

Low level asbestos exposure – How significant an issue?

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Background

Those who have been following the CLASP controversy will be aware that background asbestos fibre concentrations in such and other system-built buildings can exceed the Clearance Indicator.

So

What are the risks in CLASP - type buildings?

Silver Hill Primary School, Derby – a case study

Silver Hill - background

Silverhill is a CLASP school.

*Window contractors removed
original windows and new
windows.*

Silver Hill - background

The window reveals were lined with AIB sheets and the under-window panels in the classrooms were lined with one 5mm and one 8 mm thick AIB sheets.

Silver Hill - background

Window contractors, who had not been warned about the AIB, removed the glass, used a jig saw to cut through the bottoms of the frames into some of the AIB lined panels, levered out the frames and dumped the frames and panels into the classroom or playground.

Silver Hill - background

Work started on 16th Feb 2004.

Removal of windows took up to 2 hours at the start of each of 11 days.

Pupils and staff were present on 9 of these days.

Silver Hill - background

Pupils were nominally excluded from work areas but teachers entered these areas to clean up their own classrooms.

3 weeks after the job started Derby Council stopped it.

Silver Hill - background

*A programme of air monitoring,
starting on 13th March 2004,
was carried out.*

Silver Hill - background

*The School was closed for 3 months
and decontaminated at a cost of
£750,000*

Derby Council were prosecuted.

*The window contractor was
prosecuted.*

The head teacher was prosecuted.

Silver Hill - background

Derby Council pleaded guilty.

The window contractor was fined.

*The head teacher was found not
guilty.*

Silverhill - background

Two risk assessments were carried out, one by IOM in Edinburgh and one by HSE.

Silverhill - background

IOM concluded that “The future risks for pupils and school staff from asbestos-related cancers from this incident were very low and comparable with risks that many in society would consider unimportant.

Silverhill - background

*The HSE report concluded that
“None of the groups identified in the
IOM report is expected to die from
lung cancer or mesothelioma as a
result of window replacement at the
school.*

So

Uncontrolled removal of windows and disturbance of AIB which led to closure of a school, a £750,000 clean up and prosecution of the Council, the Window Contractor and the Head Teacher led to “very low risk” and non-one is expected to die from lung cancer or mesothelioma.

So

I was very dubious and carried out my own risk assessment which was based on information obtained by a colleague, Mr. Michael Lees, under Freedom of Information requests to Derby Council and HSE.

Exposure assessment

Exposure assessment

It must be appreciated that the monitoring results related to the situation at least 3 days after window work had ceased.

Exposure assessment

If air infiltration effectively halved airborne fibre concentrations every hour, such concentrations would have been reduced to 1/1,000,000 of the initial concentration in about 20 hours.

Exposure assessment

It is therefore considered that the monitoring data give no indication of likely airborne fibre concentrations while window work was ongoing and provides information only on fibres released from residual contamination left in the school.

Exposure assessment

Where possible, exposure assessments will therefore be based on relevant published data. If no such data are available, assessments will be based on professional judgement.

Exposure assessment

Windows in offices and kitchens did not have AIB under their windows.

It is understood that 2 days were spent in replacing windows in offices and kitchens and 9 days in replacing windows in classrooms.

Exposure assessment

After completion of work in each classroom the teacher spent about an hour with brush and dust pan cleaning up the classroom.

Exposure assessment

Release of asbestos could have occurred when:

Jig saws cut into AIB panels;

AIB panels were being removed;

Damaged AIB panels were being handled;

Workmen worked on top of debris;

Teachers cleaned up their classrooms.

Exposure assessment

Exposure data for most of these activities can be identified in the published literature.

Jig sawing AIB

*HSE Guidance Note EH35: 1989
notes that jig sawing AIB without
effective exhaust ventilation can
generate 5-20 fibres/ml.*

Jig sawing AIB

These data had been carried forward from older guidance from 1973.

Due to changes in analysis techniques since the mid-1970s later measurements would have given up to 8 times higher concentrations, see Rickards (1994), i.e. about up to about 40-160 fibres/ml.

Jig sawing AIB

*A “low” figure of about 20 fibres/ml
from jig sawing AIB was adopted.*

Forcibly removing panels

HSE Guidance Note EH35: 1989 notes that “rough handling” AIB could generate >15 fibres/ml.

Stranks (1997) observed 30-312 fibres/ml, mean 147 fibres/ml, when AIB ceiling tiles were removed.

Howie (2001) measured a personal exposure of 50 fibres/ml when a dry AIB panel was broken out.

Forcibly removing panels

Howie's figure of 50 fibres/ml lies in the lower range of the reported range and was adopted.

Cleaning up - workmen

Stranks (1997) observed 2.5->50 fibres/ml while dry debris from the removal of AIB ceiling tiles was being cleaned up. 7 of Stranks' 16 samples were too dense to analyse.

Howie (2001) observed 70 fibres/ml on a personal sample during the 15 minutes taken to dry brush up and bag debris from AIB removal.

Cleaning up - workmen

A central figure of 50 fibres/ml was adopted for workmen cleaning up debris containing AIB.

Working on top of debris

No published data were found for this “activity”

As a first approximation I suggest that continual disturbance would generate about 10% of the concentrations generated by deliberate disturbance, e.g. as during cleaning up.

Working on top of debris

*A figure of 5 fibres/ml was adopted
for working on debris.*

Exposure summary - workmen

Jig sawing – 20 fibres/ml

Removing AIB panels – 50 fibres/ml

Working on debris – 5 fibres/ml

Sweeping up – 50 fibres/ml

Exposure summary - workmen

If it is assumed that: removing glass took about half an hour; jig sawing frames took about 5 minutes; removing and handling panels took about 1 hour, fitting new windows while working on top of debris took about 7 hours and cleaning up took about $\frac{1}{4}$ hour the daily cumulative exposure can be calculated.

Exposure summary - workmen

Jig sawing - 20 fibres/ml x 1/12 hr

Panel removal - 50 fibres/ml x 1 hr

Working on debris - 5 fibres/ml x 7 hr

Cleaning-up - 50 fibres/ml x 1/4 hr.

Total ~100 fibres/ml.hours per day.

Exposure summary - workmen

The workmen's total exposures over the about 9 days of renewing windows in classrooms would have been about 880 fibres/ml.hours.

Workmen's exposure summaries

IOM	HSE	Howie
44 f/ml.hours	44 f/ml.hours	880 f/ml.hours

Cleaning up - teachers

Given that teachers felt constrained to clean up after the workmen, it can be assumed that there must have been significant visible contamination left in the classrooms.

Cleaning up - teachers

The description of teachers using a dust pan suggests that the teachers used a hand brush rather than the long handled brush which would have been used by the workmen.

Cleaning up - teachers

This suggests that the teachers' breathing zones were within about 0.5 metres of the debris rather than the about 1.5 metres for the workmen.

Cleaning up - teachers

Assuming that dust concentrations fall linearly with distance, the teachers' would have been exposed to about 3 times the concentrations of the workmen, i.e. each could have been exposed to about 150 fibres/ml.

Cleaning up - teachers

If each each teacher spent one hour cleaning up and being exposed to about 150 fibres/ml, each teacher's cumulative exposure would have been about 150 fibres/ml.hours.

Teachers' exposure summaries – cleaning up

IOM	HSE	Howie
0.16 f/ml.hours	0.56 f/ml.hours	150 f/ml.hours

Cleaners

Although the cleaners cleaned up on about nine occasions rather than on one occasion as for the teachers, it is considered likely that the asbestos contamination they cleaned up would have been progressively less severe than that cleaned up by the teachers.

Cleaners

If it were assumed that the teachers had removed, say, about 75% of the contamination, it could be considered that the cleaners would have experienced about 25% of the teachers' cumulative exposures.

Cleaners

That is, the cleaners could have been exposed to about 40 fibres/ml in each classroom.

Cleaners

If the cleaners spent about half an hour in each classroom, their cumulative exposure over the nine days of the window work would have been about: 40 fibres/ml x 0.5 hours/classroom x 9 classrooms = 180 fibres/ml.hours.

Cleaners' exposure summaries

IOM	HSE	Howie
2.4 f/ml.hours	2.4 f/ml.hours	180 f/ml.hours

Pupils and other school personnel

*What are the main mechanisms of
contamination spread in buildings?*

Pupils and other school personnel

*There are three main mechanisms:
personnel movement entraining
contamination, effects of ventilation
systems, wind forces.*

Pupils and other school personnel

There was unlikely to have been significant personnel movement while window work was underway.

Did Silverhill school have a mechanical ventilation system?

Pupils and other school personnel

Wind effects

Pupils and other school personnel

*Contamination in a room at higher
pressure than adjacent
rooms/corridors will be blown into
the building.*

*Contamination in a room on the
downwind side of the building will
be sucked out of the building.*

Pupils and other school personnel

*It is air movement between high and
low pressure sides of a building
which causes the movement of
contamination.*

Pupils and other school personnel

Harries (1971) observed that when removing asbestos insulation from naval vessels the airborne contamination level one deck above the stripping zone was about 30% of that in the stripping zone.

Pupils and other school personnel

If it were assumed that air infiltration/exfiltration in buildings is higher than in the ships studied by Harries (1971), it could be assumed that spread in such buildings was about 10% of that in ships.

Pupils and other school personnel

That is, it could be assumed that airborne fibre levels in rooms at lower pressure and adjacent to those being worked in would be about 3% of those in the work room.

Pupils and other school personnel

If it were further assumed that on about $\frac{3}{4}$ of the time the room being worked on was on the downwind surfaces of the school, and contamination was sucked out of the room rather than blown into the school, the effective total cumulative exposure would have been about a quarter of the possible.

Pupils and other school personnel

On each day the fibre emissions into the room being worked on would have been about 100 fibres/ml.hours from window workers, 150 fibres/ml.hours from a teacher and 20 fibres/ml.hours from cleaners, i.e. a total of about 270 fibres/ml.hours.

Pupils and other school personnel

*Assuming spread of 3% of 270
fibres/ml hours x 9 days x 0.25 to
take account of wind direction, the
total emissions into the school, and
the cumulative exposures
experienced by all pupils and
personnel therein, would have been
about 18 fibres/ml.hours.*

Other school personnel's overall exposure summaries

IOM	HSE	Howie
0.016- 0.024/ml.hours	Deemed to be insignificant	18 f/ml.hours

Teachers

As the teachers would also have been exposed to the general emissions into the school, their total exposures would have been 150 fibres/ml.hours from their own cleaning up plus 18 fibres/ml.hours from emissions, i.e. a total of about 170 fibres/ml.hours.

Silverhill total exposures – fibres/ml.hours

	IOM	HSE	Howie
Contractors	44	44	880
Teachers	0.16	0.56	170
Cleaners	2.4	2.4	180
Pupils and others	0.016-0.024	insignificant	18

Risk estimates

The risks associated with the assessed cumulative exposures can be calculated from the Hodgson & (2000) model with corrections for exposures below age 20 using the Doll & Peto (1985) model.

What is the life expectancy of 5 year-olds?

*From the ONS website the current
life expectancy of male toddlers is
88 yr and of female toddlers is 91 yr.*

Risk estimates

Risks for adults were estimated to age 80 and for the children to age 90

Silverhill total risk – deaths/million

	IOM	HSE	Howie
contractors	25 @ 30 yr	60 @ 30 yr	1,100
teachers	0.3	40	300
cleaners	0.5 @ 40 yr	10 @ 40 yr	310
others	0.2	“insignificant”	60
pupils	0.3	“insignificant”	250

What does a death rate of 250/million mean?

Consider a school with 700 pupils.

*Consider handling each child a
loaded revolver and playing Russian
Roulette by pulling the trigger once.*

*If one bullet is live, the risk would be
240/million.*

**Would anyone here
wish/permit their child to
participate?**