



# **Asbestos Content in Wall and Ceiling Plasters in Buildings Built between 1880 and 1980**

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OEHS<sup>2</sup>

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Roger G. Morse Associates

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# Presentation Overview

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- **Describe Yale's Facilities**
- **Review components of plaster systems**
- **Describe the events that precipitated our interest in asbestos content of plaster**
- **Describe the techniques and methods developed to accurately determine the percent asbestos in plaster**
- **Summarize the findings of our campus wide building plaster study**

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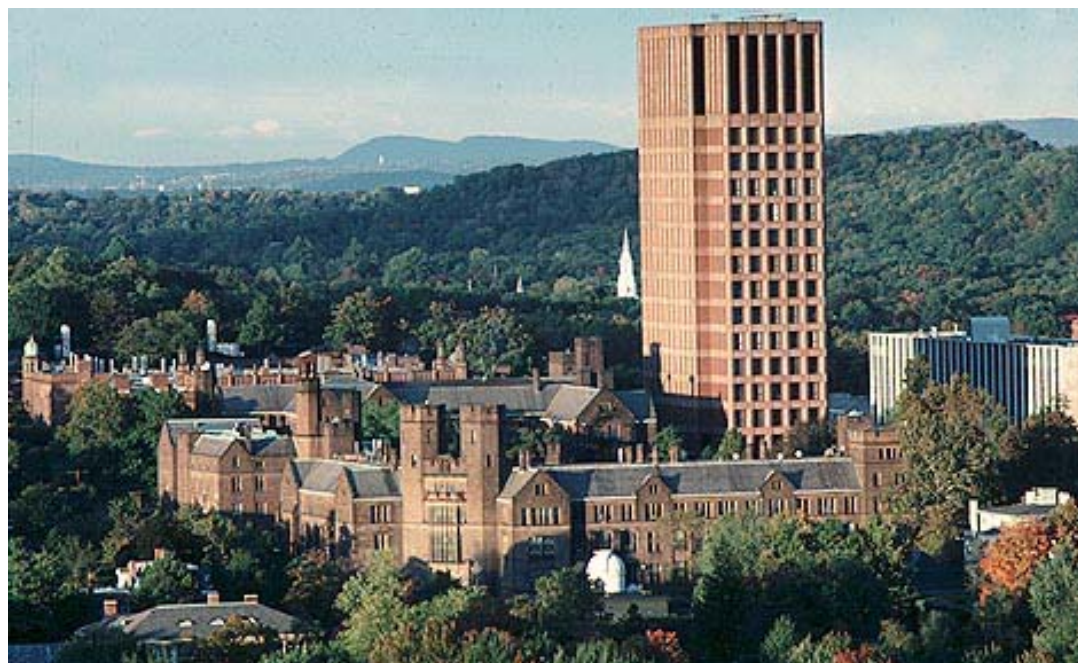


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# Yale University Facilities

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- **Over 200 core academic buildings constructed between 1780 and the present.**
- **Plaster is found in ~85% of these buildings.**

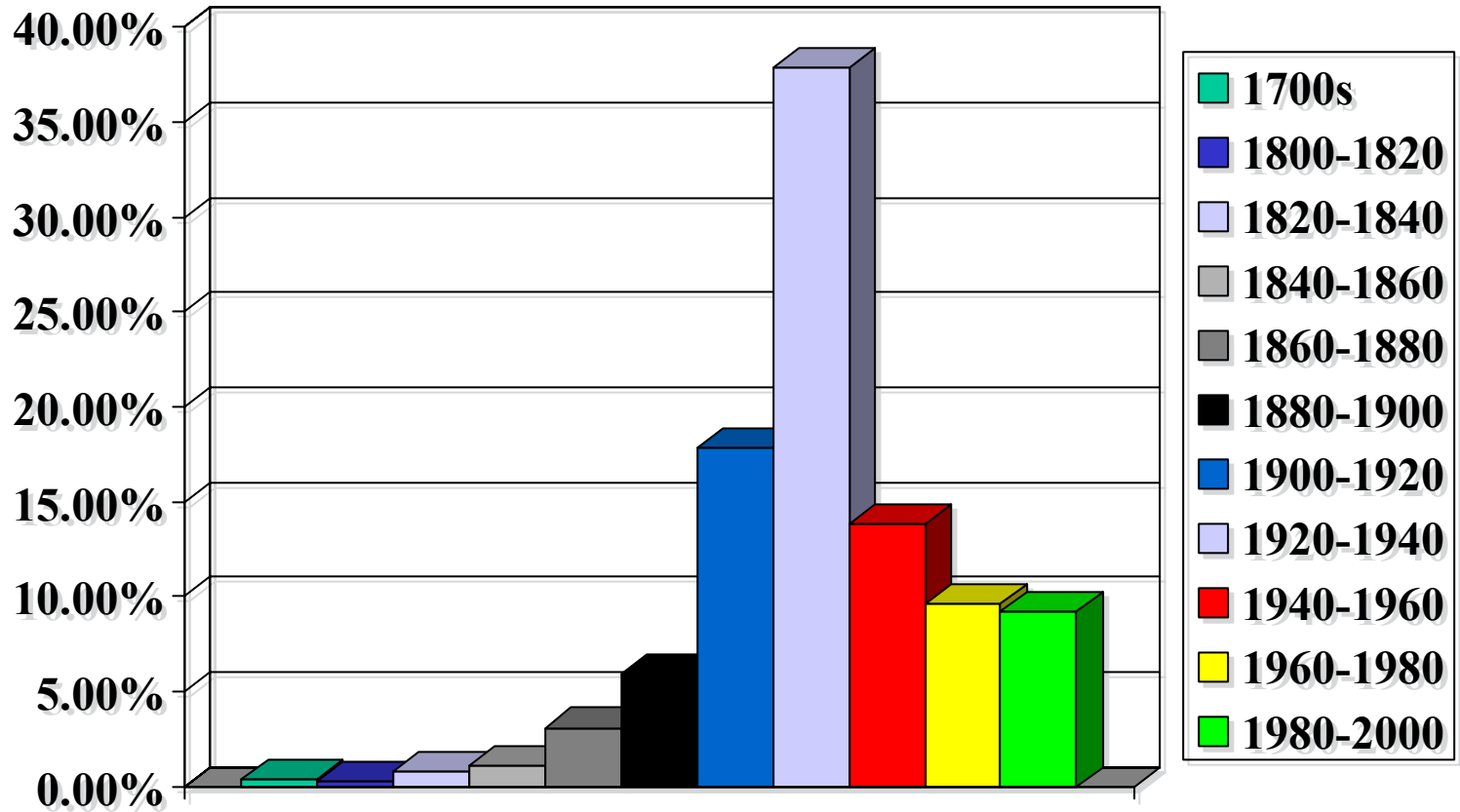


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# Gross Ft<sup>2</sup> Constructed By Decade

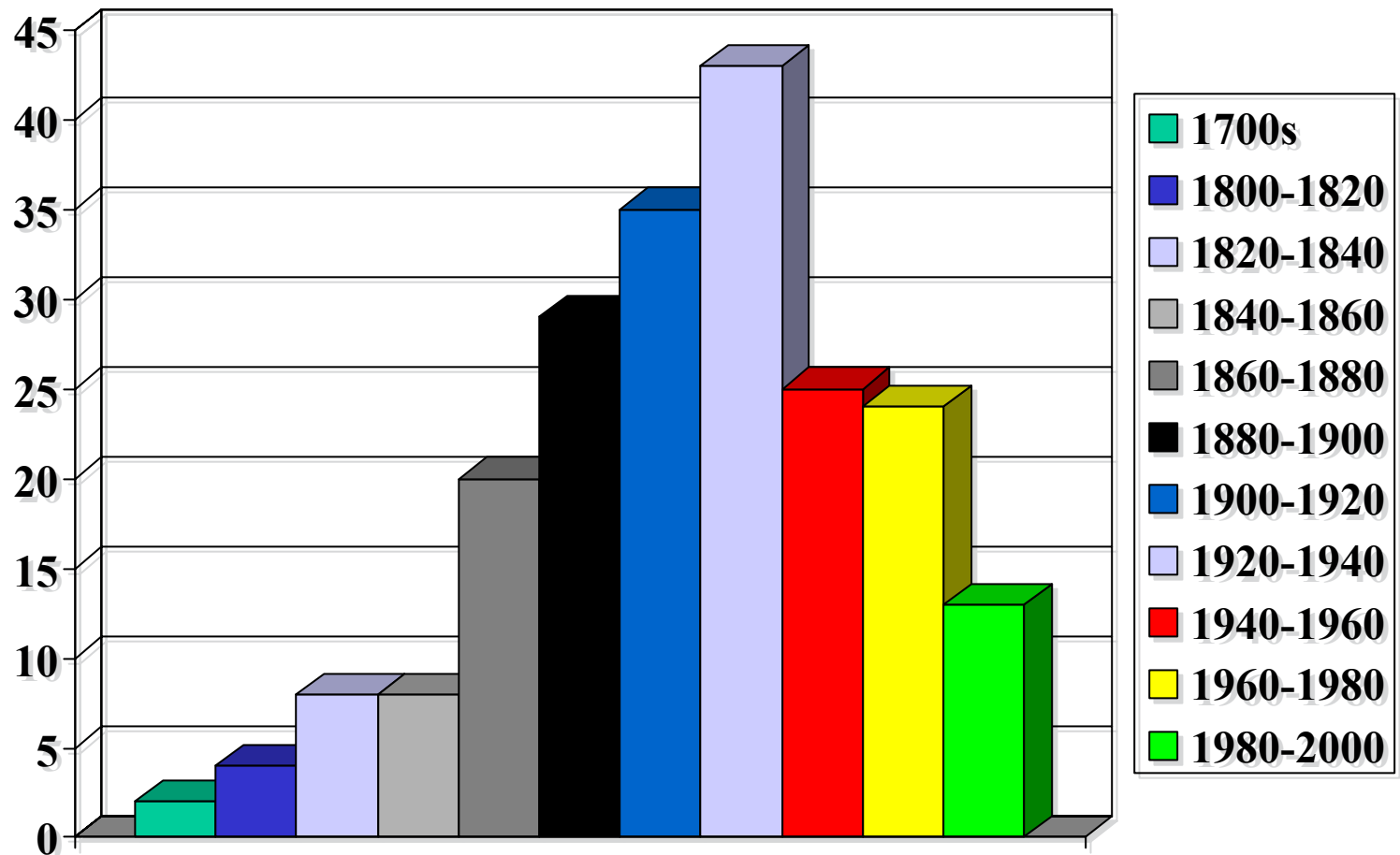


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# Number of Buildings Constructed By Decade



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# Plaster Systems

- **Two or three layer systems**



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# Plaster Systems

- **Two or three layer systems**



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# Plaster Systems

## Components of plaster

- **aggregate**

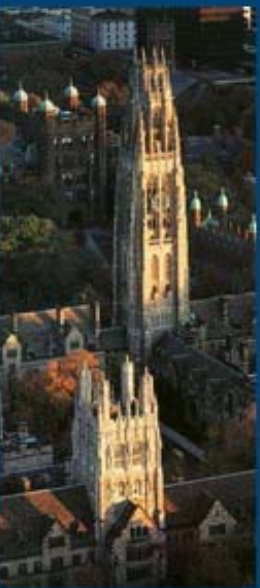
sand; vermiculite perlite;  
pumice; micas;

- **cement**

lime ( $\text{CaO}$ ); gypsum ( $\text{CaSO}_4$ )  
portland cement

- **fiber**

animal hair; asbestos; wood  
fiber; synthetic fibers



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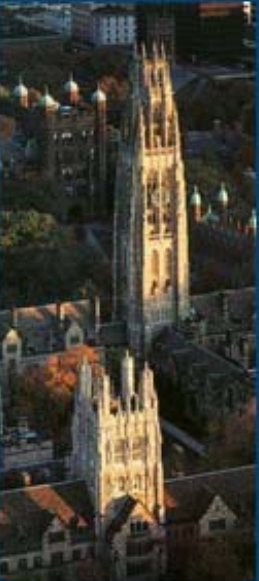


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# Plaster Systems - Fiber Component

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# Historical Plaster Bulk Results

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- **1978 - 1995 plaster bulk asbestos results were typically less than 1% - but detectable**
- **Bathroom plaster in some areas  $> 1\%$**
- **Sample collected with core sampler**
- **Analysis by NAVLAP certified lab using optical microscope and EPA procedure**
- **After  $\sim 1992$  used gravimetric methods**

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# Plaster Bulk Sample Results - 1996

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- **10-20% of the plaster samples collected to support three large renovations were reported to contained between 1-3% asbestos by weight.**
- **Results were not consistent**
  - different labs obtained different results with split samples
  - the same lab obtained different results when sent duplicate samples

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# Potential Causes

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- **EPA's interpretation (12/95) that each layer of a plaster system must be analyzed separately**
- **Flawed methodology for assessing asbestos in plaster**

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# Potential Impact

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- **Significant cost impact on renovations**
  - Plaster removed as asbestos abatement
  - All trades impacting plaster must be trained as OSHA Class III asbestos workers
  - State DPH required tasks impacting plaster to be “enclosed” or release less than 0.01 fibers/cc.
  - 1.5 billion dollar capital spending program to upgrade facilities

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# Management Directive

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- **Identify why we have inconsistent results and accurately determine what the asbestos concentrations of our plasters are.**
  - Approached the EPA (1-97)
  - Retained two consultants:
    - Dr. Eric Chatfield, Chatfield Technical Consultants, LTD
    - Mr. Roger Morse, Roger G. Morse Associates

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# Plaster Bulk Collection & Analysis

- **Developed method for collecting plaster cores that contain all plaster layers on the substrate**



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# Plaster Bulk Collection & Analysis

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- Submitted cores to Chatfield lab and obtained consistent results
- Chatfield lab was using a modified gravimetric procedure<sup>1</sup> (included sedimentation)
- EPA accepted analytical procedure as use of best available technology

<sup>1</sup>**Reference:** Chatfield, E.J., “A Validated method for Gravimetric Determination of Low Concentrations of Asbestos in Bulk Materials,” *Advances in Environmental Measurement Methods for Asbestos*. ASTM STP 1342, M.E, Beard and H,L. Rook, Eds., American Society for Testing and Materials, West Conshohocken, PA, 2000

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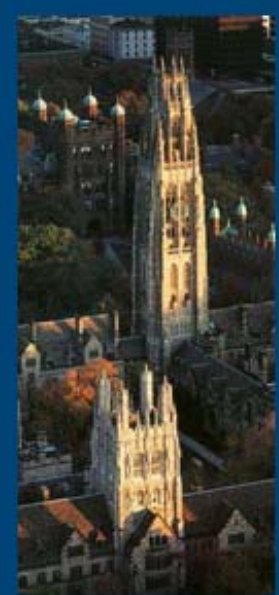
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# Campus Wide Plaster Study

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- **Collected ~ 5,000 plaster cores out of approximately 200 buildings (25-30 per building)**
- **Each core was cleaned so that each layer and layer characteristics were clearly visible.**
- **Gross visual examination conducted of core**
  - function; thickness; color



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# Campus Wide Plaster Study

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- **Cores examined under stereoscopic microscope and each layer was further classified by:**
  - cement type and color
  - aggregate type and color
  - reinforcing fiber
- **Each layer was a separate sample.**
- **Subset of each plaster type analyzed by the Chatfield Lab**



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# Campus Wide Plaster Study

## Findings

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- **Plaster on walls and ceilings contained less than 1% asbestos by weight and ranged from <0.01% to 0.8% with two exceptions:**
  - acoustical plaster
  - patching materials (dry wall taping compound)

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# Campus Wide Plaster Study Findings

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- **Base Coat Plasters - no asbestos found**
- **Brown Coat Plaster - 0.3-0.6 %<sup>1</sup>**
- **Finish Coat Plaster - 0.1-0.3 %<sup>1</sup>**

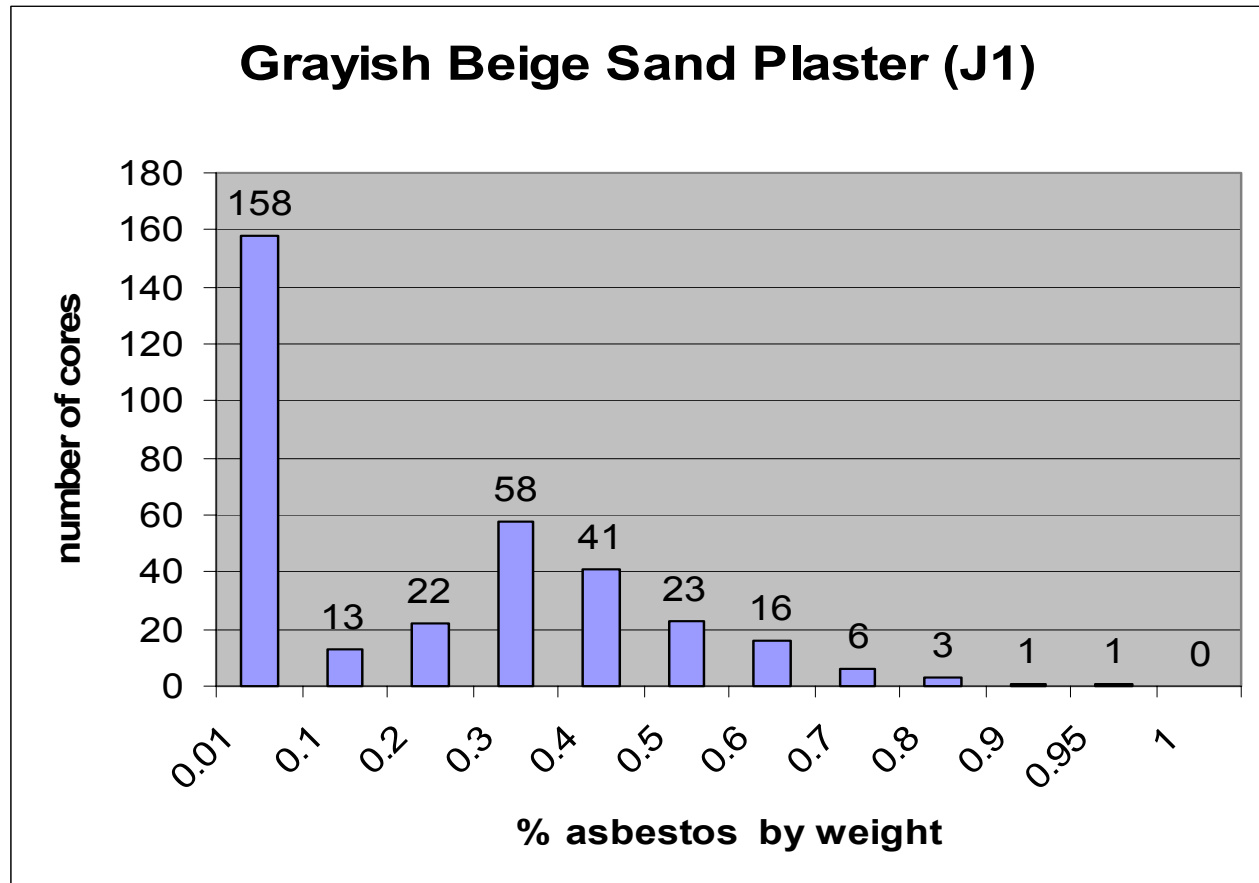
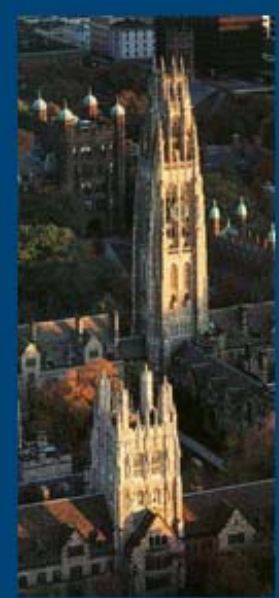
<sup>1</sup> In plasters that contain some asbestos

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# Campus Wide Plaster Study Findings



Mean asbestos content 0.18% (SD 0.203)  
(342 samples)

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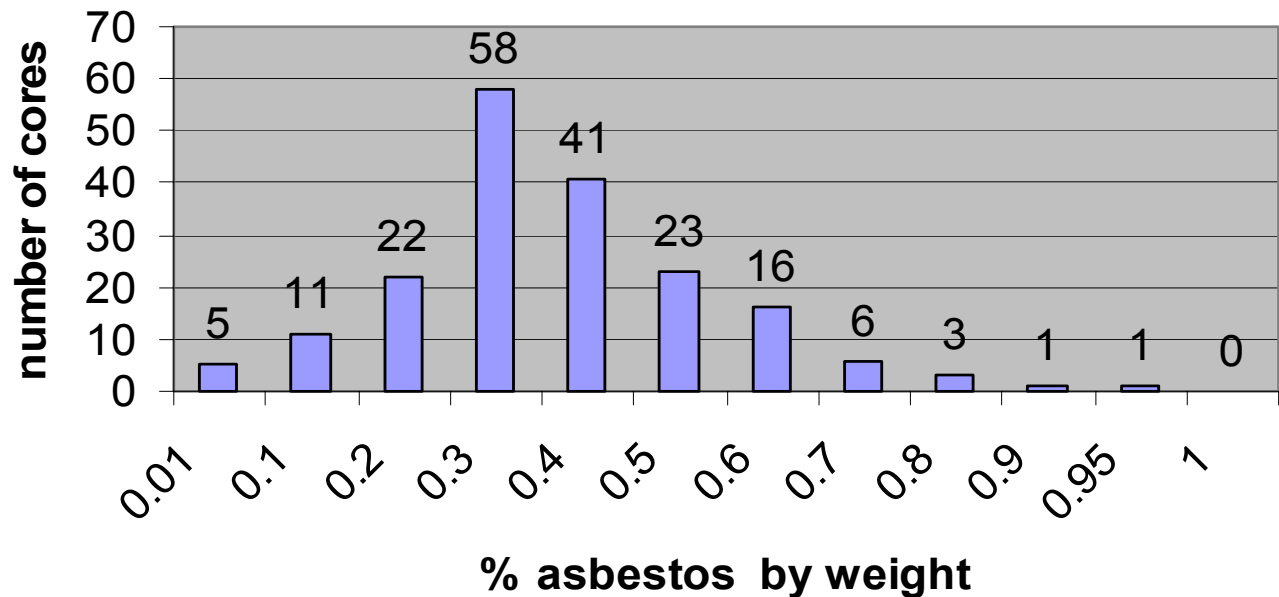


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# Campus Wide Plaster Study

## Findings

### Grayish Beige Sand Plaster (J1) (removing ND values)



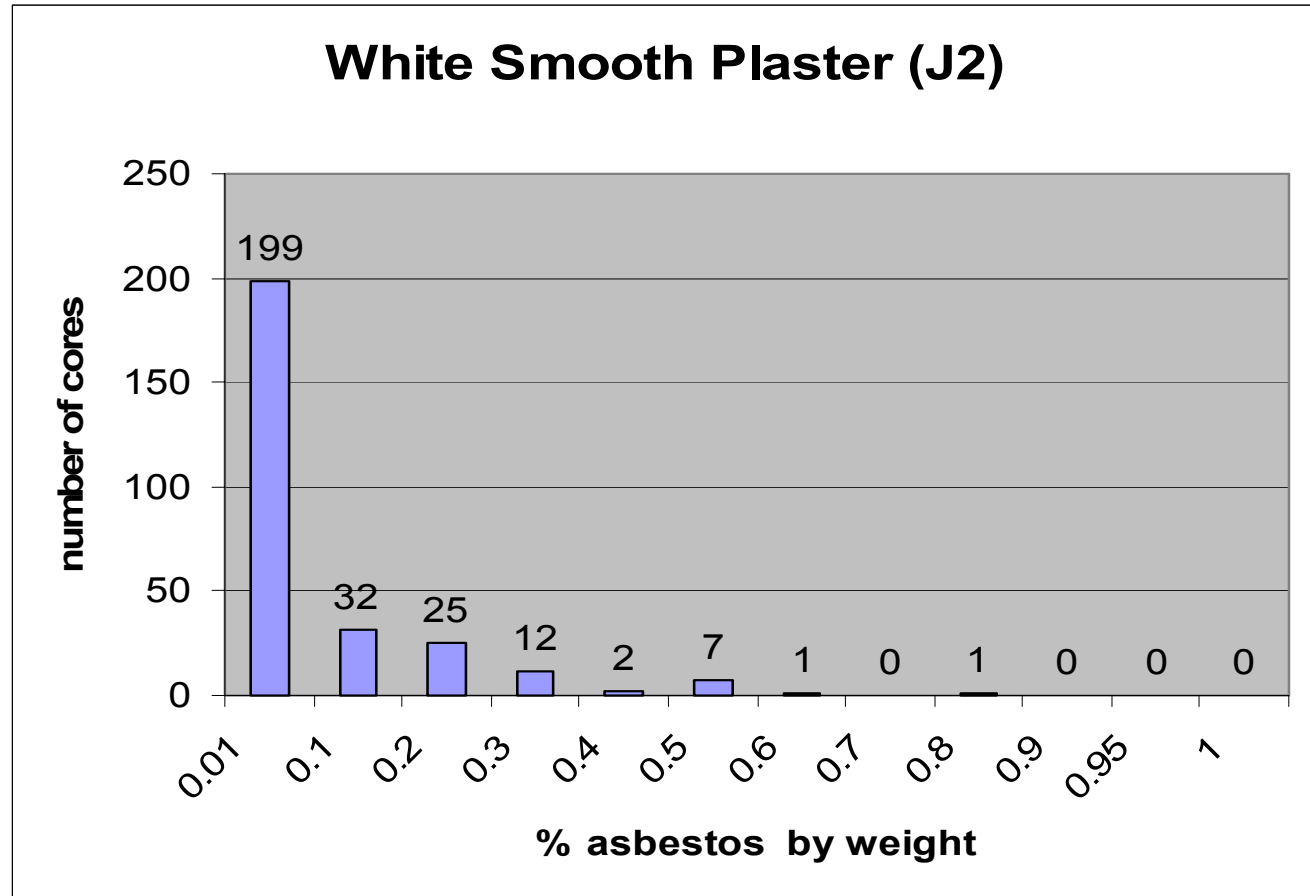
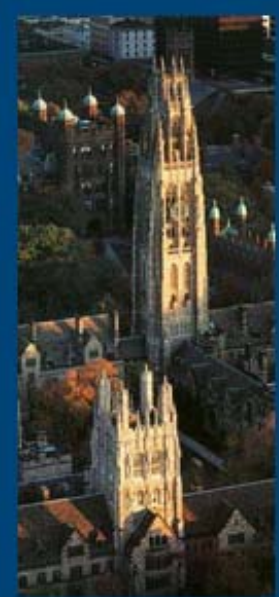
Mean asbestos content 0.32% (SD 0.168)  
(184 samples)

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# Campus Wide Plaster Study Findings



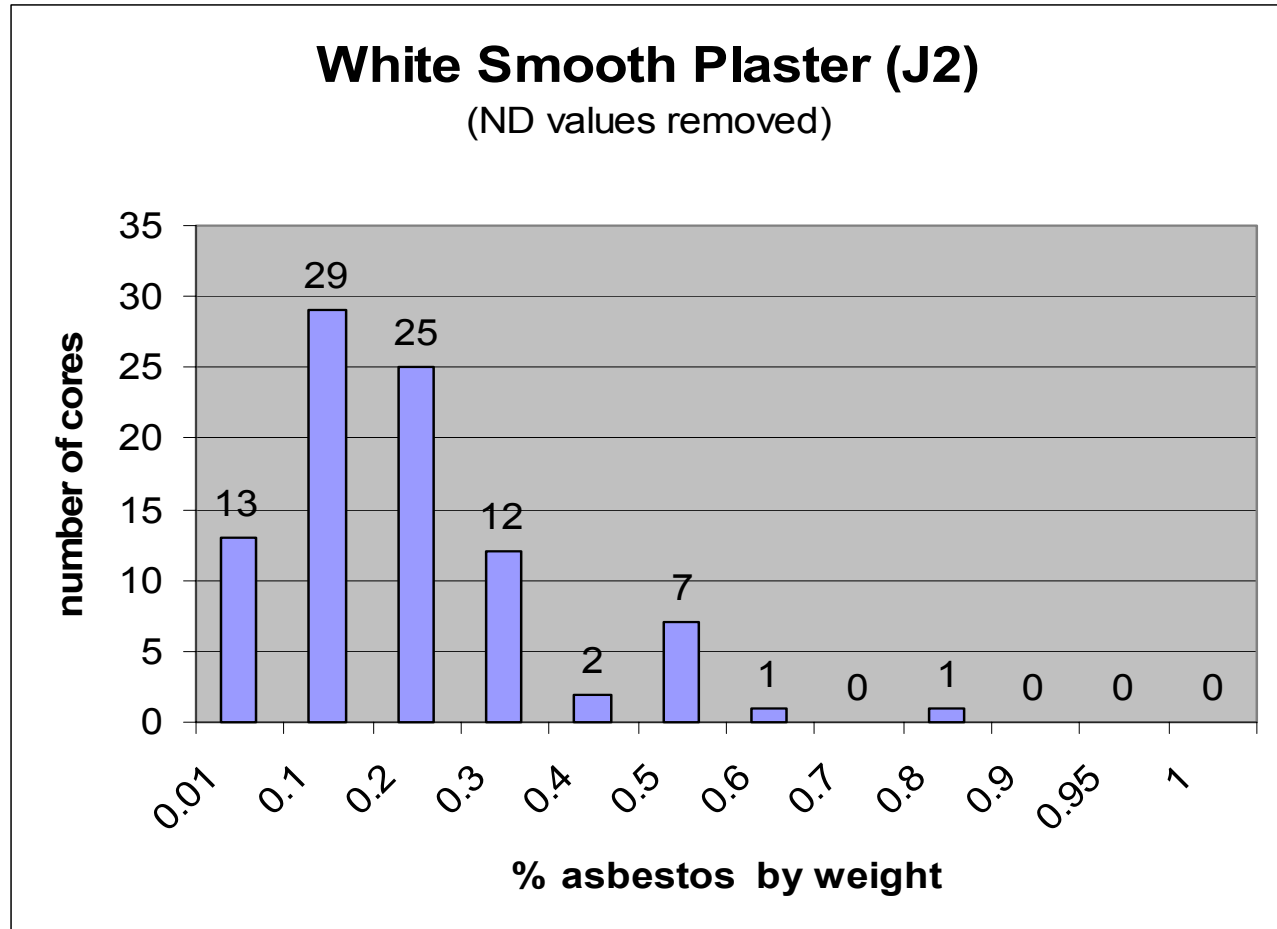
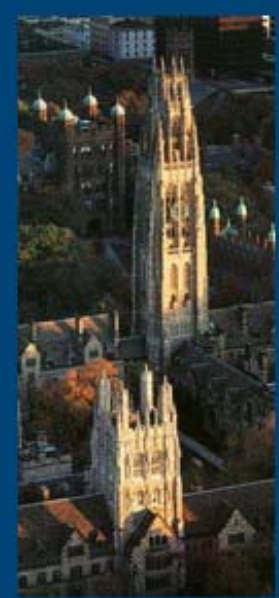
Mean asbestos content 0.05% (SD 0.11)  
(279 samples)

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# Campus Wide Plaster Study Findings



Mean asbestos content 0.15% (SD 0.15)  
(80 samples)

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# Campus Wide Plaster Study

## Findings

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- **The presence of asbestos was not related to any characteristic of the aggregate, cement, or the presence of other fibers.**
- **The probability of finding asbestos in plaster was related to the time the building was constructed.**

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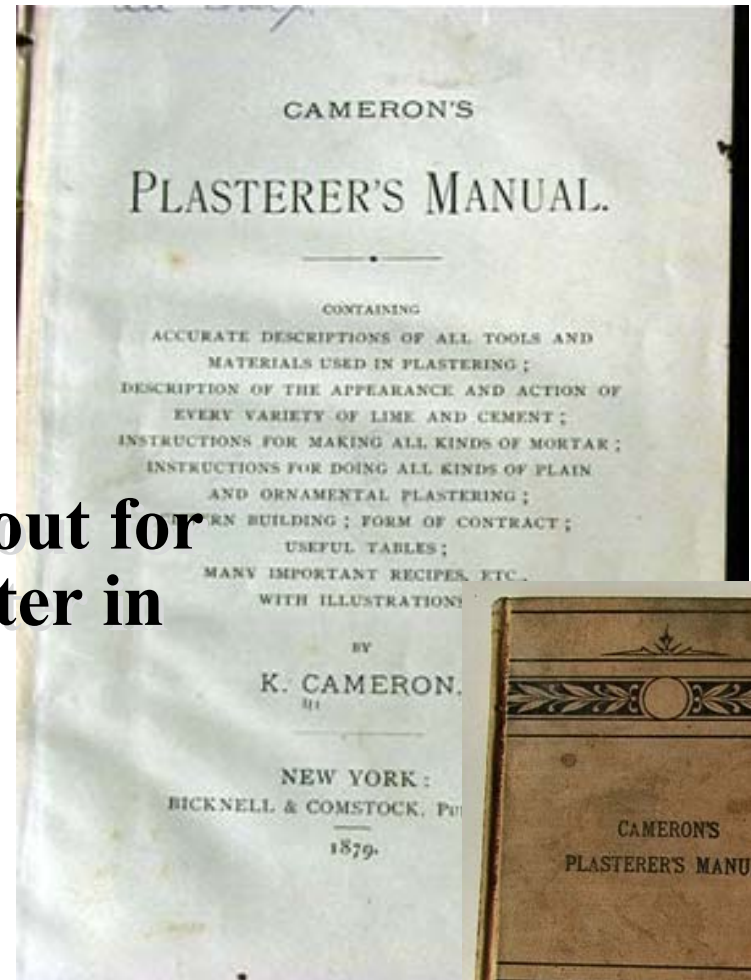
# Literature Review

**1879**

- **Fiber - cattle hair**  
8 lbs/ton plaster (0.4%)

- **Technique worked out for mixing fiber in plaster in exact proportions**

- **The cost**



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# Literature Review

1928 (Eckel, E.C. "Cements, Limes and Plasters," John Wiley & Sons, NY, 1928)

- **finely picked animal hair or other fiber**

1.5-3 lbs/ton (0.15%)

- **processed wood fiber (cottonwood)**

7.5-15 lbs/ton (0.38-0.75%)

1960 (Diehl, J.R. "Manual of Lathing and Plastering," MAC Publishers Association, 1960)

- **ASTM C28 specifies 0.75% wood fiber in plaster**

CEMENTS, LIMES  
AND PLASTERS

THEIR MATERIALS, MANUFACTURE  
AND PROPERTIES

BY  
EDWIN C. ECKEL, C.E.

*Affiliate, Amer. Soc. Civil Engineers; Fellow, Geological Society of America;  
Formerly Major, Engineers, U. S. A.*

THIRD EDITION

WITH CHAPTERS ON  
ALUMINA CEMENTS AND HIGH-STRENGTH PORTLANDS

NEW YORK  
JOHN WILEY & SONS, INC.  
LONDON: CHAPMAN & HALL, LIMITED  
1928

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# Take Home Lessons

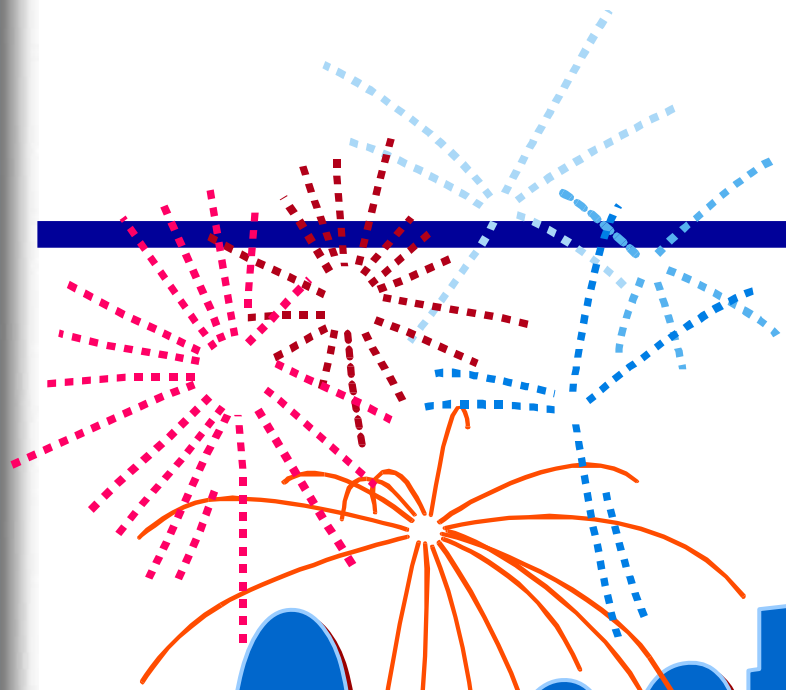
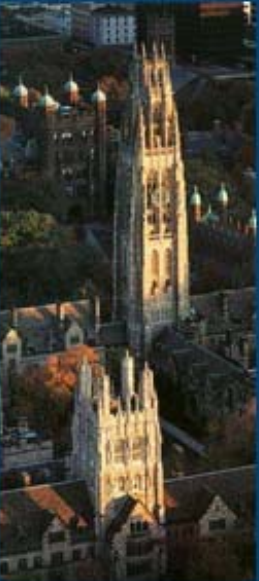
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- **If you find plasters containing 1-3% by weight (conventional analytical technique) it is highly likely <1%.**
- **Asbestos commonly mixed into plaster starting approximately 1880 (~ 0.5 %) and the practice was discontinued sometime after WWII.**
- **Asbestos is found in greater than 1% in acoustical plaster and patching compounds.**

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# Questions?



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