement from all known factors exceeded that and inevitably caused debonding. Wider tile joints and closer expansion joints would have relieved the stresses.

(n) According to Bowman, a differential movement of 0.035% translates to 3.78mm movement in 10.8m.

(o) Toh testified that at 18 Anderson Road the tiles did not debond. They were 300mm x 300mm and 8mm thick, with 8mm wide joints.

(p) The failure of the faade was primarily caused by stresses at interfaces of different materials generated by differential movements – moisture expansion, concrete/render shrinkage, shortening of the building and reversible thermal and moisture movement. As designed, the tiles would have debonded. Also, according to Bowman, the render did not fail.

(q) Debonding was inevitable, even with perfect workmanship.

III Workmanship

(a) Defendants' expert Venning stated that (a) the tile debonding was due to poor workmanship, (b) water had ingressed behind the tiles at the window sills and weakened the bond, and (c) that the screed was lean and outside the specifications. But he could not explain the buckling/tenting of the tiles or why the tiles did not fall off immediately.

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(b) Venning stated that water ingress at the roof coping, window sills and through the grouts had weakened the bond between tile and substrate. If so, tiles below the window sills ought to have debonded first, but did not. Only 268 out of 2400 tiles below the window sills (1.2%) had debonded. Therefore water if any must have made its way into the tile-adhesive interface only after debonding had occurred. Hydrostatic pressure was insufficient to push out the tiles.

(c) The Architects' expert, Dr Ong, was of the opinion that poor workmanship caused the debonding, but however, the window sill detail had no effect on the debonding.

(d) The Architects failed to specify expansion joints over different background materials. According to Mundell, "there is much more likely to be a substantial movement where two different materials join".

(e) The Architects also did not specify expansion joints at the columns and at external angles vertically within 0.25m to 1m from the angle" as required by BS 5385 Part 2.

(f) According to Mundell, poor workmanship would have resulted in isolated failures and not the type and pattern of failure observed.

(g) Regarding the debonding:

(i) the buckling/tenting was thermal/compressive in nature; (ii) the buckling/tenting was on both horizontal and vertical planes, and therefore water could not have caused the thermal/compressive failure; (iii) the debonding was due to shearing between two surfaces; (iv) debonding, which occurred in all the building facades due to thermal/differential movements, could have been prevented by allowing for the movements in the design; (v) perfect workmanship would not have prevented the deleterious effects of the movements in the faade; (vi) the responsibility for the choice of the tiles and the design was the Architect's and the defendants'; and (vii) the 300mm x 300mm homogeneous tiles in Lobby B had 3mm wide joints but did not debond because there was no exposure to the sun and no moisture expansion from rain.

(h) The adhesive supplier's representative, Lim Chwee Hock, recommended the use of SAC23 with neat cement as the tile keys are shallow. No back buttering was needed. The Contract specified neat white cement for grouted joints up to 3mm wide, and cement/sand for joints exceeding 3mm wide.

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(i) If there were hairline cracks in the grout through which water could penetrate and weaken the tile-adhesive bond, moisture expansion would have closed them up.

(j) If the bond had been weakened at the tile-adhesive interface, water would have caused rapid chemical attrition of the tile or the adhesive, of which there was none. The adhesive had water resistance and met several national standards, all of which required a water immersion test of at least 7 days.

(k) SAC23 had been used successfully in many public projects and was correctly applied, using the right trowel and the right proportions with the mandatory 10 minute slaking, within the recommended open time and pot life.

(l) The use of toothpicks to maintain the gaps between the tiles is, according to Mundell, not unusual. The use of a dogtooth trowel is also common practice in Singapore.

(m) The screed was cured for 7 – 8 days before tiling commenced. Curing times in Singapore can be shorter than in England because of the relatively small variations in weather and higher humidity. According to Mundell, concrete needed 14 days in England to cure, but only 2 days in Singapore. Polymer additives would shorten the curing times needed.

(n) Lim Chwee Hock testified that:

(a) back buttering was not recommended as there was a level screed coat and the keys of the tiles were shallow; (b) the trowel used in this case was the right one, which is typically used on construction sites in Singapore; (c) the tiler Toh Kim Boon took not more than 15 minutes from the start of spreading the adhesive on the wall to the completion of laying all 16 tiles in a panel, well within the open time for the adhesive of 25 minutes; and (d) the adhesive pot life was one to two hours.

(o) Tang Deng Wee, for the defendants, had to withdraw his statement that the adhesive was mixed at ground level and transported to the tilers by means of ropes and buckets, and agreed that the materials were hoisted to the correct level by cranes and mixed where tiling was being done. A mechanical mixer was used to mix the cement/SAC23. The SAC23 was dispersed from large drums by a hand pump.

(p) According to Venning,

(i) the edges of each panel were "feathered" so as not to cover the setting out lines, which resulted in a distinctive pattern of debonding due to poor adhesive coverage in the tiles at the borders. However, this did not happen.

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IV *The Setsco tests*

(a) The Setsco test on a grout sample showed that there was polymer in the grout.

(b) The Setsco tests for shear bond did not properly evaluate the tile-adhesive interface shear strength as it was the epoxy which joined the metal plate to the tile used in the test which failed first. This meant that the shear strength at the tile-adhesive interface exceeded the epoxy – tile shear strength of 0.33N/mm2.

(c) Varying values of bond strength in the Setsco tests were due to inconsistencies in the testing procedures which were non-standard and did not simulate field conditions (different size of tiles, different applied pressures, different substrate, different trowel, no slaking for 10 minutes) and were unreliable.

(d) The tensile bond tests were also inconsistent and unreliable.

(e) Setsco's tests on the screed were non-standard, and were unreliable because:

(i) the samples were not tested for contamination; (ii) the samples were not measured for uniformity; (iii) the samples were not re-tested; (iv) the samples were not tested for latex or polymer content; (v) the flour bags used to deliver the samples to Setsco would have contaminated the samples; and (vi) only 10 samples were tested, which were not representative.

(f) The screed had to be hacked off when it was decided to install a new faade which was evidence of the performance of the screed.

(g) According to Bowman, Setsco:

(i) assumed that the sand was 100% silica oxide; (ii) failed to determine the typical amount and type of silt in the sand used, which could be the source of both soluble silica and calcium oxide; (iii) did not test the "white material" which allegedly leached out, which could have come from the adhesive bed rather than the render; (iv) assumed the calcium oxide and silica oxide content in the cement; (v) did not correct for free lime when assuming the calcium oxide content; and (vi) did not adopt a precise experiment to determine the approximate polymer content in the render samples.

(h) The results of the Setsco tests were inconsistent and the correlations were poor:

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(i) Of the 15 out of 44 samples of the screed tested, based on calcium oxide content, 10 were supposedly cement-rich and 2 lean whereas when based on soluble silica analysis, 13 of the same samples were rich and none lean; (ii) Five of the same 15 samples showed supposed failure in the screed, yet in all 5 cases the bond strength exceeded the AS2358 requirement of 0.15 N/mm2; (iii) the supposedly leanest of the samples analysed (1:72 based on calcium oxide) still had a bond strength of 0.23 N/mm2; (iv) in 3 of the 4 analyses of tile/adhesive interface failure in the tests, the strength of the render must have exceeded 0.22 N/mm2; and (v) where the tile/epoxy bond failed, the tensile bond strength of the render would have exceeded 0.53 N/mm2.

(i) The polymer content did not correlate with bond strength. The tested tiles were at the corners of the faade, which had undergone the greatest movement stress. Also, sawing the tile to isolate it severely stressed the tile. Localized stresses were created in cutting the tiles on an already distressed tiled faade.

(j) Although the test results were highly variable, no additional samples were tested.

(k) The concrete was cured for 30 days (only 14 days were required, according to Mundell). The screed bed which was between 20mm and 30mm thick, had to be thicker over the brickwork which was set in, as compared with the concrete background, to obtain a level screed layer. It was applied in 2 layers. The Contract did not call for reinforcement in the screed. According to Ong, "it was the tiles that came off and not the render."

Points highlighted by the defendants

184 **I *The Plaintiffs' Defaults***

The Plaintiffs' Contractors:

(a) did not use suitable adhesive for the tiles;

(b) did not use sufficient adhesive for the tiles;

(c) did not ensure proper adhesion of the tiles;

(d) did not provide sufficient clearance between tiles to cope with thermal expansion of the tiles;

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(e) did not ensure that moisture did not collect behind the tiles after they had been laid;

(f) did not execute the tiling works with due diligence and care;

(g) did not check with the architect or his agents on how to carry out the tiling, especially with regard to clearance between tiles;

(h) did not properly cure/dry the screed for fixing the tiles;

(i) did not use a consistent cement-sand-polymer screed;

(j) used excessively thick, unreinforced screed; and

(k) did not properly apply the screed in layers.

II *Tile Characteristics*

The suitability of the tiles for use on external wall faade was confirmed by the tile manufacturer. Sebastian Kho himself conceded that he was no longer alleging that the tiles were unsuitable.

III *Variability in Composition of Screed*

(a) AS 3958.1 states that for screed, the sand-cement ratio should not be richer than 3:1 by volume when based on dry sand and 4:1 for damp sand.

(b) BS 5385: Part 2 states that rendering should be 3-4:1 by volume (3.5-4.5:1 by weight) for dry sand, and 4-5.5:1 by volume for damp sand.

(c) Ministry of Labour (MOL) Guide to Safe Installation of External Cladding states that the sand:cement ratio should be 3:1 to 4:1 by volume with minimum water content.

(d) The actual sand:cement ratio was determined by volume, and the additive SAC 22 was never measured.

(e) Wong gave evidence that there is only one source of sand in Singapore which contains no calcium carbonate. This was confirmed by Sebastian Kho, therefore the calcium oxide analysis used in the Setsco tests was valid.

(f) The leanest composition in the Setsco tests was 8.9 to 1, (sand-cement ratio) and found to be grossly at variance with the specifications. The effect was that the tensile bond strength between substrate and plaster had failed.

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(g) Setsco found that the composition of the screed was very variable, with sand-cement ratio ranging from 1.7 : to 1 to 7.2 : 1.

(h) Because of the variability of the results Wong repeated some tests up to 3 times.

(i) Mr Venning and Dr Ong agreed that the variable results were attributable to poor quality control.

IV *Excessively Thick Screed without Reinforcement*

(a) AS 3280 states that "attempts to apply over thick rendering may result in unduly high shrinkage stresses and consequent cracking and loss of adhesion. It is not good practice to apply rendering having a total thickness in excess of 20mm without reinforcements". Similar provisions can be found in the BS and MOL Guidelines.

(b) Toh Kim Boon told the court that:

(i) the screed was applied in 2 layers of total thickness 20-25mm; (ii) 20-25mm thickness was common because the brickwalls were uneven; and (iii) there was no necessity for reinforcement.

(c) Dr Ong found that 90% of the screed samples tested by Setsco were thicker than 20mm, and 80% measured 25-40mm.

V *Screed not Properly Cured and Dried*

(a) AS 3280 states that "screeds should be cured for at least 7 days and be subjected to continuous air-drying after curing for at least 2 weeks before the bed and tiling are applied".

(b) BS 5380 Part 2 recommends 3 weeks of continuous air drying for cement:sand screeds.

(c) The MOL Guidelines recommend that "the plaster should be protected to prevent rapid drying out and should be completed at least 1 week and preferably 2 weeks depending on weather, humidity and site conditions, before laying cladding".

(d) Toh Kim Boon stated that the screed was left for 7 – 8 days before setting out works commenced, alternatively it was left for

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10 days before adhesive was applied. The curing was insufficient.

VI Concrete not Properly Cured and Dried

(a) The AS states that "structural concrete should be subjected to continuous air drying after the end of curing for at least 6 weeks before either a screed or a tile bed is applied to it".

(b) As little as 13 days elapsed between the last cast of concrete and the start of tiling in certain cases.

(c) The AS states that shrinkage of the screed due to drying could produce forces to break adhesion between the tiles and the tile bed (under the screed).

VII *Variability in Composition of Adhesive*

(a) Sebastian Kho testified that:

(i) no sand was used with the adhesive; (ii) reliance was placed on the consistency of the mixture without any attempt to fix the proportions; (iii) the majority of the debonded tiles did not have adhesive on them; and (iv) only a faint impression of the dog tooth trowelling on the rear of the tile could be seen.

(b) Based on Sebastian Kho's observation of no adhesive adhering to the back of the tiles, Nathan had concluded that bonding was broken in the initial stages of development which suggested a workmanship fault.

(c) Polymer content in 70% of the samples was much lower than the 19 litres per 50kg of cement recommended by the manufacturer.

(d) The plaintiffs departed from the prescribed mix sand:cement : SAC23 proportions of 25:25:1 by volume.

(e) A typical mix following the specifications would have a coefficient of thermal expansion similar to that of concrete. The difference in the coefficients of thermal expansion contributed to differential movement.

VII *Open Time*

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(a) The open time stated by Lim Chwee Hock was 25 minutes in Singapore, the pot life being 1-2 hours.

(b) Toh Kim Boon testified that the open time was up to 20 minutes, and that the adhesive would harden if the adhesive was left for 15 minutes.

(c) Setsco estimated the open times to range from less than 10 minutes to more than 30 minutes.

(d) According to Lim Chwee Hock, had sand been added to the mix, the open time could have been longer.

IX *Adhesive not Applied to Setting out Lines*

(a) According to Toh Kim Boon, markings of the panels had to be preserved and therefore there would be no adhesive at the edges of the tiles at the setting out lines.

(b) The AS stresses that the ability of an adhesive based tiling system to meet the performance requirements is effected by contact coverage of the adhesive.

(c) According to Mr Venning, where there was incomplete adhesion, water could collect in voids behind the tiles and degrade the adhesive. The pattern of voids which was crisscross behind the total tiled area was due to poor workmanship.

X *Direction of Trowelling*

(a) The AS recommends "wherever possible, spread adhesive so as to leave horizontal ribs".

(b) Through Lim Chwee Hock, the adhesive supplier recommended horizontal trowelling.

(c) Trowelling was haphazard and multidirectional.

(d) Sebastian Kho said that:

(i) vertical trowelling was carried out at the rooftop, at expansion joints and vertical corners, and at some locations depending on the position of the scaffolding; (ii) angled trowelling was generally done when approaching obstacles; and (iii) trowelling could be done either way at expansion joints.

(e) However, no explanation can be given for the haphazard and multidirectional trowelling (ER85 photo 38 and ER83 photo 31) contrary to the adhesive supplier’s recommendation. As the keys were vertical, vertical trowelling made the situation worse.

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(f) Toh Kim Boon explained that when the adhesive was found to be uneven, another coat of adhesive would be applied over the first one and vertical or angular notching would be carried out.

(g) The Setsco tests showed that vertical trowelling reduced bond strength.

(h) Lim Chwee Hock recommended horizontal trowelling.

XI *Not Buttering with Adhesive*

(a) The Contract Specification requiring buttering of the adhesive was not complied with.

(b) The BS prescribes either notched trowelling and buttering or alternatively buttering alone, and does not recognize application of adhesive to the wall without buttering.

(c) Toh Kim Boon stated that where it was difficult to put adhesive on the wall, adhesive was applied to the back of the whole tile, otherwise no buttering was carried out.

XII *Tiles not Installed Top-Down*

(a) The Contract requires top-down tiling. This is also recommended by the BS.

(b) Toh Kim Boon testified that industrial practice was top down and cited JTC works as an example.

XIII *Adequacy of Expansion Joints*

(a) According to Bowman (defendant's submission page 64):

(i) creep shrinkage caused buckling of the tiles and movement of 0.01%; (ii) 0.01% of reversible movement was due to thermal expansion; and (iii) 0.025% of movement was due to moisture expansion.

(b) However,

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(i) creep shrinkage of concrete does not translate in the differential movement of the same order as the screed and adhesive layers can accommodate some movement; (ii) Venning made the point that the heat also expands the layers below the tiles; (iii) ISO 10545-10 states that "the majority of glazed and unglazed tiles have negligible natural expansion that does not contribute to tiling problems when tiles are correctly fixed"; (iv) BS 5385 Part 4 states that "low porosity tiles have a negligible expansion"; (v) Bowman assumes that Korzilius tiles behave in the same way as Australian tiles without basis; (vi) Venning's view is that any movement from the expected thermal and moisture expansion can be accommodated by the system as designed; (vii) Venning's calculations show that the expansion joints as installed are adequate to cater for the magnitude of movement encountered by the tiles; (viii) Venning has calculated the thermal expansion of the tiles due to 15oC temperature rise; (ix) the local range of temperatures is minimal as compared to UK or Australia; and (x) according to Mr Venning the tile falls were random, from sheltered areas and soffits of overhangs.

XIV Joints Widths

(a) 3mm joint-widths were prescribed and would have been adequate, but were not complied with.

(b) The use of toothpicks to determine the spacing of tile joints was improper and inaccurate as a means of achieving the 3mm joint width.

(c) Venning, Nathan, Mundell and Dr Ong all agreed that the joint widths were 1-3mm.

(d) The BS recommends approximately 10mm wide joints with an area of about 10% of the total tile area:

(i) to allow for variations in size; and (ii) to enable the operative to insert the joint material solidly to the full depth of the joint spaces to eliminate the danger of voids, and should be "capable of restricting undue water penetration but allowing passage of water vapour in appropriate conditions".

(e) Mundell stated that the greater the joint size, the lesser the problem but joint size alone rarely contributed to failures, and a 6mm joint could not have complied with the BS, in contrast to Nathan who stated that at least 6mm tile-tile joint should be provided.

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(f) Ong's evidence was that at Beauty World Centre 3mm joints were used and the smaller joints did not cause any debonding.

XV *Grouting*

(a) Venning explained that the polysulphide sealant should not be used as it could not accommodate the movement of water vapour.

(b) Plaintiffs used neat cement without sand, although the specification required to joint and point joints exceeding 3mm with cement and sand.

(c) An additive should have been used in the grouting/pointing but the Contractor used neat cement without additive.

(d) According to Venning "when joints between tiles become too narrow, it is difficult to grout into the joint to solid pack it and pinholes and holidays result. These were evident at many locations.

XVI *Window Sills*

(a) Contrary to standards and good practice, the horizontal tiles at window sills did not cap the vertical tiles, but butted them, allowing ingress of water. Further, the horizontal tiles were often not installed to slope away from the window, as shown in Alternative A and Alternative B in the Architect's Drawings.

XVII Coping at Parapet Wall

(a) The top most tile did not extend all the way to the coping of the parapet and there was a 12mm-15mm gap between the tile and the coping, which was not tiled nor sealed.

Points highlighted by the third party/architects

185 **I** *The plaintiffs' defaults*

The defects in the tiling were caused by the plaintiffs' poor workmanship in breach of their contract and duty to carry out

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and complete the works in a good and workmanlike manner, as follows:

(a) cement rich polymer modified adhesive with no sand in the mix, contrary to manufacturer's recommendations;

(b) application of the adhesive in patches as opposed to uniformly;

(c) excessive thickness and variability of the screed, contrary to BS 5385 Part 2;

(d) inadequate tapping or pressing of the tiles into the adhesive;

(e) notching/ribbing in several directions;

(f) excessive open time;

(g) use of neat cement grout with no polymer or sand; and

(h) inadequate grouting of the joints between the tiles.

II *Deviations from the Contract Specifications*

(a) tile joints installed at less than 3mm spacing;

(b) failure to lay tiles from top to bottom;

(c) failure to butter the back of the tiles and to ensure proper bonding of the tiles to the adhesive;

(d) incorrect screed mixing and application;

(e) incorrect adhesive mixing and application;

(f) skinning due to long open time;

(g) not submitting shop drawings according to Architect's drawing showing alternatives;

(h) improper installation of tiles at window sill areas;

(i) gap at top of parapet wall; and

(j) poor workmanship in the installation of tile-to-tile joints.

III Dr Ong's findings

(a) in some instances the adhesive was ribbed vertically and in line with the key direction of the tiles;

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(b) the combing was irregular resulting in 2-3mm voids behind the tiles;

(c) the adhesive bedding was found to be wet;

(d) there was faint or no depression of the tile keys or ribs on the adhesive;

(e) there was a large variation in the vertical joint width;

(f) thermal movement of the tiles was not significant;

(g) there was discontinuity in the adhesive;

(h) if the tile adhesive bonds were strong, the tiles would have cracked and exploded on debonding, but it did not happen that way.

IV *Joints*

(a) Anson Ho's evidence:

(i) The contract provision of 3mm tile joint width means that the joints should be a minimum of 3mm. (ii) It would be fair for the tiler to deal with variations in tile size within the accepted tolerances and still produce tile joints of 3mm. (iii) The tile joints are to allow variations in size and tolerance of the tiles.

(b) Toh Kim Boon's evidence:

(i) Toh was given a sketch by Richard Wang which Toh had followed. (ii) Toh's understanding was that the joint width should not be more than 3mm.

(c) Tan Deng Wee's evidence:

(i) The Clerk of Works was by definition a representative of the Architects on site, (ii) Tan discovered that some of the tile joints were not 3mm and verbally asked the contractor to attend to it but did not tell the Architect about it.

(d) Dr Ong's evidence:

(i) At least 3mm joint width is required, but no tile joint space is necessary if the workmanship is good, for internal application. (ii) At Beauty World Centre the tile-to-tile joint is about 3mm and after 20 years there are only little problems.

(e) Nathan's evidence:

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Plate 7 shows tiles which abutted against each other, due to insufficient width between two tile-to-tile joints; the tiles had actually cracked and crushed.

(f) Venning's evidence:

(i) photo 7 shows an unwrapping effect of the tiles on the column. (ii) photo 6 is well sheltered from sun, wind, rain etc (iii) photo 8 shows where tiles have fallen from the soffits (iv) from photo 2 there is no obvious reason why tiles should fall from expansion movements

(g) The two standards referred to (AS and BS) do not say that the 3m-4.5m requirement (for expansion joints) exists for vertical joints.

V *Bottom Up Construction*

(a) Venning's evidence:

The reasons for top down construction are

(i) to prevent contamination of work below; (ii) to facilitate removal of scaffolding; and (iii) compressive creep, giving the lower portions the opportunity to dry out and become relatively stable before tiling is fixed to them.

(b) Sebastian Kho's evidence:

Although the contract specification required tiling to be done from the top down, the plaintiffs decided to tile from the bottom up, as the alignment of the tiles goes from the bottom up. It is industrial practice to install tiles from bottom up.

(c) Toh Kim Boon's evidence:

Normally tiling is downwards starting from the top, but at that time the building was still under construction and tiling works commenced from the top of the completed building or completed levels.

VI No Buttering and Failure to Ensure Proper Bonding of Tile to Adhesive

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(a) From Couillard's paper, for a tile of the size used, floating and back buttering is required.

(b) Toh testified that he had never spread adhesive on the back of a tile.

(c) The NCTA's (National Tile Contractors Association) commentary on back buttering was that "a thin layer of bonding mortar trowelled firmly on the back of a tile will produce a stronger bond than a tile that is set on the notched ridges of mortar and pressed into place"

(d) Dr Ong and Venning said that the trowel used was a 8-9mm notched dog toothed trowel.

(e) Photographs by Venning show:

- 30 – hollow sound and leakage at expansion joint; - 32 – wet areas, irregular combing; - 34 – area devoid of adhesive; - 44 – no adhesive at setting out lines; and - ER 350, 351, 352 notching patterns.

(f) There were voids behind the tiles and points of entering at the parapet coping, at window openings where no drip was provided at lintol and no nosing at sills, and through the grout at the joints.

(g) The notching was irregular.

VII *Screed*

(a) Toh Kim Boon's evidence was that mixing of sand and cement was by volume as stipulated by the foreman to reach the right consistency and that the screed was usually applied in two layers, the first layer being 10-15mm thick and the second layer about 10mm thick.

(b) It would appear therefore:

(i) the mixing of the screed did not follow the manufacturer's requirements; (ii) the thickness of the screed was not 20mm as required but varied from 20 to 40mm and the screed was unreinforced; and that (iii) there were two contradictory reports on whether the screed was rich or lean.

VIII *Adhesive*

(a) Sand was not used in the adhesive in accordance with Toh Kim Boon's usual practice and the specification of the supplier.

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(b) There was no regard for the manufacturers' requirements on SAC 22 in the mixing of the adhesive.

(c) Nathan observed the following workmanship errors: (i) there were areas on the wall where the adhesive had not been 100% applied; and (ii) there were a few joints which were not fully grouted.

IX *Open Time*

(a) Venning's evidence:

(i) The adhesive had skinned before the tiles were pressed in. (ii) In answer to a question from the Court as to whether pressing the tiles on against the adhesive after "skinning", would result in substantial tile failure after or soon after the tiling was completed, Venning stated that the water ingress would have created some sort of suction, not related to hydraulic pressure.

X *Coping at the Top of the Parapet Wall*

(a) Anson Ho's evidence: (i) The plaintiffs ought to know how the coping was to be installed through the Architect's drawings. (ii) A gap between the top tile and the coping was quite normal but should be sealed up; this was the responsibility of the tiler.

XI *Moisture Expansion*

An article by Bowman, "the Kinetics of Moisture Expansion", states that "when there is a pop-up involved in a failure (of floor tiles), the cause of the bond failure, not the cause of compression, should be sought. If bond is continuous as it should be, no amount of compression would buckle it".

XII *Liability*

(a) According to Dr Ong, 85% of the liability should be to the Contractor and 15% to the Architect and the owner, because of the following mitigating factors: (a) the tiles were very big on the insistence by the owner; and (b) the tile size varied by about 4mm.

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(b) According to Venning, the liability should be 80% to workmanship and 20% to "superficial supervision, direction" by the Architect.

XIV *Testimony Evidence of Goh Chong Chia (PW4)*

(a) In Singapore when you lay tiles you normally have to comply with the British Code and the Australian Standards.

Issues for determination

186 The core issues the court was asked to determine in the present case are as follows:

(1) *Responsibility for defective external wall tiling works*: Who is responsible – the Contractors (plaintiffs), the Architects (third party) or both - having regard to workmanship and design?

(2) *Inspection/supervision:*

a. To the extent that poor workmanship was a cause, is the third party also liable for failing to properly inspect/supervise the works? b. In the context of inspection/supervision, who is vicariously liable for the clerk of works: the third party or the defendants?

(3) *Joint/separate judgment*: If both the plaintiffs and the third party are responsible, should judgment be entered in favour of the defendants against both of them jointly, or should judgment be entered against the plaintiffs and the third party in separate proportions?

(4) *Damages*: Are the defendants entitled to the damages claimed?

Issues 1 and 2

187 The first and the second issues listed revolve around causes of tile debonding and could be dealt with together. In this respect, the court had considerable assistance both in terms of research and input on technical aspects

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by Dr Y S Lau the expert unanimously nominated by the contestants' solicitors. Having considered all the relevant evidence, my comments and findings as regards issues 1 and 2 are as follows:

> (1) The observed debonding was predominantly at the tile-adhesive interface at random locations in the building faade. It began not long after completion of tile installation, and worsened with time, until the tiles were replaced with "Eleganstone". At the last count, 7784 tiles out of 90,490, or 8.6%, had debonded. The observed failures in the building and according to the Setsco tests were short term, in the context of the normal life of the building faade;
>
> (2) There have been contradictory views by several experts on the primary cause of the debonding. There are photographs of bulging, "tenting" and cracking of the tiles and delamination at various locations, voids in the bonding adhesive and other deviations from good workmanship. The randomness of the debonding locations supports the view that there was more than one cause of the debonding. Delamination near the expansion joints was most likely caused by inadequate provision of expansion joints to accommodate movements. Greater delamination at the topmost storeys indicates probable negligent or careless construction and supervision to meet a tight deadline. Debonding in sheltered areas may eliminate thermal movements as the primary cause of the debonding at such locations but does not rule out the more important expansion and shrinkage of the cladding system due to changes in moisture. Bulging, cracking and "tenting" of tiles in the interior of the tile panels could only have been caused by the inability of the narrow rigid tile-to-tile joints to accommodate moisture and thermal movements;
>
> (3) Numerous types of defective workmanship have been cited as the causes of the debonding, such as failing to butter; using toothpicks as tile spacers; insufficient curing; variability in adhesive and screed composition; not using sand in the adhesive; excessively thick screed which was not reinforced; use of incorrect trowels and incorrect trowelling direction; "bottom up" construction.
>
> (4) According to the 44 Setsco pull-out tests to failure:
>
> (i) 26 (59%) failed at the tile-adhesive interface, of which the results of 21 (48% of 44) were unsatisfactory; ten of them failed during cutting prior to pulling out and 11 of them failed at low strengths below 0.15N/mm2. (ii) 15 (34%) failed within or principally within the screed, of which the results of 4 (9% of

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44) were unsatisfactory, i.e. failed at low strengths below 0.15N/mm2. (iii) Of the three remaining tests, one failed at the screed-adhesive interface, one at the screed-background interface, and one at the tile-epoxy interface. Of these, the screed-background interface failure was at low strength.

(5) According to the pull-out tests, the low strength failures were predominantly at the tile-adhesive interface. There were five low strength failures at other locations in the tests. However, Dr Ong and Mr Ho reported that the adhesive bedding was always found to be intact on the walls. Their observations have a number of implications as follows:

(i) there were no actual failures in the building faade either in the screed or at the screed background interface, notwithstanding the low or zero strengths obtained in the Setsco tests, which, due to damage in cutting did not reflect the actual strength of the screed or its bond to the background in the building, and only indicated relative strengths and substantial loss of strength of the test specimens; (ii) the cutting and handling of the test specimens prior to testing weakened the bond at the screed-adhesive interface; (iii) the variability of the screed composition and defects in the application of the screed were irrelevant to the debonding; (iv) the variability of the adhesive mix was also largely irrelevant to the debonding; and (v) the bond strength of the adhesive at the screed-adhesive interface was generally adequate,

(6) The lack of correlation between screed composition and tensile bond strength where the specimens failed in the screed in the Setsco tests indicates that variability of screed composition was irrelevant to the tile debonding;

(7) The main causes of debonding were:

(i) poor bedding of the tiles; (ii) inadequate provision of joints in the tiling system; (iii) poor construction details at the window sills and roof parapet coping; and (iv) voids in the adhesive.

(8) The poor bedding of the tiles was principally due to:

(i) excessive open time; and/or (ii) insufficient pressure in applying the tiles to the adhesive. (But, however, neither could have caused the observed bulging and "tenting" of the tiles by themselves, and their effects would have been apparent shortly after the tile installation and not four months afterwards. Mr Mundell noted in his letter of December 1992 that "less than 10% of the tiles found to be debonded were as a result of poor bedding of tiles".)

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(9) In the long term, the tile adhesive bond was bound to degrade due to infiltration of water and repeated soaking and the inability of the tiling system to accommodate temperature and moisture changes.

(10) The infiltration of water and consequent degradation of the tile adhesive bond were the result of:

(i) bad details at the window sills for which the Architects and the Contractors were jointly responsible, the former in failing to supply and to supervise the implementation of important details, and the latter, for carrying out unsound construction in the absence of guidance from the Architect; and (ii) voids in the adhesive which allowed the rapid infiltration of water into the system. (The Setsco tests indicated that repeated soaking adversely affected the tile adhesive bond strength and Venning pointed out that in addition, it exerted pressure on the tiles. It is significant that tiles usually debonded after a few days of rain, which was observed by both Dr Ong and Mr Venning.) The adverse effects of the voids on the bond were much more severe than those due to the bad details at the window sills and the parapet coping.

(11) Although deviations from the British (and Australian) Standards do not always result in failure, in the case of the Haw Par Technocentre they unquestionably did. Of the main causes of the tile debonding, the failure to provide a proper jointing system was the most serious.

(12) The Australian Standard (AS) recommends 6mm joint width for extruded tiles (AS3958.1, clause 5.4.6 (c) and AS3958.2 clause 4.3.4.2). BS5385 Part 2 states that "where it is necessary to provide for adequate release of water vapour to the atmosphere, the area of jointing should be about 10% of the total tile area. The relationship between joint width and tile thickness is also important as an adequate width of joint is necessary to enable the joint filling material to be inserted to the full depth of the joint spaces and thus eliminate the danger of voids". This requirement is echoed in AS3958. BS5385 Part 2 also states that "joints between extruded tiles are usually approximately 10mm wide to allow for variations in size and tolerance". 10% of the tile area would require 13.5mm wide joints. It is clear that the specified 3mm width of joints between tiles fell far short of the recommendations of both standards.

(13) In fine, the tile debonding was ultimately due to a combination of incorrect specification and design and defective construction, the former namely incorrect specification and design playing a major role. In my opinion, having considered all the factors, the third party's responsibility for the failure

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> both as respects defective design and failure to exercise proper supervision shall be 80% and the responsibility of the plaintiffs on account of bad workmanship shall be 20%.

188 In arriving at the foregoing proportion of liability, the court has also taken into consideration the inspection-supervision elements which were found to be lacking on the part of the third party. In my opinion, had the architect taken due care to inspect at random how the workmen had been carrying out their work on the external wall, he might well have come across the lapses on their part. This apparently was not the case. Counsel for the third party contended that in the event that the third party was held liable, in whatever proportion, the defendants should be made to bear at least 80 to 90% of the third party's liability by reason of the feature that the Clerk of Works who was on the payroll of the defendants had been negligent in his duty. The main bulk of the third party's complaint is set out in para 12 of their defence and counsel underscored the aspect that the Clerk of Works should have reported to the third party that the plaintiffs were not achieving the requisite 3mm tile joints (pages 226 to 251 of the third party's submission).

189 In my opinion, the foregoing criticism levelled against the Clerk of Works is highly overstated. I cannot overlook the aspect that the declared stand of the third party at para 3(2) of their defence was that they were not to be held responsible for the design as opposed to the aesthetic qualities of the external tiling. This leads me to conclude that the third party did not at the design stage really pay attention to the effects of the specified width of the tile joint and that they were only concerned with the aesthetics of the external faade.

190 Now as respects other lapses, if any, on the part of the Clerk of Works the issue to be determined is who is vicariously liable for his negligence. Minutes

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of the weekly site meetings show that the Clerk of Works was at all times representing the third party though his salary was at all times being met by the defendants. Counsel for the third party relied on the case of ***The Kensington And Chelsea And Westminster Area Health Authority v Wettern Composites and Others*** (1984) 31 BLR 57 and submitted that the Clerk of Works could be aptly described as the Regimental Sergeant-Major; he acted as the eyes and ears of the architects and had the responsibility to keep the architects informed as to what was or was not happening on site.

191 The facts in ***Kensington v Wettern*** as set out in the headnotes of the case are as follows.

192 In the early 1960s the plaintiffs wished to construct an extension to the Westminster Hospital and retained the second defendants (Adams, Holden & Pearson) as their architects upon the RIBA conditions of Engagement and the second defendants (Travers Morgan & Partners) as their consulting engineers upon the ACE conditions of Engagement to design the structural engineering works. The extension was built by Tersons Ltd and was completed in 1965. The first defendants were the sub-contractors for the supply and erection of the pre-cast concrete mullions.

193 In 1976 the plaintiffs discovered that some mullions had cracked. Investigation showed that there were defects of three types: first, defects of manufacture in the mullions; secondly, the vertical and lateral fixing of the mullions was defective by reason of damaged or poorly fixed corbels and ill-fitted panels and missing or ill-fixed cramps or dowels respectively; thirdly, during construction the contractor had failed to leave soft joints between the mullions. In consequence many of the mullions were susceptible to thermal

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movements. Certain of the defects in the first or second categories had been noticed by the engineers who had drawn them to the attention of the architects by a letter dated 3 February, 1965. The third category had also been detected during the works but remedial works prescribed by the engineers had not been properly done.

194 The plaintiffs started proceedings against the first and second defendants in 1978. The engineers were made defendants in 1980. The first defendants went into liquidation.

195 The plaintiffs' claim was in negligence against the architects and engineers. In addition to denying negligence and challenging causation, the architects and the engineers also contended that the plaintiffs' causes of action were barred by limitation and that any damages awarded should be reduced since the Clerk of Works had been negligent in the inspection of the works.

196 Giving judgment for the plaintiffs HH Judge Smout QC held, inter alia at page 58:

> …
>
> The architects had failed to exercise reasonable skill and care in supervising the works in that they had been alerted to the lack of competence of the contractor; that the fixing of the mullions was work which would be covered up; that poor workmanship in the fixing could result in physical danger; whilst the appointment of a clerk of works was a factor to be taken into account that could not reduce the architects' liability to use reasonable skill and care to ensure conformity with design as opposed to mere detail.
>
> …
>
> The clerk of works must have negligently overlooked defects in the fixings. Although under the direction and control of the architects the clerk of works was employed by the plaintiffs. Accordingly the burden of proof rested upon the plaintiffs to

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> shift the *prima facie* responsibility for the negligence of the servant employed and paid by them: *Mersey Docks and Harbour Board v Coggins & Griffiths (Liverpool) Ltd* [1947] AC 1 applied. Neither the RIBA conditions of engagement nor the building contract did so provide. The plaintiffs were vicariously liable for the clerk of works' negligence in overlooking the defects in the fixings so as to reduce the damages recoverable from the architects by 20%.

197 It must be observed presently that in ***Kensington v Wettern*** (*supra*) the court had to contend with the terms of the building contract which contained cl 10 of the 1963 edition of JCT Form (cl 12 of the 1980 edition) which provides:

> The Employer shall be entitled to appoint a clerk of works whose duty shall be to act solely as inspector on behalf of the Employer under the direction of the Architect … [see page 60 of the case, *supra*].

198 However there is no equivalent provision in the present case. Clause 1.11 of the SIA agreement referred to by the third party (see para 3(d) of the third party's defence) reads:

> Where frequent or constant supervision of the Works is required, a Clerk-of-Works may be employed either directly by the Client or the Architect. Where a Clerk-of-Works is to be employed directly by the Client, the Clerk-of-Works shall be nominated or approved by the Architect and be under the Architect's direction or control. If the Architect appoints the Clerk-of-Works, the Client shall nevertheless pay for the services of and all incidental expenses connected with such Clerk-of-Works in accordance with section 5.3.5 of these Conditions. The Clerk-of-Works may be employed on conditions recommended by the Architect.

199 The difference between the two foregoing clauses cannot be missed. Besides, the minutes of the contract site meetings invariably list the Clerk of Works as representing the third party as distinct from the representatives of the plaintiffs (see for example AB-739 onwards). The Clerk of Works asserted during his testimony that he had reported directly to the architect (see pages

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2420B and 2644 of the NE). In the circumstances the reliance by counsel for the third party on ***Kensington v Wettern*** is somewhat misaligned.

200 There is a passage in ***Keating on Building Contracts*** (6th Edn) at page 353 which states that if an architect acquiesces in the appointment and carrying out of his duties by an incompetent clerk of works, he cannot afterwards set up such incompetence as a defence (see ***Saunders and Collard v Broadstairs Local Board*** (1890) HBC (4th Ed) Vol 2, page 164 (DC)). In another case, ***Leicester Board of Guardians v Trollope*** (1911) HBC (4th Edn) Vol 2, page 419 Channell J held that an architect under contract to supervise work is entitled to leave details to the Clerk of Works but is personally responsible for seeking that his design is carried out. Where, therefore, the Clerk of Works fraudulently permitted a floor to be laid otherwise than in the way and without precaution provided for in the specification and the supervising architect failed to see that this part of his design was adhered to, such architect was held personally responsible for the consequences. Consequently the ruling by Smout QC in ***Kensington v Wettern*** (*supra*) in shifting the burden of proof to the plaintiffs in that case, in the light of the specific phraseology of cl 10 of the 1963 edn of JCT Form cannot be applied to the defendants in the present case. In the premises, the submission that the defendants should bear 80 to 90% of the third party's liability is found to be far-fetched and untenable and that lapses on the part of the Clerk of Works in regard to inspection and supervision of the work in progress must squarely rest on the shoulders of the third party and they are the party vicariously liable for the acts and omissions of the Clerk of Works.

Issue 3

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201 The next issue to be determined is whether judgment be entered in favour of the defendants against the plaintiffs and the third party jointly or it should be entered against the plaintiffs and the third party separately according to their respective proportions of liability. The defendants argue in favour of a joint judgment; the plaintiffs contend against it whereas the third party appears to have no strong views on this issue.

202 In ***Victoria University of Manchester v Hugh Wilson & Others*** (1984) 2 Con LR 43, His Honour Judge John Newey QC, cites with approval the case of ***Nowlan v Brunswick Construction Ltee*** (1973) 34 DLR (3d) 422, a decision by the New Brunswick Supreme Court, Appeal Division. In that case a house had developed dry rot because its architects' design had failed to provide proper ventilation and its builder had failed among other things to provide a vapour barrier which would be impervious to water. Limerick J said at page 425:

> Where there are concurrent torts, concurrent breaches of contract or a breach of contract and a concurrent tort both contributing to the same damage, whether or not the damage would have occurred in the absence of either cause, the liability is a joint and several liability and either party causing or contributing to the damage is liable for the whole damage to the person aggrieved. …

203 On appeal, Limerick J was supported by the majority in the Supreme Court of Canada (1974) 21 BLR 27. The principles enunciated in ***Nowlan*** was followed by His Honour Judge Newey QC in ***Victoria University of Manchester***. He observed at page 87 (*supra*) that 'the law is clear: *if two or more defendants have each committed breaches of the same or different contracts with the plaintiff and as the result of each defendant's breach the plaintiff has suffered the same damage he may recover the whole amount of it from any of the defendants*.'

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204 In the case at hand, although the fault or the breach by the contractor/plaintiffs is measurably much less than that of the designer/third party, their faults or breaches indisputably overlap and interweave. Both contributed to the same damage. In the circumstances, having regard to the principles expressed in ***Nowlan*** as well as in ***Victoria University of Manchester***, I am of the opinion that judgment in this case shall have to be joint and consequently be entered in favour of the defendants against the plaintiffs and the third party jointly. The parties against whom judgment is entered can recover contributions from each other to the extent of their respective liabilities and entitlements.

Issue 4

205 The next issue revolves around the amount of damages the defendants are entitled to in this case. The defendants' revised claim in this regard totals $2,046,893.86 which is made up of the following components (see para 4 of the defendants' submission as well as para 39 of the defendants' Further Re-Re-Amended Defence and Counterclaim):

(1) Amount owing as detailed in certificates C18, C19, C20 an C21 $ 40,259.40

(2) Costs of protective and two interim measures:

> (i) costs of RAK Materials Consultants Pte Ltd's Report $ 10,000.00 (ii) Costs of tile testing $ 1,120.00 (iii) Costs associated with removal of debonded tiles, protection of property and people against falling tiles, gondolas, etc $276,480.00 ---------- Sub-total $287,600.00 ========== (3) Costs relating to new faade: (i) Consultants' fees (5% of contract sum of $1,020,000) $ 51,000.00 (ii) Preparation of surface for new faade $639,290.34 ---------- Sub-total $690,290.34 ========== (4) Miscellaneous claims: (i) Expenses of meeting tenant's claims $ 3,150.00 (ii) Lost

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> management time $ 40,692.79 (iii) Lost rental $917,533.65 (5) Replacement of floor tiles* (*not arising from tile failure) $ 67,367.68 ---------- Total: $2,046,893.86 ==========

206 The rule as to the limits of recoverable damages is set out in ***Hadley v Baxendale*** (1854) 9 Ex 341, although in relation to breach of contract, as follows:

> Where two parties have made a contract, which one of them has broken, the damages which the other party ought to receive in respect of such breach of contract should be such as may fairly and reasonably be considered either arising naturally, i.e. according to the usual course of things, from such breach of contract itself, or such as may reasonably be supposed to have been in the contemplation of both parties at the time they made the contract, as the probable result of the breach of it. …

207 The claim by the defendants against the plaintiffs and the third party is founded on contract as well as on tort (see paras 20 to 38 of the defendants' Further Re-Amended Defence and para 22 of the defendants' Amended Statement of Claim against the third party).

208 At first blush, it would seem that the approach followed by the courts in assessing damages for breach of contract differs from that in tort. As regards breach of contract, the rule of common law, as stated by Baron Parke in ***Robinson v Harman*** (1848) 1 Ex 850 at 855 (154 ER 363 at 365) is that 'where a party sustains a loss by reason of a breach of contract, he is, so far as money can do it, to be placed in the same situation, with respect to damages, as if the contract had been performed.' Alderson B in the same case observed that 'where a person makes a contract and breaks it, he must pay the whole damage sustained.'

209 As respects tort, the principle formulated by Lord Blackburn in ***Livingstone v The Rawyards Coal Company*** (1880) 5 App Cas 25 at 39 is:

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> that sum of money which will put the party who has been injured, … in the same position as he would have been in if he had not sustained the wrong for which he is now getting his compensation or reparation.'

210 However in ***Hudson's Building and Engineering Contracts*** (11th Edn, Vol 1 at paras 8 to 110), the learned authors express the view that the modern judicial tendency is to harmonize the two views, building on their shared compensatory basis and that increasing doubts have been expressed as to the validity of any distinction between them. In ***H. Parsons (Livestock) Ltd v Uttley Ingham & Co*** [1978] 1 QB 791 at 792, it was held (per Lord Denning MR and Scarman LJ) that in a factual situation where all have the same actual or imputed knowledge and the contract contains no term limiting the damages recoverable for breach, the amount of damages recoverable does not depend on whether the plaintiffs' cause of action is breach of contract or tort for, in principle, the test of remoteness of damage is the same in contract as in tort (see also the decision by the High Court of Australia in ***Butler And Others v The Egg and Egg Pulp Marketing Board*** (1966) 114 CLR 185 at 191.

211 It is also useful to recall yet another passage in ***Parsons v Uttley*** (*supra*) where Scarman LJ observed at page 806B-D (*supra*): 'I also agree with him [Lord Denning MR] in thinking that, notwithstanding the interpretation put on some dicta in *C Czarnikow Ltd v Koufos* [1969] 1 AC 350, the law is not so absurd as to differentiate between contract and tort save in situations where the agreement, or the factual relationship, of the parties with each other requires it in the interests of justice.' He further observes at page 807B-C:

> As to the first problem, I agree with Lord Denning M.R. in thinking that the law must be such that, in a factual situation where all have the same actual or imputed knowledge and the contract contains no term limiting the damages recoverable for breach, the amount of damages recoverable does not depend upon whether, as a matter of legal classification, the plaintiff's

> cause of action is breach of contract or tort. It may be that the necessary reconciliation is to be found, notwithstanding the strictures of Lord Reid at pp. 389-390, in holding that the difference between "reasonably forseeable" (the test in tort) and "reasonably contemplated" (the test in contract) is semantic, not substantial. Certainly, Asquith L.J. in *Victoria Laundry (Windsor) Ltd.* v. *Newman Industries Ltd.* [1949] 2 K.B. 528, 535 and Lord Pearce in *C. Czarnikow Ltd.* v. *Koufos* [1969] 1 A.C. 350, 414 thought so; and I confess I think so too.

212 As I mentioned earlier the defendants' claims against the plaintiffs as well as the third party are framed in both contract and tort. There is a passage in the speech of Lord Scarman in ***Tai Hing Cotton Mill Ltd v Liu Chong Hing Bank Ltd And Others*** (1986) AC 80 at 107 which reads:

> Their Lordships do not believe that there is anything to the advantage of the law's development in searching for a liability in tort where the parties are in a contractual relationship. This is particularly so in a commercial relationship. Though it is possible as a matter of legal semantics to conduct an analysis of the rights and duties inherent in some contractual relationships including that of banker and customer either as a matter of contract law when the question will be what, if any, terms are to be implied or as a matter of tort law when the task will be to identify a duty arising from the proximity and character of the relationship between the parties, their Lordships believe it to be correct in principle and necessary for the avoidance of confusion in the law to adhere to the contractual analysis: ...

213 The foregoing principle which tends to project the view that where parties are in a contractual relationship, it would not be appropriate for a party to bring an action against another in tort, did not quite meet up with the approval of the House of Lords in ***Henderson v Merrett Syndicates Ltd*** [1994] 3 WLR 761 at 779 to 781.

214 In ***Henderson*** the problems relating to concurrent claims arising from breach of duty under the law of tort and the law of contract came up again for discussion. Lord Goff of Chieveley in his speech specifically made reference to

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the often-quoted observation of Lord Scarman in ***Tai Hing***, referred to earlier, and said at page 781H that '[it] is however right to stress, as did Sir Thomas Bingham M.R. in the present case, that the issue in the ***Tai Hing*** case was whether a tortious duty of care could be established which was more extensive than that which was provided for under the relevant contract.' After extensive analysis of the development of the law, Lord Goff endorsed the view expressed by Le Dain J in ***Central Trust Co v Rafuse*** (1987) 31 DLR (4th) 481 at 522 which reads:

> A concurrent or alternative liability in tort will not be admitted if its effect would be to permit the plaintiff to circumvent or escape a contractual exclusion or limitation of liability for the act or omission that would constitute the tort. Subject to this qualification, where concurrent liability in tort and contract exists the plaintiff has the right to assert the cause of action that appears to be most advantageous to him in respect of any particular legal consequence.

215 Lord Goff later re-emphasised at page 788E-H:

> It is however my understanding that by the law in this country contracts for services do contain an implied promise to exercise reasonable care (and skill) in the performance of the relevant services; indeed, as Mr. Tony Weir has pointed out (XI *Int.Encycl.Comp.L.*, ch. 12, para. 67), in the 19th century the field of concurrent liabilities was expanded "since it was impossible for the judges to deny that contracts contained an implied promise to take reasonable care, at the least, not to injure the other party." *My own belief is that, in the present context, the common law is not antipathetic to concurrent liability, and that there is no sound basis for a rule which automatically restricts the claimant to either a tortious or a contractual remedy. The result may be untidy; but, given that the tortious duty is imposed by the general law, and the contractual duty is attributable to the will of the parties, I do not find it objectionable that the claimant may be entitled to take advantage of the remedy which is most advantageous to him*, subject only to ascertaining whether the tortious duty is so inconsistent with the applicable contract that, in accordance with ordinary principle, the parties must be taken to have agreed that the tortious remedy is to be limited or excluded.

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[Emphasis added.]

216 Consequently, my finding is that both the plaintiffs and the third party are not only in breach of their respective obligations under their contractual arrangement with the defendants to provide them with a satisfactory product for which they were engaged but are also negligent as respects their obligations in failing to carry out their works properly.

217 I have already summarised the claim for damages by the defendants against both the plaintiffs and the third party. The plaintiffs' counsel contends (para 159 of his submission) that firstly, the consequential losses pleaded by the defendants have no causal link to the plaintiffs and secondly that the defendants had failed to mitigate. Counsel's arguments as respects the alleged failure on the part of the defendants to mitigate their losses (see paras 115 to 124) revolve by and large around tenancies. In essence, the plaintiffs contend that the defendants could have, if they had tried, found alternative tenants; that they could have leased the premises at a reduced rental; or that they could have leased out the units to tenants who did not require windows. As regards the 'Eleganstone' finish obtained by the defendants, the plaintiffs suggest that the award as well as the scaffolding costs were high and unreasonable.

218 The defendants submit on the other hand the losses suffered by them are recoverable and in this regard they rely in the main on the rule as stated in ***Hadley v Baxendale*** (*supra*). There are two limbs to the said rule: the first, arising naturally, ie, according to the usual course of things from such breach of contract itself, and the second, being such as may reasonably be supposed to have been in the contemplation of both parties at the time they made the contract, as the probable result of the breach of it.

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219 'Causation', as stated by Lord Wright in ***Monarch Steamship Co Limited v Karlshamns Oljefabriker*** [1949] AC 196 at 228 is a 'mental concept, generally based on inference or induction from uniformity of sequence as between two events that there is a causal connexion between them.' It must be observed presently that the argument that all losses pleaded by the defendants had no causal link and are therefore not claimable, is plainly ill-conceived. Having made this comment, I now propose to deal with the various items claimed by the defendants against the plaintiffs as well as the third party.

220 The first item is the claim for a sum of $40,259.40 (see Interim Certificate Nos C19 and C21 vide items A and B under para 39 of the Further Re-Re-Amended Defence and Counterclaim less the amount mentioned in Interim Certificate No C18 (ie, $621,192.50 less $580,933.10 yielding a sum of $40,259.40).

221 What is significant about this claim is that it originally started as a deduction for defects in Interim Certificate No C19 for the sum of $49,500 (as being the deduction for defective external tiling works constituting 5% of the total cost of the external tiling works). It then ballooned to $750,000 in Interim Certificate No C20, only to be lowered in Interim Certificate No C21. Broadly speaking, what is being claimed by the defendants comprise the following:

(i) Costs of tiles $319,458.00

(ii) Installation cost of tiles $238,154.50

(iii) Preliminaries $ 29,580.00

(iv) Cost of associated works –

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expansion joints $ 34,000.00

_____

$ 621,192.50

Less amount stated in Certificate C18 $ 580,933.10

_____

Sum now claimed $ 40,259.40

==========

222 No amplification is provided in relation to this claim in the defendants' submission; nor is it dealt with in any detail in the plaintiffs' submission. The rationale, as could be culled from the evidence, appears to be that inasmuch as the plaintiffs had not delivered a wall finish that was contracted for, the plaintiffs should be made to compensate the defendants' loss. It makes sense and I therefore allow this claim.

223 The next item concerns a claim by the defendants for a sum of $287,600 (item C in para 39 of their counterclaim). This claim seems to have arisen as a result of protective and interim measures taken by the defendants and includes the cost of the report submitted by RAK ($10,000); tile testing ($1,120) and costs associated with the removal of debonded tiles, protection of property and people against falling tiles, gondolas, etc ($276,480). In my finding this claim arises as a direct consequence of the defective tile finish due to lapses in workmanship as well as design fault and consequently the defendants having

expended these sums justifiably are entitled to recover the said sums from the defaulters, ie, the plaintiffs and the third party.

224 The next item (item D in para 39 of the counterclaim) concerns the claim by the defendants for part of the costs of the new faade. The defendants claim in this regard a sum of $51,000 being the consultants' fees and $639,290.34 as the cost of preparation of surface for new tile facade works. They are not, however, claiming the costs of the new finish. The law as summarised by the learned authors of ***Keating*** (6th Edn) at page 222 (*supra*) suggests that where a breach results in the destruction of the premises or part of them and the innocent party has no option but to rebuild, the measure of damages is the cost of the replacement. He is not, however, entitled to recover the cost of improvements made voluntarily by him (see ***Harbutt's "Plasticine" Ltd v Wayne Tank And Pump Co Ltd*** [1970] 1 QB 447). Whilst it is possible that the defendants might well have settled for a finish similar to the one provided to them earlier, the fact they chose an entirely different finish does not disentitle them to claim a reasonable sum for it. Having noted that the defendants are not seeking to claim from the defaulters the costs of installing the new 'Eleganstone' finish, I hold that the defendants are justified in claiming the costs of the consultants' fees as well as the cost of the preparation of surface for the fresh faade works. In my view, the 'Eleganstone' finish is strictly not a voluntary improvement. The sums therefore claimed ie, $51,000 and $639,290.34 are not in any way unreasonable or excessive and I therefore allow this sum in favour of the defendants.

225 This brings me next to item E (para 39 of the defendants' counterclaim) which includes one of the major components of the defendants' claim for lost rental. The claim under item E is for the following:

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(i) Claims by tenants $ 3,150.00

(see para 36 of the counterclaim)

(ii) Lost management time (see particulars provided by the defendants under para 37 of their counterclaim) $ 40,692.79

(iii) Lost rental (see paras 29 to 35 of the defendants' counterclaim) $917,533.65

226 As regards the claim for $3,150 ($2,4750 paid out by the defendants to Sony International (Singapore) Ltd in May 1993 in respect of Sony's claim for repair to electrical and building works due to water infiltration and a sum of $700 paid to AST Singapore Pte Ltd in September 1993 in respect of their claim for damage to wallpaper and ceiling due to water infiltration), I am of the view that the defendants are entitled to their reimbursement and consequently I allow the defendants' claim for the said sum.

227 As regards the claim for lost management time, I had considered the details of calculations provided by the defendants under para 37 of the defendants' counterclaim. Having regard to all the evidence and supporting documents placed before me, I agree with defendants' counsel's submission that the defendants' personnel indeed expended much time in getting protective measures installed and obtaining tenders and quotations from other contractors for the rectification works to be carried out as a result of the tile failure. Lost management time in rectifying defects can be claimed as special damages (pages 215 to 216, ***Keating***; see also ***Tate & Lyle Food And Distribution Ltd v Greater London Council and Anor*** [1982] 1 WLR 149 at 152, per Forbes J; the point being unaffected by subsequent appeals – [1982] 1 WLR 971 (CA) and [1983] 2 AC 509 (HL)). In my opinion, the sum claimed as lost management

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time is satisfactorily documented and it is not excessive nor unreasonable. In the circumstances, I also allow the defendants' claim for S$40,692.79.

228 As regards the claim for lost rental in the sum of $917,533.65 (paras 408 to 424 of the defendants' submission and paras 115 to 124 of the plaintiffs' submission), the main criticism by the plaintiffs against the defendants is that the latter had not mitigated their loss. Upon review of all the evidence, I find the foregoing criticism unmeritorious.

229 Reverting to the issue as to causation, case law and learning support the view (page 222, ***Keating***, 6th Edn) that where the works are for industry or commerce the defaulter would invariably be liable for some loss, for example, 'in a contract to build a mill the builder knows that a delay on his part will result in the loss of business': Parke B in ***Hadley v Baxendale*** (1854) 23 LJ Ex 179 at 181 and ***Victoria Laundry (Windsor) Ld v Newman Industries Ld*** [1949] 2 KB 528 (CA). Citing ***Fletcher v Tayleur*** (1855) 25 LJCP 65, the authors of ***Keating*** (at page 222) also say that 'if he is building houses or blocks of flats for letting, then on analogy with shipping cases he is probably liable for loss of rent.'

230 I considered carefully whether the tile failure on the external wall of a building should lead to damages being awarded for loss of rental of the premises. Upon review, I am of the opinion that the failure – albeit an external feature – would have naturally put off any prospective as well as committed tenants as was the case in regard to the defendants' building. In my opinion, it would have been well within the contemplation of the parties that if there was going to be a failure of this nature, it would indeed affect the rentability of the building substantially. In my view the causal link is clearly established and

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consequently the defendants' claim for lost rental in the sum of $917,533.65 is allowed.

231 The other claim was for a sum of $67,367.68 being replacement of floor tiles at Main Lobby B1 and Second Lobby B1 pursuant to the Architects' Directions of 29 March 1993 and 13 August 1993. The plaintiff's submission is curiously scant on this aspect. Though plaintiffs' counsel had at one stage suggested (pages 3334-3336 of the NE) that there would be legal submission based on cl 27(2) of the contract concerning the list of defects to be given 14 days after the maintenance period and that at any rate the claim could not exceed more than $17,000, little came to pass. There was a muffled protest by the plaintiffs at one stage that the defects were due to vandalism or wear and tear but nothing more was forthcoming from them. Having regard to the evidence presented by the defendants at the trial (see defendants' closing submission at para 385 pages 111-112; see also pages 3301, 3313-3315, 3583-3588 of the NE) which in my view is not fanciful or excessive, I also allow this claim. However, this award can be enforced only against the plaintiffs and not against the third party since it is not apparently related to tile failure.

232 I must in closing say that the fine points raised by counsel for the plaintiffs on the issue as to the distinction between architects' directions and instructions and the architects' bona fides in issuing the revised certificates are all academic. As held by the House of Lords in ***Beaufort Developments (NI) Ltd v Gilbert-Ash NI Ltd And Another*** [1998] 2 All ER 778: 'the court had not been deprived, … to open up, review and revise certificates, opinions and decisions of the architect, of its ordinary power to determine the rights and obligations of the parties and to provide them with the usual remedies.'

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233 In the premises, the plaintiffs' claim is dismissed and there shall be judgment in favour of the defendants against the plaintiffs and the third party in terms of the orders contained in these grounds. The defendants shall also be entitled to costs according to the plaintiffs' and third party's respective share of liabilities. There shall also be an order that the plaintiffs and the third party shall have recourse to each other to the extent of their respective liabilities under this judgment.

Order accordingly.

Dated this 27th day of February 1999.

M P H RUBIN

Judge

MPH Rubin J

Salem Ibrahim, Subramaniam Pillai and Amarjit Singh (Harry Elias & Partners) for the plaintiffs
Andre Francis Maniam and Susan Kaur (Wong Partnership) for the defendants
Ng Kai Ming, J G Advani, Janice Wu and Winston Quek (P K Wong & Advani) for the third party

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