29/14.7

TECHNICAL SERVICES Head of Service: James F. Paul
Perceton House, Irvine KA11 2AL
Tel [redacted] Fax: [redacted]

NORTH AYRSHIRE
COUNCIL

Your Ref: Our Ref: 06/IRV/424/001/GDW/LW

If telephoning please call: Mr G D Wallace, [redacted]

13 July 1999

Fire Research Station
BRE Ltd
GARSTON
Watford
WD2 7JR

<u>For the Attention of Peter Field, Deputy Director</u>

Dear Sirs

FIRE : HIGHRISE RESIDENTIAL PROPERTY, IRVINE

Following a serious incident on Friday 11 June 1999 at Garnock Court, Irvine the Council wish to appoint an expert consultant to carry out a study into the circumstances surrounding fire – spread through a number of floors of the building.

I understand from my telephone conversation with Ms P Morgan that you have been consulted on an informal basis by Professor Drysdale of Edinburgh University who is preparing a report for the procurator fiscal and that members of your staff have already visited the site.

I would therefore appreciate your response to the following points.

1. The capacity and appropriateness of the BRE to carry out such a study on behalf of the Council.

2. The cost and timescale for such a study.

3. Possible dates for meeting to agree scope, method and confidentiality of the study.

The Council is anxious to proceed as quickly as possible with this study and to complete the refurbishment of the damaged flats and so an early reply would be appreciated.

Yours faithfully

James F Paul

<u>Head of Technical Services</u>

analysis of what happened in the fire – no samples analysed yet – materials calculation
carry out tests.
replacement walls September

w:\irv\424\001gdwg9.doc

POSITIVE ABOUT DISABLED PEOPLE

BRE

Fax Transmission

From **J N Smithies**

Director, Centre for Fire Protection Systems

Telephone [redacted]

Local Fax

E-mail smithiesjn@bre.co.uk

Date 26 July 1999

Your Ref

Our Ref

To **Mr G D Wallace**

At North Ayrshire Council

Fax [redacted]

Number of Pages (including this page) 7

If you do not receive all these pages please call the telephone number given above.

Message

TRANSACTION REPORT

Transmission
Transaction(s) completed.

No.	DATE/TIME	DESTINATION	DURATION	PGS.	RESULT	MODE
149	JUL. 26 09:18	901294225044	0° 02' 56"	007	OK	N ECM

BRE

Fax Transmission

From J N Smithies
Director, Centre for Fire Protection Systems
Telephone [redacted]
Local Fax [redacted]
E-mail smithiesjn@bre.co.uk

Date 26 July 1999
Your Ref
Our Ref

To Mr G D Wallace
At North Ayrshire Council
Fax [redacted]

Number of Pages (including this page) 7

If you do not receive all these pages please call the telephone number given above.

Message

(1)

Mr G D Wallace
Head of Technical Services

Please FAX

Fire - High Rise Residential Post Project Enquiry

Dear Mr Wallace

I am responding to your letter of 13 July and have delayed replying for a few days in order to assess some of the impact of the enquiry which took place on Tuesday 22 July.

The FRS is the first research division of BRE and has been carrying out detailed fire investigations for over 75 years, most of these have been on behalf of government, some have been on behalf of commercial clients and we have also carried out

(5)

work on behalf of the Procurator Fiscal. Most of the investigations have been focussed primarily on fire and smoke spread from ~~the~~ a building regulatory perspective, although have had aspects of litigation associated with the commissions. We have also carried out re creation of fire scenarios for both the forensic purposes and also as part of general fire investigations. Recent high profile fire investigations we have been associated with include Windsor Castle and the Channel Tunnel.

We have large scale test facilities both at BRE Garston and also at Cardington near Bedford.

10 Cardington we have a prototype building façade / cladding fire test rig and a large steel frame building, both of which could be used for full scale reconstructions and tests — these could include a reconstruction of ~~the~~ 5 or more floors of the Investa fire where we could replicate the infill panel and window scenario.

We also have a range of small scale standard test facilities which can be used to ~~evaluate~~ evaluate the fire behaviour of the façade material - both in terms of its ability to resist fire and also its possible contribution to fire development.

BRE

Centre for Fire Protection Systems
BRE, Garston, Watford, WD2 7JR
Telephone: [redacted] Fax: [redacted] E-mail: smithiesjn@bre.co.uk

Mr G D Wallace
Technical Services
North Ayrshire Council
Perceton House
Irvine
KA11 2AL

Your reference
06/IRV/424/001/GDW/LW

Our reference

26 July 1999

+ comments
Proposed
on remedial works

Dear Mr Wallace

HIGHRISE RESIDENTIAL PROPERTY, IRVINE

I am responding to your letter of 13 July and have delayed replying for a few days in order to assess some of the impact of the enquiry which took place on Tuesday 22 July.

I hope the following deals with your specific points. FRS is the fire research division of BRE and has been carrying out detailed fire investigations for over 75 years, most of these have been on the behalf of government, some have been on behalf of commercial clients and we have also carried out work on behalf of the Procurate Fiscal. Most of the investigations have been focussed primarily on fire and smoke spread from a building regulatory perspective, others have had aspects of litigation associated with the commissions. We have also carried out recreations of fire scenarios for both forensic purposes and also as part of general fire investigations. Recent high profile fire investigations we have been associated with include Windsor Castle and the Channel Tunnel.

We have large scale test facilities both at BRE Garston and also at Cardington near Bedford. At Cardington we have a prototype building façade/cladding fire test rig and a large steel frame building, both of which could be used for full scale reconstructions and tests – these could include a reconstruction of a 5, or more floors of the Irvine fire where we could replicate the infill panel and window scenario.

We also have a range of small scale standard test facilities which can be used to evaluate the fire behaviour of the façade material – both in terms of its ability to resist fire and also its possible contribution to fire development.

Clearly there are a number of options available for a full scale study of the Irvine fire and charges would vary widely with full scale reconstruction costing tens of thousands of pounds.

A logical starting point would appear to be for FRS to carry out an analysis of the fire incident and prepare a report for yourselves. The report would include a recommendation for further work including a schedule for testing and the scenario reconstruction.

Our standard charges are £525 per day for a senior Fire Consultant and, due to the fact that we already have some involvement in the investigation we are prepared to provide you with a confidential report including an analysis of what happened during the fire and what further investigations should be carried out, for a fee of £1575. We could then follow this up with a meeting with yourselves to formulate a way forward.

FRS

BRE is now fully privatised and is owned by the Foundation for the Built Environment. Any work we do for non-government customers is confidential.

I enclose some information which will tell you a little more about FRS and BRE and a copy of our standard terms and conditions is attached.

We would anticipate producing a report within three working weeks of receiving your instructions and I look forward to hearing from you.

Yours sincerely

J N Smithies
Director, Centre for Fire Protection Systems

Encl.

NORTH AYRSHIRE COUNCIL

TECHNICAL SERVICES
Perceton House IRVINE KA11 2AL

FAX MESSAGE
FAX No: [redacted]

TO: D. H. Smithies
Director
Centre for Fire Protection Systems

Date: 28 | 7 | 99

FAX No: [redacted]

FROM: Graham Wallace

EXT No: [redacted]

SUBJECT: High Rise Residential Property Irvine

No of Pages: 3
(Including this one)

MESSAGE:

REMARKS: ☐ Urgent ☐ For Your Review ☐ Reply ASAP ☐ Please Comment

TECHNICAL SERVICES Head of Service: James F. Paul
Perceton House, Irvine KA11 2AL
Tel: [redacted] Fax: [redacted]

NORTH AYRSHIRE COUNCIL

Your Ref: Our Ref: 06/Irv/424/GDW/MBT

If telephoning please call: Mr. G. Wallace [redacted]

28th July 1999

J H Smithies
Director
Centre for Fire Protection Systems
BRE
Garston
WATFORD
WD2 7JR

Dear Sir,

HIGH RISE RESIDENTIAL PROPERTY, IRVINE

Thank you for your response of 26 July 1999 and wish to accept your offer to prepare a confidential report for North Ayrshire Council along the lines outlined in your letter and our subsequent telephone conversation.

I understand that this initial report will be completed within 3 working weeks and that the cost will be £1575.00.

I would also confirm that the initial site visit by your team will take place on Tuesday 3rd August and in this regard I enclose a location map for our offices at Perceton House, Irvine.

Yours faithfully

Graham Wallace

Head of Technical Services

Encl./

c.c. J. Paul
J. Robertson

W:\Irv\424GWG9

POSITIVE ABOUT DISABLED PEOPLE

ARSON PREVENTION

The motives and psychology behind fire raising are large and complex. Fire raisers often start by setting fire to rubbish, grass, bushes, progress to empty buildings and vehicles, and eventually target property. There is a clear line between children experimenting and learning about fire and deliberate vandalism.

Occupied buildings most frequently targeted are schools, community facilities and dwellings.

If you are worried about the possibility of an attack on your property :-

1. Evaluate the risk ;
2. Consider your security and fire detection systems ;
3. Remove items of possible fuel if practicable and consider a first strike fire extinguishing media ;
4. Have a plan of action ;
5. Educate the occupants ;
6. Consult your Crime Prevention Officer AND the Fire Brigade.

Your actions and forethought can improve the effectiveness of these measures.

BRE00035380/11

For further information, contact -

Strathclyde Fire Brigade,
Fire Investigation.

[redacted] (Direct)

(Mobile)

(Fax)

FIRE

INVESTIGATION

RISK MANAGEMENT UNIT

semper paratus

FUNCTION

Using scientific principles and procedures, Fire Investigation Officers analyse the circumstances, events and materials involved in the process of ignition and combustion so that the facts can be understood and furnished in a detailed written format.

Fire Investigation therefore seeks to -

(a) Provide a definite cause and establish accurate development of the fire.

(b) Demonstrate trends or patterns.

(c) Network with other agencies.

(d) Incorporate results into the organisation's feedback loop.

(e) Provide appropriate training and/or control measures.

(f) Review, assess and compare the overall results and make any necessary adjustments.

Adopting a proactive approach, the department aims to provide a positive catalyst to improving safety and performance in fire situations.

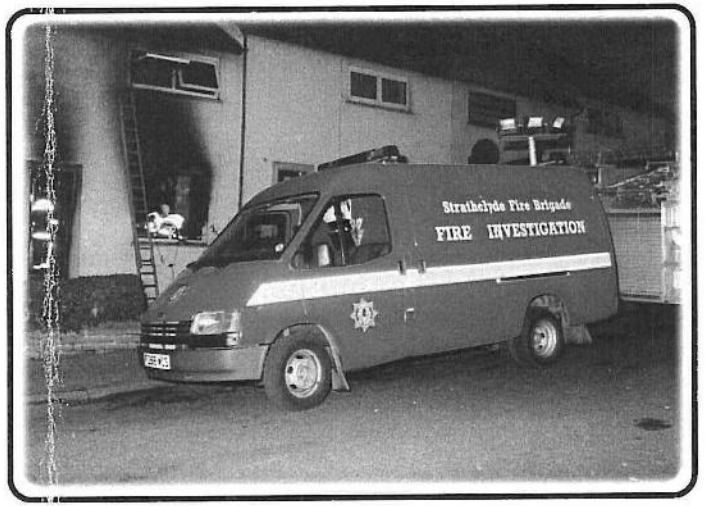
Scotland has a particularly poor record of fire and fire deaths. Strathclyde Fire Brigade therefore considers finding solutions of the highest priority.

ORGANISATION

Fire Investigation is established at Brigade Headquarters, Bothwell Road, Hamilton, where a team are always available to respond anywhere within the Brigade's area.

The department comprises four watches, on a similar basis to that found in fire stations. There is a Station Officer and one other rank holder in each watch and the overall function is controlled by an Assistant Divisional Officer who reports to a Divisional Officer (Grade 2). All the officers involved have undergone specialist training in the Fire Sciences and the application of Forensic Science procedures.

The management of Fire Investigation is administered by the Risk Management Unit of the Brigade where organisational links exist to other departments such as Health & Safety, Legal and Fire Safety.



T. Morris
B Martin
P Morgan

3/8/99 3 seats

Luton — Glasgow

7 Am

Copy

Travel and Expenses claim form: UK and Overseas

Notes: Do not use this form to claim permanent transfer expenses or detached duty allowances - contact Personnel
Please submit claims promptly (ie within one month of the journey)

Personal details Name: Penny Morgan Integra No: 712

Bank details This claim will be paid into your bank account. If you have changed your account please contact Finance.

Regulations and claimant's declaration

Vouchers/receipts should be produced for all expenditure claimed.

If you are claiming standard rate mileage for the use of a motor vehicle you should complete that section below.

I certify that this claim complies with BRE's travel and expenses policy, that expenses were necessarily incurred on BRE business and that where mileage allowance has been claimed I was insured to drive the vehicle at that time and that the policy covered use by me on official business.

Signed: ..... <<< To complete on printed version

Approval: Certifying Officer to complete this section

I certify that this claim covers expenses necessarily and cost effectively undertaken on official BRE business in conformity with the BRE Travel & Expenses policy.

Signed: ..... Grade: .....

Claimant to complete this section

Claimant's name: Penny Morgan

Tel Ext No: [redacted]

Date of claim: 29-Jul-99

Certifying Officer's name: Nigel Smithies

Site/Building: B16

Note: Amounts (£) shown on Integra will exclude any VAT which Finance is able to reclaim from HMC&E.

Allocation of claim to projects			
Project number	Std Rate Mileage	£ (incl VAT)	
FG2824		£318.00	
Sub-total		**£318.00**	£318.00
Less advance(s)			
Payment/refund			**£318.00**

Standard Rate Mileage Record: Claimant to complete this section

Claims at the full standard rate of motor mileage allowance are limited to 4,000 miles during any tax year (ie starting on 6 April). Once the 4,000 mile ceiling has been reached a lower standard rate is payable for claims dated in the current tax year.

Please provide the following information before you pass this claim to your Certifying Officer:-

	Claimed at standard rate
Total miles for this claim	.....
Mileage carried forward from previous claims since 6 April this financial year	692
Cumulative total	692
Engine cc of vehicle relating to this claim	1998

Do not enter information in the red squares - use only the green squares

Date	Total amounts claimed £	Expenses in sterling	Mileage claimed		Any Foreign Currency Claim for conversion to £ sterling (Col 2)			Supporting notes
		Total incl VAT £	Miles claimed	Rate per mile (pence)	Amount in foreign currency	Currency eg $	Exchange Rate (eg $ to the £)	Give (brief) reason for journey, description of each amount claimed, state departure and destination points, and any other information as appropriate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	£318.00	**£318.00**						
03-Aug-99	**£318.00**	£318.00						FG2824 Air tickets for self, Tony Morris and Brian Martin to Glasgow
								to investigate Irvine fire, see attached.

BRE00035380/15

online sales

itinerary

your itinerary

That's it! Your flight has been purchased. Thank you for using easyJet.
For questions or changes concerning your flight, call [redacted]

Now that you've booked your easyJet flights, please look at Travel Extras should you wish to book accomodation, travel insurance, car hire etc.

please print this itinerary for your future reference

CONFIRMATION NUMBER

M534CL

IMPORTANT: You will need to provide this confirmation number and positive I.D. at the check-in counter to receive a boarding pass for your flight.

Flight numbers in the range 900-999 are operated by easyJet Switzerland SA

OUTBOUND FLIGHT

Flight: **73** Departure:**03 Aug 99**
Luton London (LTN) to Glasgow (GLA). Dep: 08:15 Arr: 09:30

RETURN FLIGHT

Flight: **82** Departure:**04 Aug 99**
Glasgow (GLA) to Luton London (LTN). Dep: 20:45 Arr: 22:00

PASSENGERS

PASSENGERS
Morgan/Penelope
Martin/Brian
Morris/Tony

CARD HOLDER INFO
Morgan/Penelope
[redacted]
United Kingdom

PRICING INFO

TOTAL FOR 3 PASSENGER	
FARE PRICE:	£ 288.00
TAXES:	£ 30.00
GRAND TOTAL:	£ 318.00

BILLING INFO

CARDHOLDERS NAME:	Penelope B E Morgan
FORM OF PAYMENT:	MasterCard
PAYMENT AMOUNT	£ 318.00
AUTHORISATION	Approved

5/8/99

Easyjet: [redacted]

confirmation letter - 5-6 days.

SO White Derbyshire. Time to fill formula

~~Hinkley~~ - Fill time formula -

N Ayrshire. - FG 4208

Tim Cuth. FG 5169.

152.10
49-80
201.90

BRE00035380/17
BRE00035380_0017

Report to North Ayrshire outline

Introduction

Further to request for an in confidence report on the fire on 19 June and the implications P T B and C visited the site on 3 August.

Report of the fire

The building
To include info on 1991 refurb and the choice of PVC and GRP
The fire
Fire and smoke spread
Injuries
Operational implications

Discussion of the incident

To include outline of the wide interest the event has raised in the UK and being the subject of the select committee which will not publish its findings until the autumn.

Discuss implications locally and nationally. "Can't hide a cladding fire as everyone can see it" Cladding long been a concern hence the new test and the revision to BR135 already started.

Reinstatement

Understand that living-room windows will be replaced with wood and aluminium and non-combustible finish over the mosaic.

Further research

While this particular combination is unlikely to be used ie PVC and GRP it is important that the present performance of the GRP clearly seen as the item contributing to the fire spread is established. When new would have been Class 1 (Class 0) Because of the way in which it burned it may have lost that level of performance

Suggest BS476 Part 6 and Part 7 tests and the new European test. Costs and size of samples coming from Sarah .

Can we say that we think they were sold a pup ?

TRANSPORT REQUEST

Please return form to Facilities, B26/023. FAX [redacted]
Or contact any of the following: **Keith Camish - ext.** [redacted]
Maria Littledike - ext. [redacted] **(0830 to 1330 hrs)**
Dave Taylor - ext. [redacted] **or Mobile:** [redacted]

Name Penny Morgan..... Division ...FRS..... Tel Ext: [redacted] Project No FG2824.....

Outward	**Return**
Date Sunday 12 December 1999.....	Date ... Monday 13 December .....
Time when convenient.....	Time from 8.00 am onwards.....
Pick up point BRE Garston.....	Pick up point .....
Passenger/s .....-.....	Passenger/s .....-.....
Destination Irvine, W Scotland.....	Destination Garnock Court Irvine.....
Airport details if applicable:	**Airport details if applicable:**
Airport: n/a.....	Airport: n/a.....
Flight Departure Time:.....	Flight Arrival Time:.....
Terminal no.	Terminal No.....

Collection	**Delivery**
Nature of load: 20 spandrel panels 2.2m by 1.2 and one window pod	
Address from Garnock Court Irvine 9 labourers on site to help load....	Address Geotechnics ..... Compound BRE, key with Tony Fisher..... .....
Contact Name ...Rick Beausire on site at Garnock Court. Site open 8.00-16.30 Tel No [redacted].....	Contact Name David Watts architect ..... (i/c of the refurb) Tel No [redacted].....

OTHER REQUIREMENTS: TAXIS'S, COACHES – Please telephone Facilities for quotation.

FOR DRIVER'S USE ONLY

Start mileage	Actual start time .....
End mileage	Actual finish time .....
Purchases (Litres) Petrol ..... Oil	Driving time .....
Time or meal break	Waiting time .....

Cost allocated to project no £.....

The necessary vehicle checks have been carried out and that the vehicle is roadworthy. The following matters need attention:

.....

Signature ..... Date .....

WHILE YOU WERE OUT

TO: Penny DATE: 30/11/99 TIME: 10.10

CALLER: Mr. Watts, Kilmarnock

COMPANY/DIVISION: [redacted]

TEL & EXTN:

FAX:

E-MAIL:

Telephoned ☑ Please call back ☑

Called to see you ☐ Will call again ☐

Message / in connection with:

Progress on Garnet Court. Irvine?

[redacted]

[redacted]

[redacted]

Taylor Keith

Message taken by: Joan

n, Penny

om: Isabel Abbott [issycov@tinyworld.co.uk]
Sent: 06 December 1999 05:29
To: Morgan, Penny
Subject: Re: ncc curiculum

Penny Mon. 6
November
I hope the amended curriculum returned to you alright. I tried for ages to attach it to an ordinary Email message.
I am at Northampton all day today interviewing exam candidates.
My "Word" programs eventually got put right late on Thurs.after goodness knows how many long phone calls.
I have done all I can at the moment. I know the references need updating. I can only apologise for the lateness and also for the inconsistency of bold and normal typing. I have'nt had any previous experience of "Word". I expect it will come.
See you tomorrow.
Isabel

----- Original Message -----
From: Morgan, Penny <MorganP@bre.co.uk>
To: <issycov@tinyworld.co.uk>
Sent: Tuesday, November 30, 1999 12:32 PM
Subject: ncc curiculum

> Isabel,
>
> Here's another attempt by e mail. I've printed off this version. The colour
> code is red for my changes. I've included the re-ordering as agreed at the
> June meeting but have not relettered the sections so B is still B and not
> the new A.
>
> P.
> <<CURIC99.DOC>>
>

Morgan, Penny

From: Rowley, John
Sent: 11 February 2000 10:28
To: Morgan, Penny
Subject: Irvine GRP

Penny
I have sent off the extra 2 samples to LPC.
The results of the elemental analyses on the GRP panels 1 and 16 only showed traces of the elements with no significant difference from the last analysis. A copy of the analysis is in the post to you.
We also used our X ray facility to look for alluminium hydrate and did not detect any. Note that this technique has not been used before the look for alluminium hydrate in glass fiber resin, we would expect to see it, so this result can only be said to suport the theory that there is no fire retardent in the resin.

I am in Runcorn all next week working for Derrick Crump, a proper report will be sent to you later.
I hope this surfices for the moment.
John

Fire at Garnock Court, Irvine on the 11 June 1999

Prepared for:
North Ayrshire Council

Prepared by:
Penny Morgan, Brian Martin and Tony Morris
Centre for Fire Protection Systems and
Charles Stirling, Scotlab

August 1999 **79902**

Final approval on behalf of BRE (Centre Head) :

Signed _____ *Date* _____

Martin Shipp

BRE
Bucknalls Lane
Garston
Watford
WD2 7JR

Tel : [redacted]
Fax :
Email : enquiries@bre.co.uk

EXECUTIVE SUMMARY

Tips

The executive summary is important - sometimes it is the only part of the document that the client reads.

It should be one of the last parts of the document to be finalised. By all means draft it early to help you think about its contents, but check it when you have finished.

The executive summary should:

- be short, clear and concise
- remind the client why the project was commissioned
- identify the main findings of the project
- comment on whether these findings were as expected
- highlight any limitations of the work or needs for additional work

Normally, the executive summary should occupy its own page and be divided into numbered points or bullets.

CONTENTS

TIP: Move cursor to table of contents and press F9 to refresh

Fire at Garnock Court, Irvine on the 11 June 1999

1. INTRODUCTION

Following a serious fire on Friday 11 June 1999 at Garnock Court, Irvine,the Fire Research Station (FRS) of the Building Research Establishment Ltd accepted the Council's invitation to act as expert consultant to study the circumstances surrounding the fire which resulted in damage on several floors of the building.

The fire had started in the living-room of a flat on the fifth floor and spread externally to the top of the fourteen-storey building apparently across an external cladding system. The fire together with the tragic death of the occupant of the fire flat received widespread press publicity in the UK. The local MP took the subject to the House of Commons Environment Sub-Committee. The Sub-Committee are holding an inquiry into the potential risk of fire spread in buildings via external cladding systems. The committee requested written submissions by the 6 July and held an oral evidence session on the 20 July. Their report is expected in the autumn after parliament is in session.

2. DESCRIPTION OF THE PROJECT

It was agreed that the project will be undertaken in phases each dependent on the prvious phase. The first phase was for a small team to visit the site on 3 August. The team comprised, Penny Morgan, Brian Martin and Tony Morris of the Centre for Fire Protection Systems and Charles Stirling from Scotlab, another part of BRE.

The BRE team met with Jim Paul and Graham Wallace of Technical Services, North Ayrshire Council at their Perceton House offices to discuss the building and the refurbishments. A small team of Strathclyde firefighters led by Divisional Officer Ian Scade joined the meeting and gave a short briefing on the fire. They also brought and showed a security video from Tesco's s of 7minutes of the fire from approximately 13.05 h.

3. FINDINGS

3.1 The building

Garnock Court is a flat-roofed fourteen storey-high rise residential property built in 1968. It was constructed of Wimpey No-Fines concrete and faced on the vertical line of the living-rooms between the windows with concrete and mosaic. The original window frames were timber. Internally the flats are lined with two layers of plasterboard with egg-box filling; the same material is used for all the partitions. The building is all electric. There is a communal TV supply in the corner of the living-room. Water and electricity services are placed behind the airing-cupboard and reached by a cupboard door in the kitchen. There are central lift and stairs services in the centre of the block with a separate access to the rubbish chute. Garnock Court is one of five similar blocks affording four two-bedroomed flats on the thirteen upper floors and three flats on the ground floor, see plan in Figure 1. All the

flats were fitted with smoke detectors, tenants are responsible for changing the batteries.

The buildings suffered damp penetration and in 1989 invitations to tender were sent out for a partial refurbishment, concentrating on upgrading all the windows to PVC and aluminium cladding between the windows on the living-room face. However, due to unavailability of suitable aluminium and the need to complete the works in 1991 the specification was altered to allow the supplier of the windows to also supply a glass reinforced plastic (GRP) material in a custom-designed system for the five blocks on the living-room faces. Each block was fitted with a different coloured material Figure 2, Garnock being a deep yellow, Figure 3.

3.2 The fire

As the fire may be the subject of a fatal accident enquiry and we have not investigated the cause in any detail we report here the outline of the fire development as reported to us by Strathclyde Fire Brigade and what we saw in the block.

We understand that the tenant of the fire flat lived with his daughter who was handicapped. He was confined to a wheelchair but is believed to have been sitting in an arm chair in the corner of the living-room by the window. The tenant was a cigarette smoker and we understand was unable to extinguish a fire in the armchair. He urged his daughter to leave and she survived the fire. The tenant died in the fire. The brigade were called at 12.50 and attended soon afterwards and discovered a fire external to the building involving the GRP on all floors up to the roof.

- I shall go on to summarise the damage we saw in the fir flat, the 6th seventh and 12 floor. Then go on to discuss the implications ie hot smoky fire that penetrated the flats thro the widows which were open because hot day or because tenant heard alarm and opened window for a look.

The damage noted was generally heavy smoke staining and cracked glass. On 12 floor damage result of late fire fighting operational implications for fb who tackled the flats 3 x 3 x 2 sequence. Also had porobs as no dry risers so had to carry hoses and clamber over furniture on stairs on 5th and 6th floors.
Contribution made by unique system no details held by Tech Services, not a surprise and over 8 years ago.

CONCLUSION AND RECOMMENDATIONS

- BS 476 Pts 6 and 7 . cost x
- Full scale on rig at Cardingon

Tips

These should be clear and concise.
They should not be unexpected i.e. the body of the report should have prepared the reader for these conclusions and recommendations.

EXECUTIVE SUMMARY

Following a serious fire on Friday 11 June 1999 at Garnock Court, Irvine, the Fire Research Station (FRS) of the Building Research Establishment Ltd accepted the Council's invitation to act as expert consultant to study the circumstances surrounding the fire which resulted in one death and damage on several floors of the building. The Council is particularly concerned about the rapid spread of the fire in June and the potential for other fatalities in future incidents.

1. The fire damage to the outside of the Garnock Court was the result of the ignition of the GRP cladding on the living-room face of the building.
2. The GRP was ignited by the fire plume leaving the living-room of the flat on the fifth floor where a polyurethane foam-filled armchair was on fire near the window. Tragically the male tenant of this flat died in the fire; his daughter left safely.
3. A fire in another part of the building, for example the bedroom, would not have the same effect; nor perhaps, would a fire in an inner part of the living-room.
4. The GRP used in the refurbishment in 1991 should have been Class 0 as defined in the Building Regulations.
5. We do not believe that the GRP is Class 0 in its current aged state; therefore we recommend a short series of tests on the spandrel panels to be removed from Garnock Court later in 1999. We also suggest using three comparison panels from an adjoining block to establish whether the pigment used had any effect on the fire performance.
6. We suggest that the short series of tests are used to ascertain the presence of flame retardants in the samples, the ignitability, surface spread of flame and fire propagation characteristics plus seeking a European classification for the material. We suggest that we phase the tests so that we can plan them based on the results gained.
7. We confirm that the proposed remedial measures should preclude any repeat of the fire on 11 June 1999.

Fire at Garnock Court, Irvine on the 11 June 1999

1. INTRODUCTION

Following a serious fire on Friday 11 June 1999 at Garnock Court, Irvine, the Fire Research Station (FRS) of the Building Research Establishment Ltd accepted the Council's invitation to act as expert consultant to study the circumstances surrounding the fire which resulted in one death and damage on several floors of the building. The Council is particularly concerned about the rapid spread of the fire in June and the potential for other fatalities in future incidents.

The fire had started in the living-room of a flat on the fifth floor and spread externally to the top of the fourteen-storey building apparently across an external cladding system. The fire together with the tragic death of the occupant of the fire flat received widespread press publicity in the UK. The local MP took the subject to the House of Commons Environment Sub-Committee. The Sub-Committee are holding an inquiry into the potential risk of fire spread in buildings via external cladding systems. The committee requested written submissions by the 6 July and held an oral evidence session on the 20 July. Their report is expected in the autumn after parliament is in session.

2. DESCRIPTION OF THE PROJECT

It was agreed that the project will be undertaken in phases each dependent on the previous phase. The first phase was for a small team to visit the site on 3 August. The team comprised, Penny Morgan, Brian Martin and Tony Morris of the Centre for Fire Protection Systems and Charles Stirling from Scotlab, another part of BRE.

The BRE team met with Jim Paul and Graham Wallace of Technical Services, North Ayrshire Council at their Perceton House offices to discuss the building and the remedial measures. A small team of Strathclyde firefighters led by Divisional Officer Ian Scade joined the meeting and gave a short briefing on the fire. They also brought and showed a 7 minute security video from Tesco's of the fire from approximately 13.05 h.

3. FINDINGS

3.1 The building

Garnock Court is a flat-roofed fourteen storey-high rise residential property built in 1968. It was constructed of Wimpey No-Fines concrete and faced on the vertical line of the living-rooms between the windows with concrete and mosaic. The original window frames were timber. Internally the flats are lined with Paramount partitions ie two layers of plasterboard with egg-box filling; the same material is used for all the partitions. The door from the living-room to the hall appeared to be on rising butt hinges which suggests that his was a fire door separating this part of the flat from the rest of the accommodation. The building is all electric. There is a communal TV

The brigade were called at 12.50 h and attended soon afterwards and discovered a fire external to the building involving the GRP on three floors above the fifth. This rapidly spread to involve all floors from the fifth up to the roof. The Tesco's video shows full involvement 15minutes after the call to the brigade and for the next seven minutes. The video shows even burning up the external surface of the GRP with the production of flames and dense black smoke. This indicates the involvement of the GRP alone rather than the contents of the flats as the burning pattern would vary according to the materials burning. The smoke lightens towards the end of the video as water from fire fighting takes effect.

Firefighters wearing breathing apparatus had difficulty reaching the upper flats as the stairs on the sixth and seventh floors were blocked with discarded furniture that they had to climb over. Although there were dry risers on every floor there are practical limitations on fighting fires on nine floors simultaneously. These range from subjecting firefighters to increased heat, loss of visibility, limited working time as well as potential problems from loss of water pressure. Thus the brigade tackled the fires on three floors at a time.

3.2.1 The living-room fire on the fifth floor

We understand that the tenant of the fire flat lived with his daughter who was mentally handicapped. He was confined to a wheelchair but the brigade reported that the fatality had been sitting very close to the window in a polyurethane foam-filled armchair in the corner of the living-room. A fire started in the living-room and involved that armchair. The tenant's daughter was able to leave the flat and she survived the fire.

The living-room was badly damaged by fire , Figure 3, with high level damage immediately outside in the hall, Figure 4, to about 1m down from the ceiling. Heavy smoke staining was seen elsewhere and was down to floor level in the kitchen and hall. The brigade reported that the front door, which is a fire door, had kept smoke from reaching the access corridor. The wind speed at the fifth floor was recorded as being 2.5 km/hour, this was a very still day. It is also likely that many of the living-room windows were open at the time of the fire or were opened by tenants on hearing the alarm and then left open as the occupants evacuated the building.

The brigade view this as a straightforward flat fire with tragic consequences for one of the tenants.

3.2.2. Fire on the upper floors

Access to all the upper floors was compromised by the presence of discarded furniture on the emergency staircase; a two-seater sofa on the sixth floor and a single chair on the seventh floor. Working conditions for the firefighters were ~~very humid~~ difficult because of high ambient temperatures as well as the hot smoke and gases from the burning GRP entering the flats through the living-room windows. Smoke had penetrated the stair-well from the upper flats because tenants left doors ajar and because of the firefighting activities of the brigade. Ventilation in the common access lobbies was very limited and it took a long time for the smoke to clear.

supply in the corner of the living-room. Water and electricity services are placed behind the airing-cupboard and reached by a cupboard door in the kitchen.

There are central lift and stairs services in the centre of the block with a separate access to the rubbish chute. Garnock Court is one of five similar blocks affording four two-bedroom flats on the thirteen upper floors and three flats on the ground floor, see plans in Figure 1. Each flat occupies 10m by 9m and has 3m high ceilings. All the flats were fitted with smoke alarms; tenants are responsible for changing the batteries.

The buildings suffered damp penetration and in 1989 invitations to tender were sent out for a partial refurbishment, concentrating on improving the roof and upgrading all the windows to double-glazed PVC-U. In addition, aluminium cladding between the windows on the living-room face was planned to reduce water penetration in those parts of the blocks. However, due to the unavailability of suitable aluminium, its cost and the need to complete the works in 1991 the specification was altered after discussion between the architect, engineers and contractor. This resulted in Sunline, the supplier of the windows also supplying Abacus panels, a glass reinforced plastic (GRP) material, in a custom-designed system for all five blocks on the living-room faces. The new system also changed the configuration so that the windows were now enclosed in a GRP pod; there was no insulation behind the GRP. Each block was fitted with a different coloured material Figure 2, Garnock Court being a deep yellow. Full rainscreen cladding was not an option on cost grounds.

The flat roof was covered with a new tiled surface, the water tanks redone and overclad. The refurbishment was regarded by Irvine Building Control as being a window replacement scheme and no application for a Building Warrant was made. There are no drawings available of the scheme after this length of time as files are kept for seven years only. Technical Services are aware that their engineers did a number of tests to ensure that the cladding could be fixed to the building.

3.1.1. Remedial measures

The Council have made the decision to remove all the material associated with the 1991 window replacement and start again. Technical Services described their approach which has still to be finalised. They have opted for composite aluminium and timber windows which are fully openable to allow cleaning. The spandrel panel to be an external insulated render of panels between the windows of either a non-combustible or Class 0 material. The render to be taken round the corner as the outer edge of the building is No Fines/nib/column/No Fines in construction. A Building Warrant has been applied for.

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As the fire may be the subject of a fatal accident enquiry and we have not investigated the cause in any detail. We report here the outline of the fire development as told to us by Strathclyde Fire Brigade and what we saw in the block. The brigade provided some background to the fire in that the fatality was the same tenant who had been involved in a bedroom fire on the sixth floor in January 1999.

moving out of the building. Because of the low wind speed and the high ambient temperature the plume will have adhered to the surface of the building. The plume will have ignited the GRP and remained in contact with it and generated a self-propagating fire. This was assisted by the cavities behind the spandrel panels which allowed fire to attack both sides of the GRP. The heavy black smoke and flames seen on the Tesco's video support this view that the GRP was the main material involved.

Although the material used in 1991 should have been Class 0 we have reservations about its current performance.

The remedial measures planned for the high rise blocks in Irvine should address the problems identified ie damp penetration and the avoidance of an external route for fire spread. We suggest that non-combustible materials are chosen wherever possible.

5. CONCLUSIONS AND RECOMMENDATIONS

1. The fire damage to the outside of the Garnock Court was the result of the ignition of the GRP cladding on the living-room face of the building.
2. The GRP was ignited by the fire plume leaving the living-room of the flat on the fifth floor where a polyurethane foam-filled armchair was on fire near the window. Tragically the male tenant of this flat died in the fire; his daughter left safely.
3. A fire in another part of the building, for example the bedroom, would not have the same effect; nor perhaps, would a fire in an inner part of the living-room.
4. The GRP used in the refurbishment in 1991 should have been Class 0 as defined in the Building Regulations.
5. We do not believe that the GRP is Class 0 in its current aged state; therefore we recommend a short series of tests on the spandrel panels to be removed from Garnock Court later in 1999. We also suggest using three comparison panels from an adjoining block to establish whether the pigment used had any effect on the fire performance.
6. We suggest that the short series of tests are used to ascertain the presence of flame retardants in the samples, the ignitability, surface spread of flame and fire propagation characteristics plus seeking a European classification for the material. We suggest that we phase the tests so that we can plan them based on the results gained.
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Prepared for:
North Ayrshire Council

Prepared by:
Penny Morgan, Brian Martin and Tony Morris
Centre for Fire Protection Systems and Charles Stirling, Scotlab

August 1999 **79902**

Final approval on behalf of BRE (Centre Head) :

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Firefighters wearing breathing apparatus had difficulty reaching the upper flats as the stairs on the sixth and seventh floors were blocked with discarded furniture that they had to climb over. As there were no dry risers, hoses had to be carried in from the outside of the building.

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The brigade view this as a straightforward flat fire with tragic consequences for one of the tenants.

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Access to all the upper floors was compromised by the presence of discarded furniture on the emergency staircase; a two-seater sofa on the sixth floor and a single chair on the seventh floor. Conditions were very humid because of high ambient temperatures as well as the hot smoke and gases from the burning GRP entering the flats through the living-room windows. Smoke had penetrated the stair-well from the upper flats because tenants left doors ajar and because of the firefighting activities of the brigade. Ventilation in the common access lobbies was not obvious and it took a long time for the smoke to clear.

The brigade reported that debris was falling off the building and resulted in the ignition of the roof and tyre of one of their appliances. Some windows were open and some were opened when people heard the alarm and saw there was a fire.

Because of this smoke and hot gases penetrated all eight flats above the flat where the fire started. Operationally, it was only possible to tackle the fires in the flats on three levels at a time. This meant that there had to be a delay in fire fighting and the flat on the twelfth floor became the worst fire damaged with loss of the partition between the living-room and the bedroom, Figures 5 and 6. However, they pointed out that the same techniques would have been used even if this had been a night-time fire.

There was no damage to the roof apart form smoke staining on the edge panels.

The brigade sent a STOP message at 15.23 h . Fire investigators were on the scene until late that evening.

3.2.3 Means of escape and rescues

By the time the brigade arrived most people had left the building. Three people were rescued from the seventh floor on the fire side of the building early on during fire fighting. People on the non-fire sides of the building were encouraged to stay in their flats by firefighters on the corridors.

Late on in the afternoon one elderly lady who suffered from asthma was taken out of the building using the hydraulic platform from the opposite side of the building rather than walking her out of the building and climbing over the discarded furniture. She would have been safe in her flat but this action was taken as a precautionary measure. This led to a fifth person asking to be taken out of the building, the hydraulic platform was used again.

3.3. Observations by the BRE team

The BRE team from FRS and Scotlab were given access to an undamaged flat. It was evident that the GRP pod surrounding the window curved round the window sill and that a separate spandrel panel met the window pod. The timber support and the edge of the PVC-U is covered by the GRP pod. The spandrel GRP is fixed into the old mosaic; originally the spandrel consisted of No Fines/render and a mosaic decorative panel.

The PVC-U windows provided two openable panes with two smaller fixed ones beneath them. There was a trickle vent over one of the larger panes, see Figure 2. The windows have two open positions and then the full 'roll' to allow cleaning. A similar opening system will be used for the replacement windows. We noted small areas of rust/ spotting on some window hinges indicating that water penetration is still a problem. There was slight discolouration on the ceiling wall junction in some bedrooms and the inner window sills showed evidence of damp in some flats.

The damage in the fire flat was confined to the living-room with heat damage and heavy smoke staining in the kitchen. The top edge of the GRP spandrel panel immediately below the window where the fire started appears undamaged and the gaps behind the panel are clearly visible, Figures 7-9.

On the sixth floor in the flat immediately above the fire flat there is evidence of heavy smoke staining and heat damage but little evidence of burning of the contents. The glazing is cracked on the cupboard behind the clock stopped at 13.10 h, see Figure 10 and the television set casing is distorted, Figure 11. The kitchen door had been closed and there was little damage in this room, Figure 12 and no penetration of the services cupboard, Figure 13.

On the twelfth floor the damage shown in Figures 5 and 6 was the result of late fire fighting as this flat was in the last group to be tackled by the brigade. It is also possible that there was no door to the living-room as the burn pattern in the hall looks to be even on both sides, Figure 14. It may, however, be the result of the door burning through.

4. DISCUSSION

The damage noted was generally heavy smoke staining and cracked glass, which indicates that there was penetration of smoke and very hot gases *into* the flats. The heavy staining is usually associated with the deposition of 'cold' smoke from a fire elsewhere, see Figures 10 and 11. This supports the view put forward by the brigade and illustrated in the Tesco's video that the damage to the flats on the sixth floor and above was from the burning GRP.

Fire fighters had to tackle fires on nine floors and did so on three levels at a time. They were hampered by the lack of dry risers and the furniture on the emergency stairs on the sixth and seventh floors.

Figure 15 is of the aftermath of a fire in Glasgow House, London on the 15 March 1996. This shows the expected vertical spread from a severe fire in a flat where two floors show heavy smoke staining , lighter staining on the fourth and none above. We would expect to see this sort of pattern indicating a fire moving *out* of a building regardless of the type of construction and not that seen in Figure 16, Garnock court.

In the case of the fire in Garnock Court the severity of the initial fire and its position close to the window has resulted in the plume of smoke and hot gases from the fire moving out of the building. Because of the slow wind speed and the high ambient temperature the plume will have stuck to the surface of the building. The plume will have ignited the GRP and remained in contact with it and generated a self-propagating fire. This was assisted by the cavities behind the spandrel panels which allowed fire to attack both sides of the GRP. The heavy black smoke and flames seen on the Tesco's video support this view that the GRP was the main material involved. A plume of hot gases from the materials burning in the fire flat would have been pulsing as the fire inside the building built up and died down depending on the fuel and how much air was available to the growing fire.

Although the material used in 1991 should have been Class 0 we have reservations about its current performance.

The remedial measures planned for the high rise blocks in Irvine should address the problems identified ie damp penetration and the avoidance of an external route for

fire spread. We suggest that non-combustible materials are chosen wherever possible.

5. CONCLUSIONS AND RECOMMENDATIONS

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10. A fire in another part of the building, for example the bedroom, would not have the same effect; nor perhaps, would a fire in an inner part of the living-room.
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Final approval on behalf of BRE (Centre Head) :

Signed _____ *Date* _____

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3. FINDINGS

3.1 The building

Garnock Court is a flat-roofed fourteen storey-high rise residential property built in 1968. It was constructed of Wimpey No-Fines concrete and faced on the vertical line of the living-rooms between the windows with concrete and mosaic. The original window frames were timber. Internally the flats are lined with Paramount partitions ie two layers of plasterboard with egg-box filling; the same material is used for all the partitions. The door from the living-room to the hall appeared to be on rising butts which suggests that his was a fire door separating this part of the flat from the rest of the accommodation. The building is all electric. There is a communal TV supply in

the corner of the living-room. Water and electricity services are placed behind the airing-cupboard and reached by a cupboard door in the kitchen.

There are central lift and stairs services in the centre of the block with a separate access to the rubbish chute. Garnock Court is one of five similar blocks affording four two-bedroom flats on the thirteen upper floors and three flats on the ground floor, see plans in Figure 1. Each flat occupies 10m by 9m and has 3m high ceilings. All the flats were fitted with smoke detectors; tenants are responsible for changing the batteries.

The buildings suffered damp penetration and in 1989 invitations to tender were sent out for a partial refurbishment, concentrating on improving the roof and upgrading all the windows to double-glazed PVC-U. In addition, aluminium cladding between the windows on the living-room face was planned to reduce water penetration in those parts of the blocks. However, due to the unavailability of suitable aluminium, its cost and the need to complete the works in 1991 the specification was altered after discussion between the architect, engineers and contractor. This resulted in Sunline, the supplier of the windows also supplying Abacus panels, a glass reinforced plastic (GRP) material, in a custom-designed system for all five blocks on the living-room faces. The new system also changed the configuration so that the windows were now enclosed in a GRP pod; there was no insulation behind the GRP. Each block was fitted with a different coloured material Figure 2, Garnock Court being a deep yellow. Full rainscreen cladding was not an option on cost grounds.

The roof was re-tiled, the water tanks redone and overclad. The refurbishment was regarded by Irvine Building Control as being a window replacement scheme and no application for a Building Warrant was made. There are no drawings available of the scheme after this length of time as files are kept for seven years only. Technical Services are aware that their engineers did a number of tests to ensure that the cladding could be fixed to the building.

3.1.1. Remedial measures

The Council have made the decision to remove all the material associated with the 1991 window replacement and start again. Technical Services described their approach which has still to be finalised. They have opted for composite aluminium and timber windows which are fully openable to allow cleaning. The spandrel panel to be an external insulated render of panels between the windows of either a non-combustible or Class 0 material. The render to be taken round the corner as the outer edge of the building is No Fines/nib/column/No Fines in construction. A Building Warrant has been applied for.

3.2 The fire

As the fire may be the subject of a fatal accident enquiry and we have not investigated the cause in any detail we report here the outline of the fire development as told to us by Strathclyde Fire Brigade and what we saw in the block. The brigade provided some background to the fire in that the fatality was the same tenant who had been involved in a bedroom fire on the sixth floor in January 1999.

The brigade were called at 12.50 h and attended soon afterwards and discovered a fire external to the building involving the GRP on three floors above the fifth. This rapidly spread to involve all floors from the fifth up to the roof. The Tesco's video shows full involvement 15minutes after the call to the brigade and for the next seven minutes. The video shows even burning up the external surface of the GRP with the production of flames and dense black smoke. This indicates the involvement of the GRP alone rather than the contents of the flats as the burning pattern would vary according to the materials burning. The smoke lightens towards the end of the video as water from fire fighting is used. takes effect

Firefighters wearing breathing apparatus had difficulty reaching the upper flats as the stairs on the sixth and seventh floors were blocked with discarded furniture that they had to climb over. Although there were dry risers on every floor there are practical limitations on fighting fires on nine floors simultaneously. These range from subjecting firefighters to increased heat, loss of visibility, limited working time as well as potential problems from loss of water pressure. Thus the brigade tackled the fires on three floors at a time.

3.2.1 The living-room fire on the fifth floor

We understand that the tenant of the fire flat lived with his daughter who was mentally handicapped. He was confined to a wheelchair but the brigade reported that the fatality had been sitting very close to the window in a polyurethane foam-filled armchair in the corner of the living-room. A fire started in the living-room and involved that armchair. The tenant's daughter was able to leave the flat and she survived the fire.

The living-room was badly damaged by fire , Figure 3, with high level damage immediately outside in the hall, Figure 4, to about 1m down from the ceiling. Heavy smoke staining was seen elsewhere and was down to floor level in the kitchen and hall. The brigade reported that the front door, which is a fire door, had kept smoke from reaching the access corridor. The wind speed at the fifth floor was recorded as being 2.5 km/hour, this was a very still day. It is also likely that many of the living-room windows were open at the time of the fire or were opened by tenants on hearing the alarm. . weekend added -

would they not close them? NO. that's the whole point.

The brigade view this as a straightforward flat fire with tragic consequences for one of the tenants.

3.2.2. Fire on the upper floors

Access to all the upper floors was compromised by the presence of discarded furniture on the emergency staircase; a two-seater sofa on the sixth floor and a single chair on the seventh floor. Conditions were very humid because of high ambient temperatures as well as the hot smoke and gases from the burning GRP entering the flats through the living-room windows. Smoke had penetrated the stair-well from the upper flats because tenants left doors ajar and because of the firefighting activities of the brigade. Ventilation in the common access lobbies was very limited and it took a long time for the smoke to clear.

yes does this matter re/ves firefighting chaie.

The brigade reported that debris was falling off the building and resulted in the ignition of the roof and tyre of one of their appliances. Some windows were open and some were opened when people heard the alarm and saw there was a fire. Because of this smoke and hot gases penetrated all eight flats above the flat where the fire started. Operationally, it was only possible to tackle the fires in the flats on three levels at a time. This meant that there had to be a delay in fire fighting and the flat on the twelfth floor became the worst fire damaged with loss of the partition between the living-room and the bedroom, Figures 5 and 6. However, they pointed out that the same techniques would have been used even if this had been a night-time fire.

There was no damage to the roof apart from smoke staining on the edge panels.

The brigade sent a STOP message at 15.23 h. Fire investigators were on the scene until late that evening.

3.2.3 Means of escape and rescues

By the time the brigade arrived most people had left the building. Three people were rescued from the seventh floor on the fire side of the building early on during fire fighting. People on the non-fire sides of the building were encouraged to stay in their flats by firefighters on the corridors.

Later
Late on in the afternoon one elderly lady who suffered from asthma was taken out of the building using the hydraulic platform from the opposite side of the building rather than walking her out of the building and climbing over the discarded furniture. She would have been safe in her flat but this action was taken as a precautionary measure. This led to a fifth person asking to be taken out of the building, the hydraulic platform was used again.

3.3. Observations by the BRE team

The BRE team from FRS and Scotlab were given access to an undamaged flat. It was evident that the GRP pod surrounding the window curved round the window sill and that a separate spandrel panel met the window pod. The timber support and the edge of the PVC-U is covered by the GRP pod. The spandrel GRP is fixed into the old mosaic; originally the spandrel consisted of No Fines/render and a mosaic decorative panel.

The PVC-U windows provided two openable panes with two smaller fixed ones beneath them. There was a trickle vent over one of the larger panes, see Figure 2. The windows have two open positions and then the full 'roll' to allow cleaning. A similar opening system will be used for the replacement windows. We noted small areas of rust/ spotting on some window hinges indicating that water penetration is still a problem. There was slight discolouration on the ceiling wall junction in some bedrooms and the inner window sills showed evidence of damp in some flats.

The damage in the fire flat was confined to the living-room with heat damage and heavy smoke staining in the kitchen. The top edge of the GRP spandrel panel

immediately below the window where the fire started appears undamaged and the gaps behind the panel are clearly visible, Figures 7-9.

On the sixth floor in the flat immediately above the fire flat there is evidence of heavy smoke staining and heat damage but little evidence of burning of the contents. The glazing is cracked on the cupboard behind the clock stopped at 13.10 h, see Figure 10 and the television set casing is distorted, Figure 11. The kitchen door had been closed and there was little damage in this room, Figure 12 and no penetration of the services cupboard, Figure 13.

On the twelfth floor the damage shown in Figures 5 and 6 was the result of late fire fighting as this flat was in the last group to be tackled by the brigade. It is also possible that there was no door to the living-room as the burn pattern in the hall looks to be even on both sides, Figure 14. It may, however, be the result of the door burning through. The hall cupboard outside the bedroom adjacent to the living-room had been turned round to afford a cupboard for the bedroom. It may be that the alterations had opened up the partition wall between the bedroom and living-room and provided a route for the fire to penetrate it and destroy it.

Ventilation from the access corridor next to the stairs consisted of small holes in what appeared to be replacement windows.

4. DISCUSSION

The damage noted was generally heavy smoke staining and cracked glass, which indicates that there was penetration of smoke and very hot gases *into* the flats. The heavy staining is usually associated with the deposition of 'cold' smoke from a fire elsewhere, see Figures 10 and 11. This supports the view put forward by the brigade and illustrated in the Tesco's video that the damage to the flats on the sixth floor and above was from the burning GRP.

Fire fighters had to tackle fires on nine floors and did so on three levels at a time. They were hampered by the presence of discarded furniture on the emergency stairs on the sixth and seventh floors. Ventilation from the access corridor appears to have been minimal. However, if it had been a larger fixed opening it is possible that hot smoke would have made the occupants on the rear of the building very uncomfortable and more of them may have wished to leave the building whereas they were safe in their own flats. Openable ventilators could have been useful in clearing the corridors of smoke and hot gases to assist the firefighters.

Figure 15 is of the aftermath of a fire in Glasgow House, London on the 15 March 1996. This shows the expected vertical spread from a severe fire in a flat where two floors show heavy smoke staining, lighter staining on the fourth and none above. We would expect to see this sort of pattern indicating a fire moving *out* of a building regardless of the type of construction and not that seen in Figure 16, Garnock Court.

In the case of the fire in Garnock Court the severity of the initial fire and its position close to the window has resulted in the plume of smoke and hot gases from the fire moving out of the building. Because of the slow wind speed and the high ambient

temperature the plume will have stuck to the surface of the building. The plume will have ignited the GRP and remained in contact with it and generated a self-propagating fire. This was assisted by the cavities behind the spandrel panels which allowed fire to attack both sides of the GRP. The heavy black smoke and flames seen on the Tesco's video support this view that the GRP was the main material involved. A plume of hot gases from the materials burning in the fire flat would have been pulsing as the fire inside the building built up and died down depending on the fuel and how much air was available to the growing fire.

Although the material used in 1991 should have been Class 0 we have reservations about its current performance.

The remedial measures planned for the high rise blocks in Irvine should address the problems identified ie damp penetration and the avoidance of an external route for fire spread. We suggest that non-combustible materials are chosen wherever possible.

5. CONCLUSIONS AND RECOMMENDATIONS

1. The fire damage to the outside of the Garnock Court was the result of the ignition of the GRP cladding on the living-room face of the building.
2. The GRP was ignited by the fire plume leaving the living-room of the flat on the fifth floor where a polyurethane foam-filled armchair was on fire near the window. Tragically the male tenant of this flat died in the fire; his daughter left safely.
3. A fire in another part of the building, for example the bedroom, would not have the same effect; nor perhaps, would a fire in an inner part of the living-room.
4. The GRP used in the refurbishment in 1991 should have been Class 0 as defined in the Building Regulations.
5. We do not believe that the GRP is Class 0 in its current state; therefore we recommend a short series of tests on the spandrel panels to be removed from Garnock Court later in 1999. We also suggest using three comparison panels from an adjoining block to establish whether the pigment used had any effect on the fire performance.
6. We suggest that we check for the presence of flame retardants in the samples, the ignitability, surface spread of flame and fire propagation plus seeking a European classification for the material. We suggest that we phase the tests so that we can plan them based on the results gained.
7. We confirm that the proposed remedial measures should preclude any repeat of the fire on 11 June 1999.

6. LIST OF CAPTIONS

Figure 1a Typical Upper floor plan of Garnock Court
Figure 1b Ground Floor Plan
Figure 2 External view of the GRP cladding, Garnock Court on the right
Figure 3 Corner of fire flat where fire started
Figure 4 High level damage in the fire flat, note destruction of Paramount board on the left
Figure 5 Twelfth-floor flat, note loss of partition between bedroom and living-room
Figure 6 Twelfth-floor flat, looking towards kitchen
Figure 7 Detail of window sill in fire flat on fifth floor, note nibblng of concrete
Figure 8 One of the cavities behind the edge of the spandrel panel
Figure 9 Indication of size of cavity behind spandrel panel
Figure 10 Sixth-floor flat, note the time on the clock
Figure 11 Sixth-floor flat, note 'melted' television
Figure 12 Sixth-floor flat, the kitchen door had been closed
Figure 13 Sixth-floor flat, the services cupboard in the kitchen was unaffected
Figure 14 Twelfth-floor flat, high level damage in the hall,
Figure 15 Glasgow House fire, London, 15 March 1996. The expected view of external post fire damage
Figure 16 External view of post fire damage at Garnock Court June 1999