Historical nail-making techniques revealed in metal structure

Krysta Ryzewski and Robert Gordon

ABSTRACT: Characteristics diagnostic of manufacturing technique are retained in the microstructure of iron nails even though the original surfaces are lost in corrosion. Distinctive metal structures differentiate hand-forged and machine-made nails. The one-operation machines that automatically cut and headed nails left unique shear bands in the nail-head metal. Presence of these shear bands indicates that nails cut and headed by machine were in use in Rhode Island before 1781. Before about 1815 nail machines in New England operated on pre-heated iron plate, as shown by the recrystallization of the shear band. Nails made thereafter until about 1850 were formed from cold iron and have un-recrystallized shear bands. Cut nails made after about 1850 are in the longitudinal rather then transverse orientation, and have a folded head structure resulting from improved design of the nail machine header grips.

Introduction

From ancient times to the middle of the 18th century the technique used by smiths to make nails remained nearly unchanged. In the hundred years beginning at least as early as 1760 a succession of more sophisticated machine techniques for making nails replaced smiths’ hand work in North America. Thereafter manufacture of machine-made nails again changed little to the present day. Architectural historians and historical archaeologists recognize the successive changes in technique visible in the nails themselves as a useful tool for dating late-18th and 19th-century buildings (Adams 2002; Nelson 1968; Wells 1998). Additionally, studies of nails offer historians of technology new information about the development of manufacturing with self-acting machinery in the early American republic, thereby adding nail making to previous research that has focused on clocks, firearms, and sewing machines (Hoke 1990; Hounshell 1984). We report here the results of a study of the metal structures found in nails made by hand and several variants of historic nail machines, in order to identify the nail-making processes used, from the surviving metal structure.

With few exceptions, investigators have relied on the external, visible, and stylistic features of nails to identify the methods used in making them. Nails retrieved from intact buildings may be sufficiently free of corrosion for these features to be preserved, but corrosion usually obscures the diagnostic surface characteristics of nails excavated at historic building sites and other in-ground archaeological contexts. However, the internal metal structure survives in corroded nails, and is a reliable record of the manufacturing technique used. In a pioneering metallographic study, Angus and others (1962) deduced the manufacturing technique used by Roman smiths in making the nails recovered from the huge hoard at Inchtuthill, Scotland. Subsequent studies of metal structure in nails from archaeological contexts were undertaken by Frurip and others (1983), who were concerned with tracing the provenance of nails from Fort Michilimackinac, based on the chemical compositions of slag inclusions, and by Geselowitz, Westcott and Wang (1991).

Methods

Nail specimens were prepared by standard laboratory techniques of sectioning, polishing, and etching for