Signature Assessment
130 Liberty Street Property

Technical Memorandum
S5: Airborne Fiber Dimensions: A Comparison of Asbestos Resuspended from WTC Dust to Airborne Asbestos in Other Buildings

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Summary

Following the World Trade Center destruction commencing on September 11, 2001 ("WTC Event"), extensive sampling was performed in and around the building located at 130 Liberty Street, New York, NY (the "Building") to determine the presence, type, amount and extent of environmental contaminants.[1] Samples of air and surface dust were collected and analyzed for asbestos using standard analytical procedures. The asbestos fiber data resulting from these samples have been used to estimate surface contamination,[1] asbestos fiber resuspension,[2,3] and, ultimately, employee health risks[4] from exposure to asbestos fibers. This memorandum discusses asbestos fiber dimensions from air samples taken in the Building.

Key Findings

- Airborne asbestos fibers in the Building are longer and thinner than airborne asbestos fibers collected in other buildings nationwide not impacted by the WTC Event (Table 3.) These longer and thinner fiber characteristics are generally accepted as resulting in higher human health toxicity.[5]

Conclusion

Airborne asbestos fibers in the Building are longer and have higher aspect ratios (length to width) than asbestos fibers collected in samples from other buildings nationwide not impacted by the WTC Event. Thus, the airborne asbestos fibers in the Building result in higher human health toxicity.[5]

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[1] RJ Lee Group, All Contamination Reports, December, 2003.
[2] RJ Lee Group, "Technical Memorandum *S2: The Relationship between Surface and Airborne Concentrations of WTC Dust Under Known Conditions*," May, 2004.
[3] RJ Lee Group, "Technical Memorandum *S4: Resuspension and Settling of WTC Dust over a Three-Day Period*," May, 2004.
[4] Goad, Phillip T. et al., "Risk Assessment and Public Health Implications of WTC Dust Contamination of the Deutsche Bank 130 Liberty Street Property," May, 2004.
[5] Berman, D. et al., "The Sizes, Shapes, and Mineralogy of Asbestos Structures that Induce Lung Tumors or Mesothelioma in AF/HAN Rats Following Inhalation," Risk Analysis, Vol. 15, No. 2, pp. 181-195, 1995.

1.0 Purpose

Prior investigations have demonstrated widespread asbestos fiber contamination in the Building.[1,6] This report describes dimensional distribution of asbestos fibers from air samples collected in the Building and compares these data with air sample data from other buildings not impacted by the WTC Event.

2.0 Background

Asbestos is the only carcinogen for which the potency is directly related to the numerical airborne concentration and to the aspect ratio of the fibers to which a person is exposed.[7] Therefore, the exposure determination must accurately reflect the airborne concentration and dimensions of respirable (breathable) asbestos fibers.

Air samples were collected to determine airborne concentrations of asbestos in the Building. Asbestos fibers in air samples collected from inside of the Building[3,8,9] were compared to asbestos fibers in air samples collected inside of other buildings nationwide not impacted by the WTC Event including commercial buildings, schools, universities and public buildings.[10]

3.0 Discussion

Air samples collected in the Building and in other buildings nationwide not impacted by the WTC Event were prepared using direct preparation techniques[11] and analyzed using Transmission Electron Microscopy (TEM). Asbestos fibers from the Building are longer and occur in higher concentrations than those from other buildings nationwide not impacted by the WTC Event. Asbestos fibers present in the Building also have a higher aspect ratio than those collected from other buildings nationwide not impacted by the WTC Event.[10] Figure 1 shows the length and Figure 2 shows the aspect ratio comparisons of the samples; the descriptive statistics are given in Table 1 and Table 2 respectively.

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[6] RJ Lee Group, "Contamination Report Pursuant to Testing Protocol-01 *Interior Spaces* Summary Report," December, 2003.
[7] Health Effects Institute - Asbestos Research, "Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge," pp 6-75. 1991.
[8] RJ Lee Group, "Technical Memorandum *S2: The Relationship between Surface and Airborne Concentrations of WTC Dust Under Known Conditions*," May, 2004.
[9] RJ Lee Group, "Technical Memorandum *R2: Test Cell Remediation and Recontamination*," May, 2004.
[10] Lee, R.J., Van Orden, D.R., Corn, M., and Crump, K.S., "Exposure to Airborne Asbestos in Buildings," Regulatory Toxicology and Pharmacology, Vol. 16, pp. 93-107. March, 1992.
[11] U.S. Environmental Protection Agency (EPA), "Interim Transmission Electron Microscopy Analytical Methods," 40CFR763 Subpart E Appendix A. July 1, 2003.

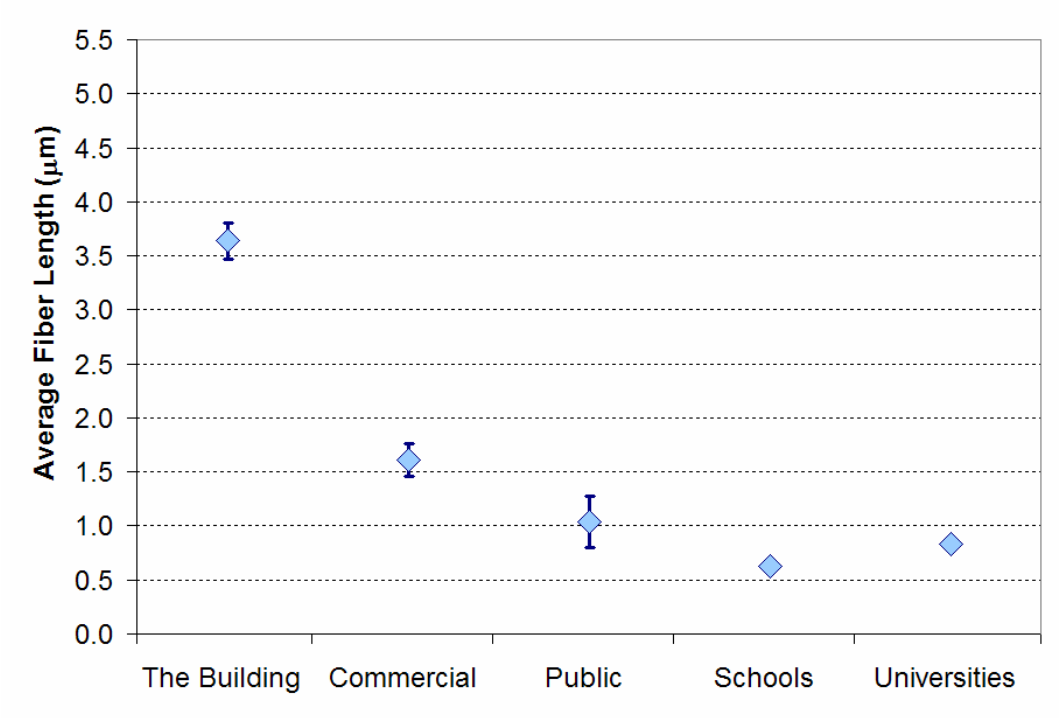

Figure 1. Average lengths of asbestos fibers in indoor air samples.

Table 1. Descriptive statistics for lengths of asbestos fibers in indoor air samples.

Location	Average Fiber Length (TEM Direct Preparation)	Confidence Interval[12]
The Building	3.64	0.343
Commercial	1.61	0.364
Public	1.04	1.157
Schools	0.63	0.019
Universities	0.83	0.070

The above information illustrates that even assuming the low end of the average fiber length for the Building samples in this study is compared to the high end of the average fiber length for the other building samples, the average fiber length in the Building is significantly longer than the average fiber length of samples in the other buildings.

[12] Confidence interval is the numerical interval in which the true mean of a distribution lies within a certain probability. For example, there is a 95% confidence that the true mean lies between 2 and 2.5 (i.e., the confidence interval is 2.25 +/- 0.25). Easton, Valerie J. and McColl, John H., "Confidence Intervals," Statistics Glossary v1.1, http://www.stats.gla.ac.uk/steps/glossary/confidence_intervals.html, September, 1977; accessed May 7, 2004. With respect to the Building this confidence level is 95%.

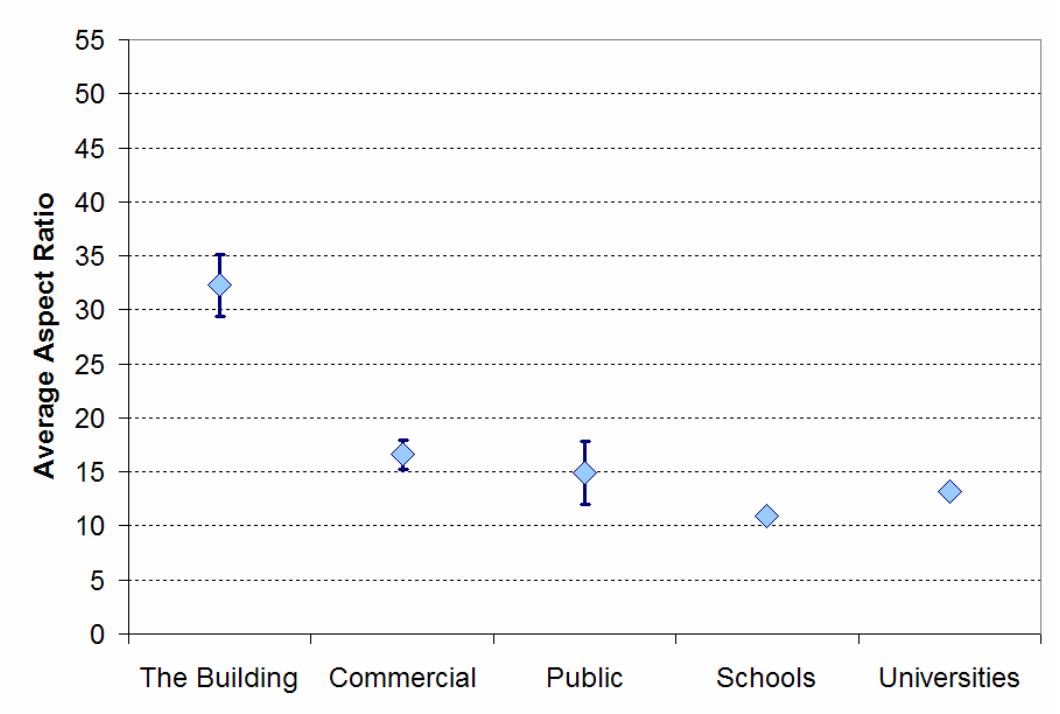

Figure 2. Average aspect ratios of asbestos fibers in indoor air samples.

Table 2. Descriptive statistics for aspect ratios of asbestos fibers in indoor air samples.

Location	Average Aspect Ratio (TEM Direct Preparation)	Confidence Interval
The Building[12]	32.3	0.252
Commercial	16.6	2.359
Public	14.9	0.013
Schools	10.9	0.002
Universities	13.2	0.006

The above information illustrates that even assuming the low end of the average aspect ratio for asbestos in the Building samples in this study is compared to the high end of the average aspect ratios of the other building samples, the aspect ratio of samples from the Building is significantly larger than the average aspect ratio of samples in the other buildings.

Table 3 displays the percentages of asbestos fibers that occur in different size ranges for the Building and other buildings nationwide not impacted by the WTC Event. The highest percentage of long, thin asbestos fibers (≥5 µm in length) is found in the Building.

Table 3. Percentages of asbestos fibers by size range for indoor air samples

Length	≥5 um	≥5 um	≥10 um	≥10 um
Width	<0.5 um	<0.15 um	<0.5 um	<0.15 um
	TEM Direct Preparation			
The Building	16.4	6.0	5.5	1.9
Commercial	3.0	0.3	1.9	0.0
Public	2.3	0.9	0.2	0.0
Schools	0.4	0.1	0.1	<0.1
Universities	1.1	0.6	0.4	0.2