



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

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Presentation Overview

- **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**

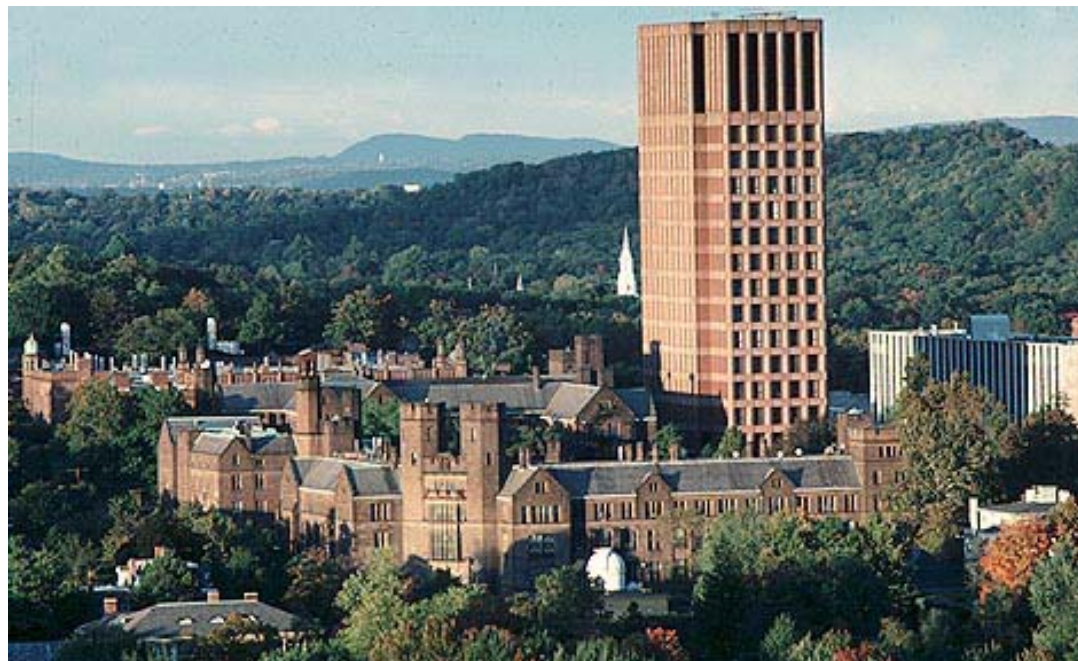
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Yale University Facilities

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

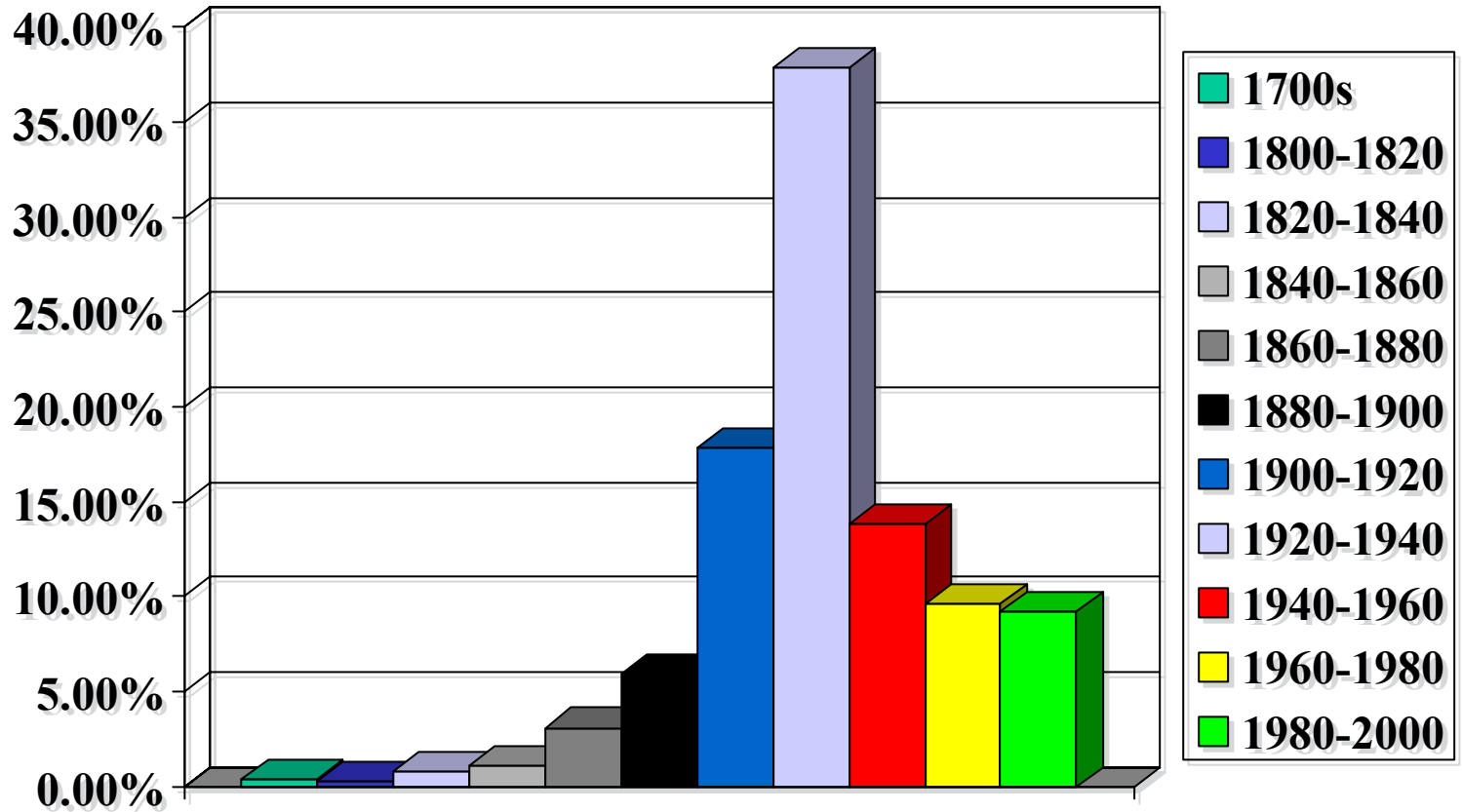


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Gross Ft² Constructed By Decade

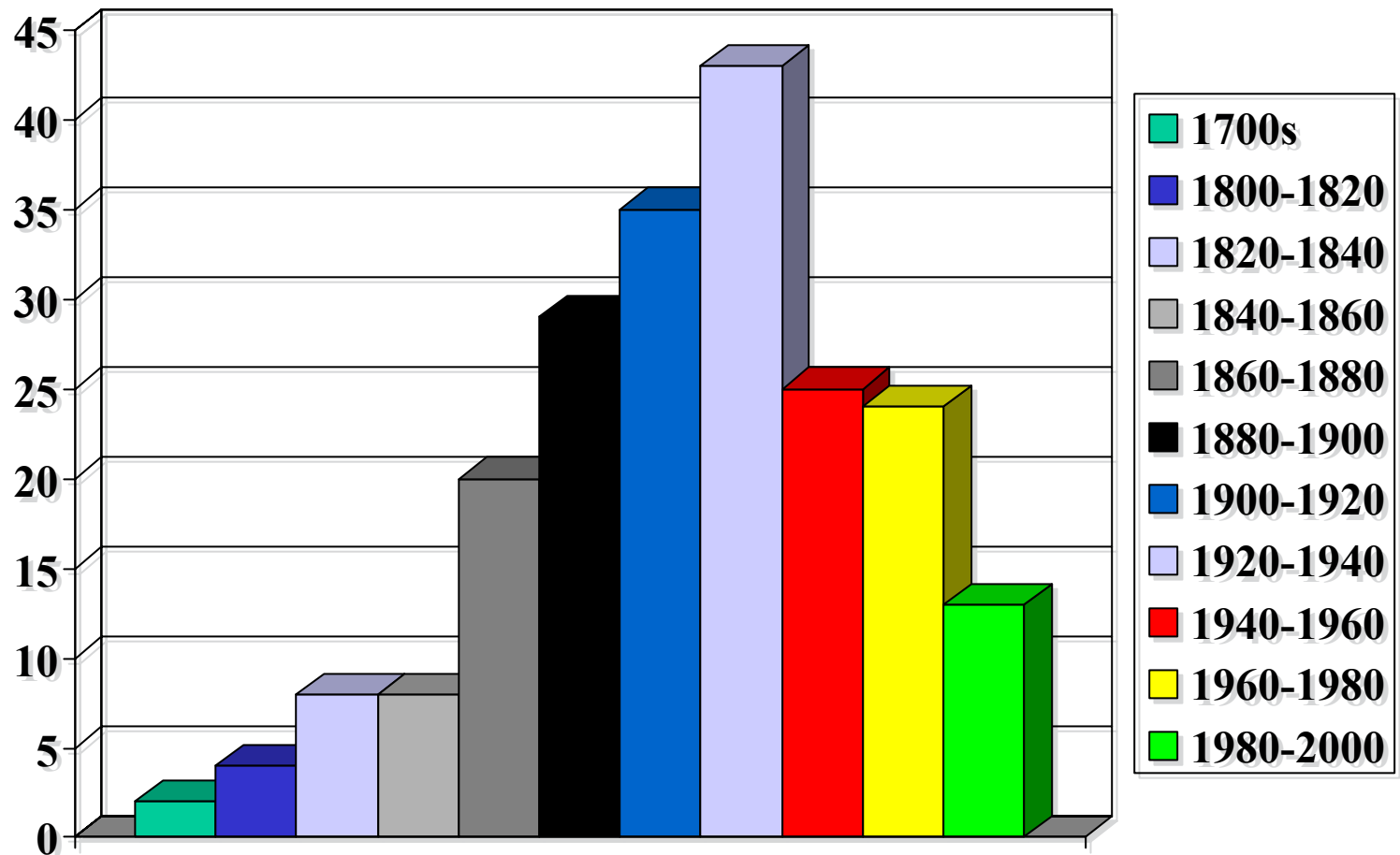


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Number of Buildings Constructed By Decade



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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**

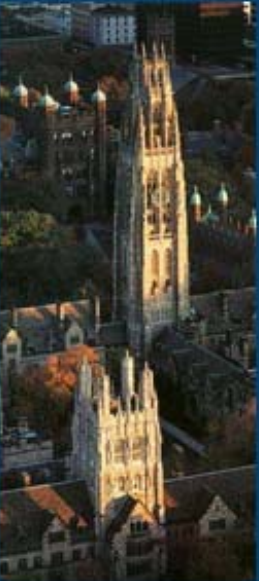
sand; vermiculite perlite;
pumice; micas;

- **cement**

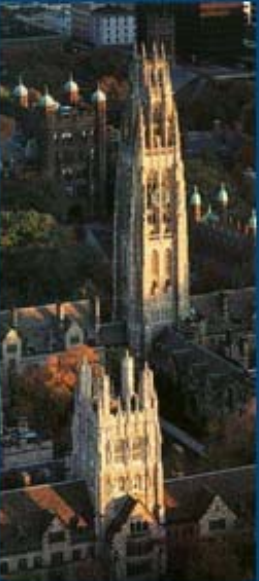
lime (CaO); gypsum (CaSO_4)
portland cement

- **fiber**

animal hair; asbestos; wood
fiber; synthetic fibers



Plaster Systems - Fiber Component



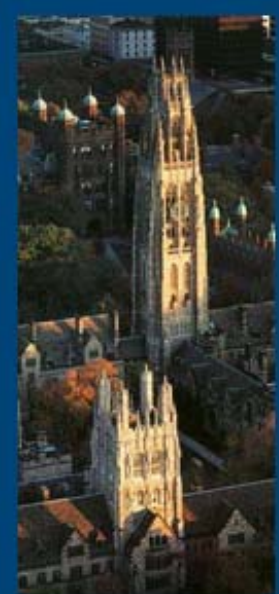
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Historical Plaster Bulk Results

- **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 ~ 1992 used gravimetric methods**



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Plaster Bulk Sample Results - 1996

- **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

- **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

- **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

- **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

- Submitted cores to Chatfield lab and obtained consistent results
- Chatfield lab was using a modified gravimetric procedure¹ (included sedimentation)
- EPA accepted analytical procedure as use of best available technology

¹**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

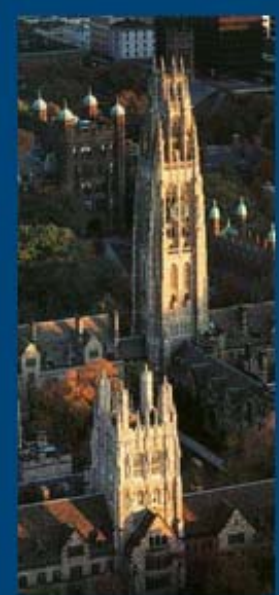
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Campus Wide Plaster Study

- **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

- **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

- **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

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

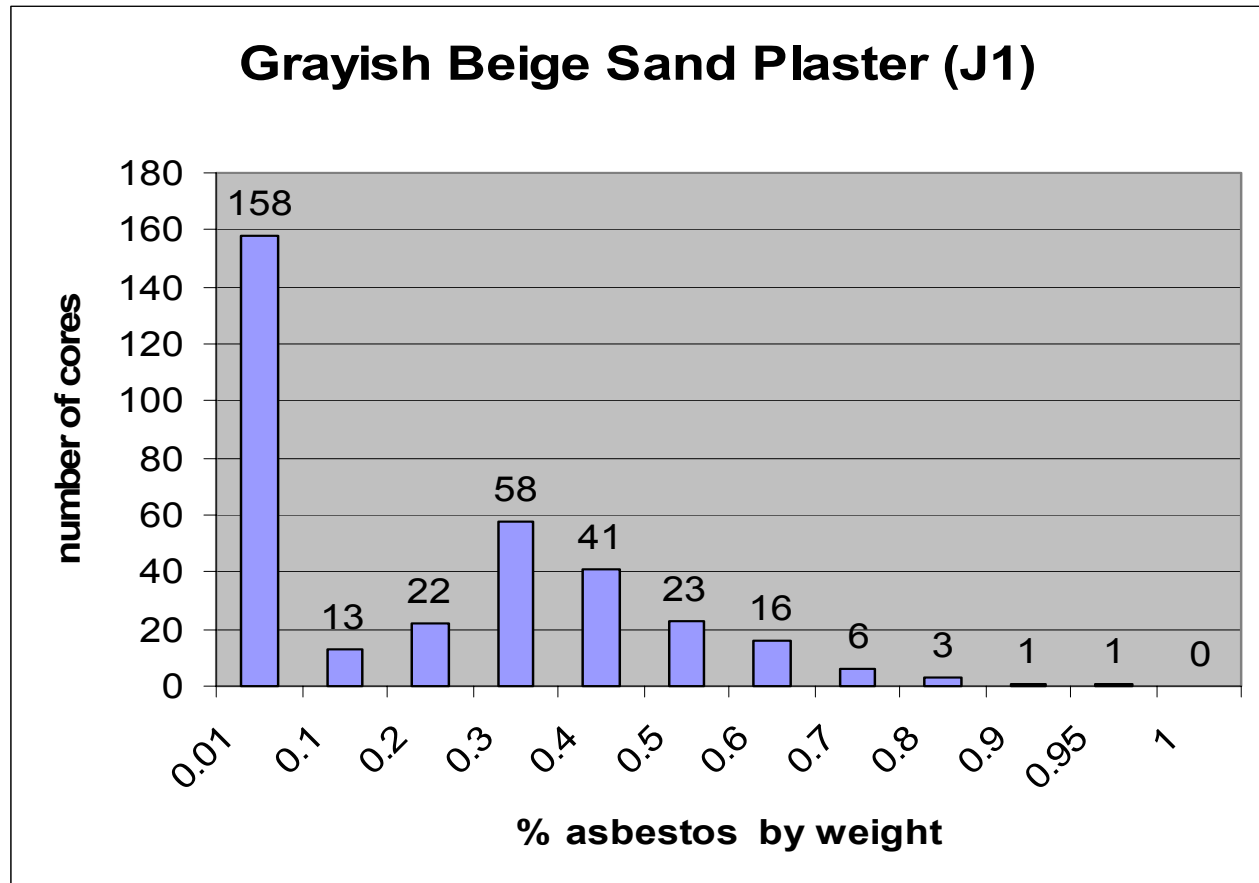
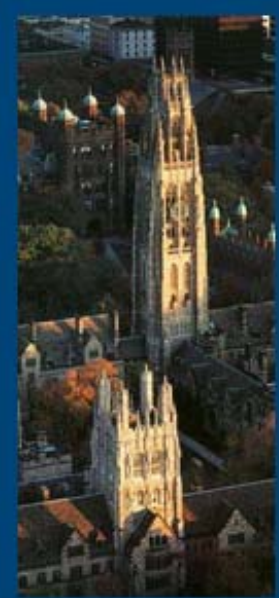
¹ In plasters that contain some asbestos

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Campus Wide Plaster Study Findings



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

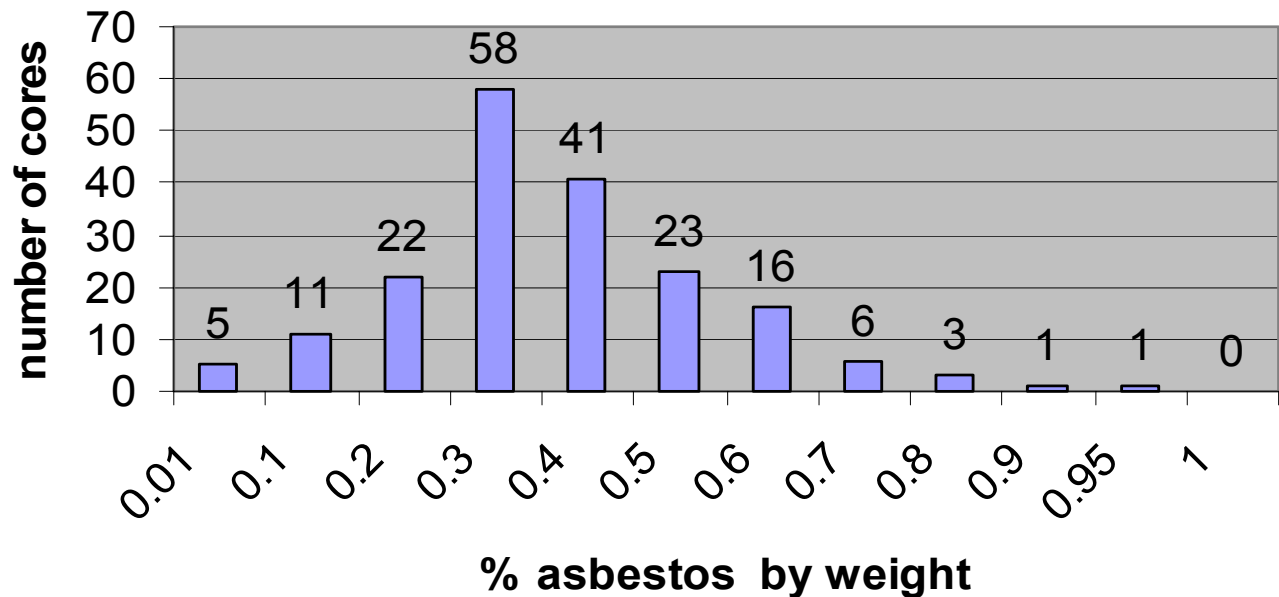
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Campus Wide Plaster Study Findings

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



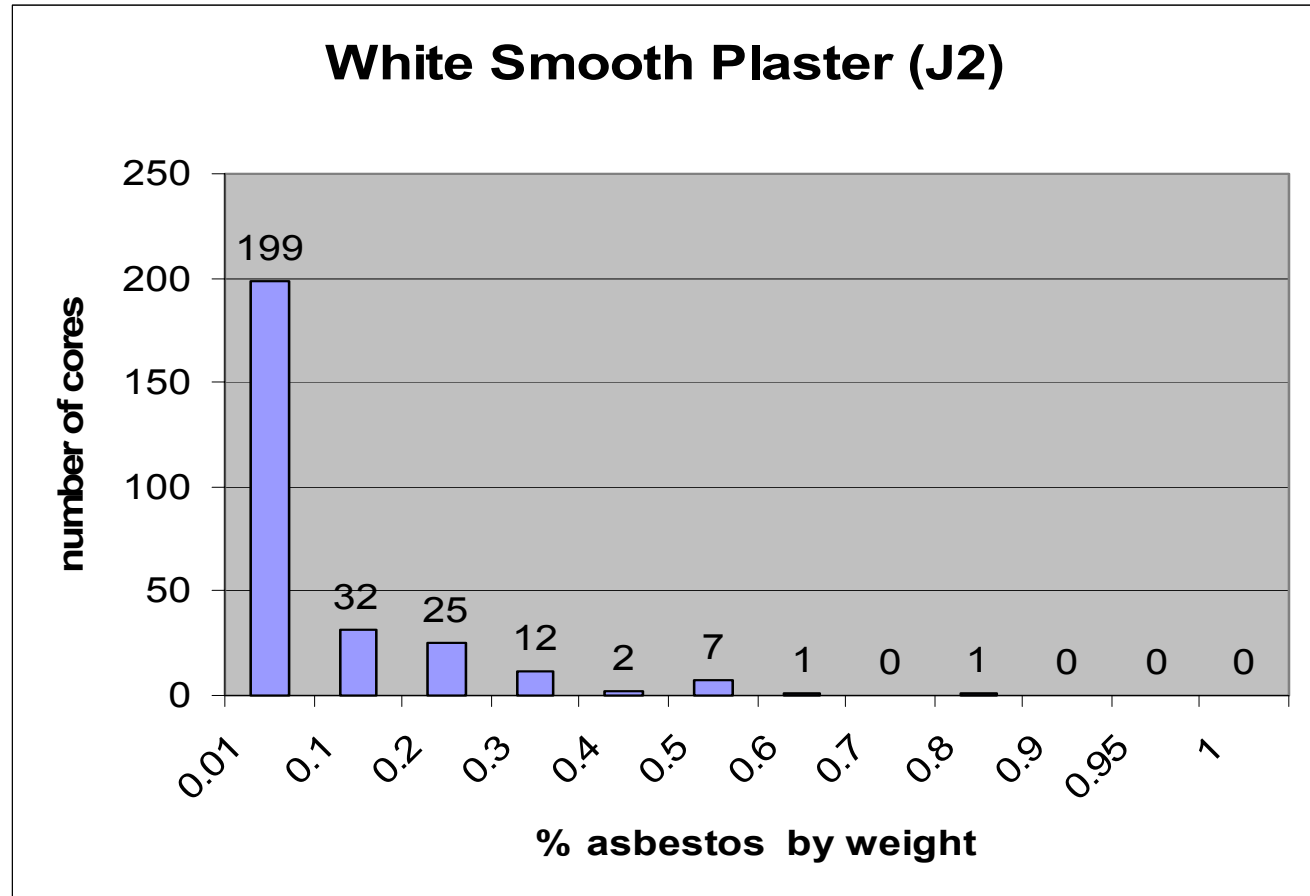
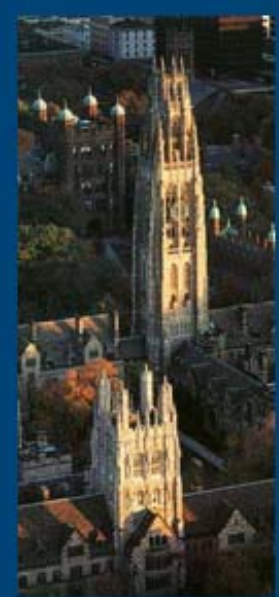
Mean asbestos content 0.32% (SD 0.168)
(184 samples)

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Campus Wide Plaster Study Findings



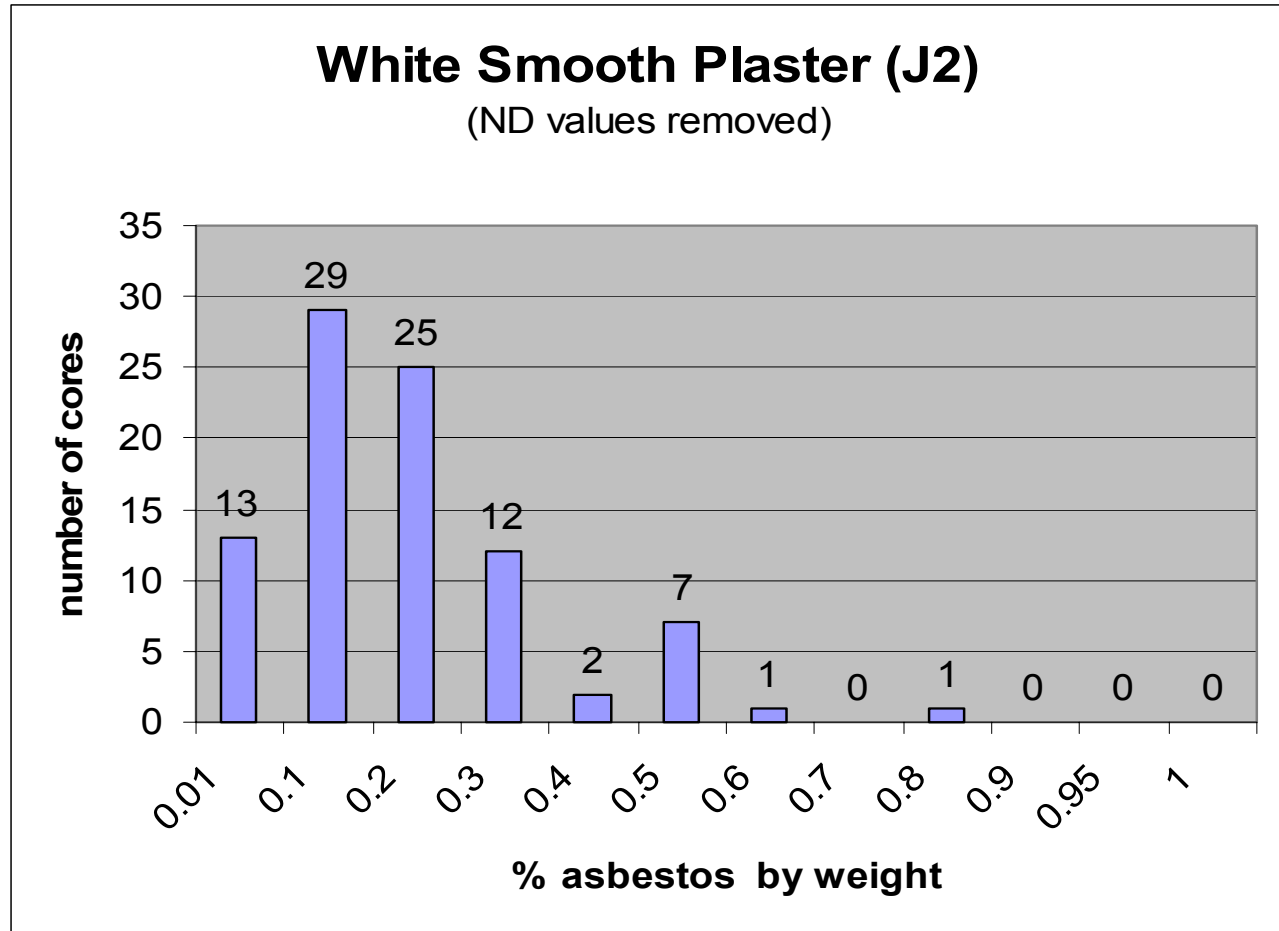
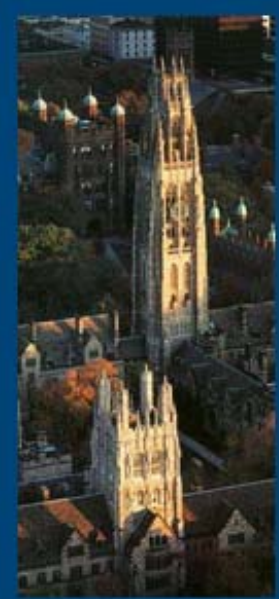
Mean asbestos content 0.05% (SD 0.11)
(279 samples)

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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

- **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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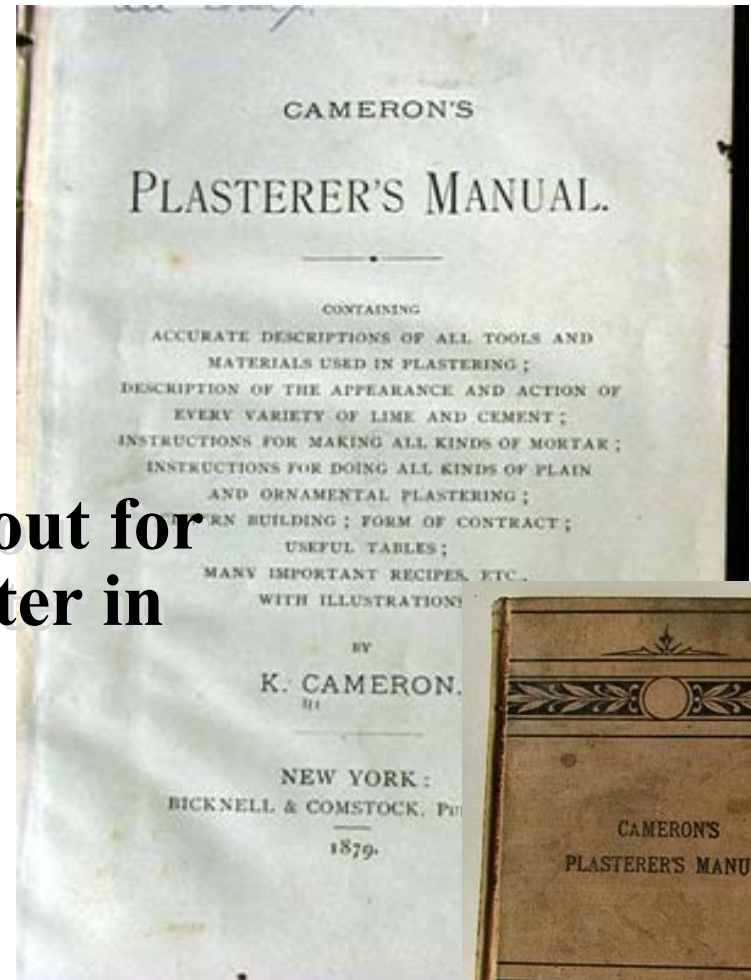
Literature Review

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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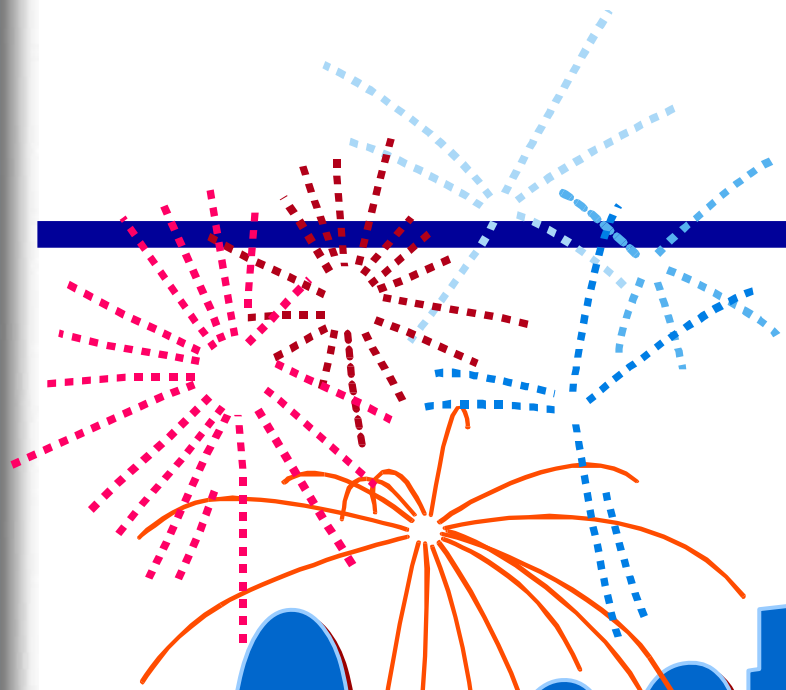
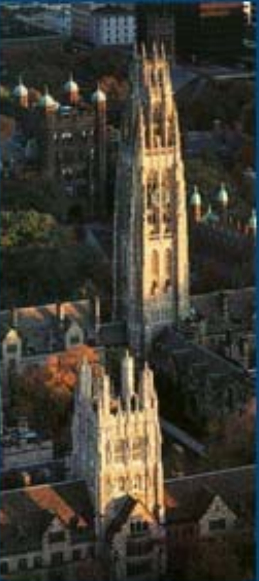
Take Home Lessons

- **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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