Evaluating Flat Glass Thickness at the Isaac Miles Farm (13CD139), Herbert Hoover National Historic Site West Branch, IA

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Evaluating Flat Glass Thickness at the Isaac Miles Farm (13CD139), Herbert Hoover National Historic Site West Branch, IA

Laura Bender

Abstract: Flat glass thicknesses can be used to date historic sites (Ball 1982; Chance & Chance 1976; Moir 1982; Richner 1996, 1997; Roenke 1978; Schoen 1990; Walker 1971; Weiland 2007). Schoen (1990) identified a trend in thickness of window glass on the Great Plains. He noted that window thicknesses increased over time throughout the nineteenth century and developed a formula for dating panes. This paper will examine flat glass from the Isaac Miles Farm (13CD139) at Herbert Hoover National Historic Site. It is hoped that by employing statistical analysis, knowledge about the large deposit of flat glass excavated from Test Unit 08-03 will be obtained.

Introduction

The Isaac Miles farmhouse was constructed between 1875 and 1879. Since its construction, the Miles house has undergone several alterations (Bearss and Husted 1970). A new porch and chimney was added between 1946 and 1947. The National Park Service conducted a stabilization project between 1970 and 1978; further work to rehabilitate the structure was done from 1984 to 1989. It is assumed that flat glass collected from the site represents one or more of these events. By examining glass thicknesses, it is hoped that a date or dates can be applied to the glass collection.

By the 1960s, archaeologists had begun to measure flat glass thicknesses. Though the first chronology did not appear until 1971 (Walker 1971), these excavators had begun to recognize that the thicknesses of flat glass may be of some significance. In his 1971 report on the Arkansas Post Branch Bank, Walker suggested that thin
flat glass fragments were from older sites and thicker glass fragments were from newer structures.

Following Walker’s work, Chance and Chance (1976) added to the archaeological knowledge of flat glass. In their 1974 report on the Kanaka Village, they noted not only that flat glass thicknesses increased over time, but also that there was some overlap in thicknesses depending on the source of the glass. For example, two flat glass fragments could share the same date, yet have dissimilar thicknesses. This may indicate that one fragment was of commercial origin and the other came from a military source (Welland 2007). Observations such as this were important because it cautioned archaeologists not to assume that flat glass thicknesses were uniformly continuous over time.

Despite the valuable information provided by the work of Walker, Chance and Chance, Roenke’s 1978 publication in the Northwest Anthropological Research Notes may be the most important work in constructing flat glass chronologies (Roenke 1978). Measurements from twenty-thousand flat glass fragments from fifteen sites and research on developments in manufacturing techniques lead him to two conclusions. First, changing cylinder glass manufacturing techniques were the source of variation of glass thicknesses over time. This allowed for more secure dating of specific thicknesses. Second, he realized that any flat glass chronologies that were constructed needed to be regional in nature (Roenke 1978).

It is upon this base that Schoen (1990) constructed his method for dating nineteenth century plains historic sites using flat glass. Schoen’s (1990) chronology will be used when discussing the results of the data analysis. His regression line, $Y = 1725.7 + 1713X$, will be used to establish specific dates for the glass recovered at the Miles Farm. This data will be combined with historical research to form conclusions about the nature of the glass deposit.

**Background**

During mid-August 2008, the Midwest Archaeological Center conducted a survey of three properties at Herbert Hoover National Historic Site. The three properties in question, the Wright House, the Miles Farm and the Leech House, are scheduled for remodeling and ADA accommodation. The goal of the project was to assess the condition of archaeological deposits before construction began. This paper will focus on Test Unit 08-03 at the Miles Farm. This test unit contained over 400 flat glass fragments, most from the first level of excavation and presumably from one or more windows.
Figure 1. Test Unit 08-03. Three hundred and three glass fragments were recovered from level 1 of this test unit, 200 of which were used in this study.

The data for this paper was gathered from glass found at Level 1 (0-10cm below surface) within Test Unit 08-03 at the Isaac Miles Farm. Test Unit 08-03 is located on the north side of the house, very close to the house foundation (Figure 1). A total of 303 flat glass fragments were collected from this level. The glass was then brought to the Midwest Archeological Center for curation.

Methods

In order to assess the characteristics of glass found at Miles Farm, thickness measurements were taken. Fragments with a maximum length of at least one inch were chosen for this study. Maximum length was determined by placing the fragment on top of a one inch line traced on a piece of paper. A total of 200 glass fragments
fit this assessment. Like Schoen (1990), three thickness measurements were taken from each of these pieces. The first measurement was taken at approximately the center of the fragment. The second two were taken parallel to the first, but as far as possible from the center for each fragment. A mean was taken of each of the three measurements to determine the average thickness of individual fragments. Thickness measurements were taken by digital calipers and measured to the one thousandths of a millimeter.

![Histogram of Level 1 Thicknesses (mm)]

**Figure 2.** This histogram represents the distribution of flat glass thickness for all of Test Unit 08-03, level 1.

The calipers took measurements to the hundredth decimal place, allowing for precise data collection. No specific definition for the placement of measurements was determined. This could negatively affect the accuracy of the data. It is hoped that by taking three measurements per fragment, any negative effects will be mitigated.

This data set therefore contains 600 measurements. A histogram of the data shows that the measurements are not evenly distributed around the mean, which is 2.92mm (Figure 2). The shape of the histogram is skewed to the left and there appear to be three modes. When examining the modes, it becomes apparent that each represents a cluster of data around a central value. In order to better understand the nature of the data, each cluster is pulled from the larger data set.
Figure 3. This histogram of Cluster 1 depicts its distribution around the first mode identified. This data is very close to a normal distribution and a variance of 0.0007 (Standard Deviation squared).

Figure 4. This histogram of Cluster 2 depicts its distribution around the second mode identified. Like Cluster 1, the data is very close to a normal distribution and a variance of 0.0003.
Cluster 1 (Figure 3) contains a total of 71 measurements and represents the first mode identified. The mean of this group is 3.16mm with a standard deviation of 0.026. Cluster 2 (Figure 4) is the largest of the three data sets and contains a total 93 measurements. This data set has a mean of 2.99mm. The standard deviation is quite low at 0.016. The last set of data is Cluster 3 (Figure 5). This group has a total of 36 measurements with a mean of 2.24mm. It has the highest standard deviation at 0.151.

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Analysis

Based on the above data examination, it is suspected that each cluster represents glass three separate dates. Therefore, the null hypothesis states that each cluster does not differ significantly from the others (C1 = C2 = C3). A one-way Analysis of Variance (ANOVA) was run using SPSS software to determine if the clusters varied significantly from one another. This test was chosen because one variable is being tested in three groups of data. In general, the data are
normally distributed with small variances (Figures 3, 4, and 6). Cluster 3 does not follow this pattern, however (Figure 5 and 6). This cluster’s distribution is skewed and the variance is quite large comparatively. It is hoped that the relatively large amount of data ($N = 36$) in this cluster will serve to overcome any negative effects caused by these qualities.

Figure 6. This error bar graph best depicts the differences among variance within the three clusters. As you can see, Cluster 3 has a much greater variance than the first two clusters.

The F-value obtained from the ANOVA test was 2448.5 with degrees of freedom being 2 and 197. A confidence level of .05 was used. The probability associated with attaining this value is 0.00 indicating it is extremely unlikely that the data gathered is due to the vagaries of sampling (Table 1). In other words, the statistical testing suggests that each cluster is significantly different from the others. It is possible that each cluster represents glass manufactured in different years.

To evaluate this result, the regression equation ($Y = 1725.7 + 1713X$) created by Schoen (1990) was implemented. In this equation, $Y$ represents the year of manufacture with an estimated standard error of approximately 6 years (Schoen 1990). $X$ represents the mean thickness (in inches) gathered from the data set. Because Schoen (1990) measured the glass fragments for his study in inches, the data
from this examination must be converted from millimeters to inches (Table 2). After undergoing this conversion, Cluster 1 had a mean of 0.124in. Cluster 2 had a mean of 0.118in and Cluster 3 had a mean of 0.088in.

**ANOVA**

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>21.582</td>
<td>2</td>
<td>10.791</td>
<td>2448.500</td>
</tr>
<tr>
<td>Within Groups</td>
<td>.668</td>
<td>197</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22.450</td>
<td>199</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. This table presents the results the ANOVA Test.**

After running Schoen’s (1990) regression equation, Cluster 1 yielded a manufacture year of 1938 +/- 6 years. Cluster 2 data resulted in a manufacture range of 1922 to 1934. The glass in Cluster 3 was most likely manufactured between 1873 and 1885.

**Table 2. This table depicts the means of all the data sets after conversion from millimeters to inches. The conversion was performed in order to evaluate the data based on Schoen’s methods.**

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Original Mean (mm)</th>
<th>Converted Mean (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>2.92</td>
<td>0.115</td>
</tr>
<tr>
<td>Cluster 1</td>
<td>3.16</td>
<td>0.124</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>2.99</td>
<td>0.118</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>2.24</td>
<td>0.088</td>
</tr>
</tbody>
</table>

**Discussion**

Considering the results of the statistical analysis, the results of the regression equation and the chronology set down by Schoen (1990); three observations can be made. First, data gathered from the glass collected at Test Unit 08-03 (level 1) contains three modes around which the data is distributed. The results of the ANOVA suggest that these three clusters of data most likely represent three significantly different groups of glass based on mean thickness.

Second, using Schoen’s (1990) regression equation, dates can be assigned to the clusters. To fully evaluate these dates, it is first important to understand that by 1903, the manufacture of glass had changed dramatically. At this time, the glass process was mechanized.
with the invention of the Lubber Machine. The machine became a major competitor in the glass making industry by 1905. "This mechanized method of production effectively standardized the thickness of window glass. For all intents and purposes, as this method of manufacture took over the window glass industry, flat glass chronologies according to thickness ceased to be viable" (Wieland 2007:9).

As stated above, Cluster 1 provided a date of 1938 +/- 6 years. Cluster 2 dated to 1928 +/- 6 years and Cluster 3 was dated to 1879 +/- 6 years. In light of what is known about the standardization of window glass manufacture, the dates for Clusters 1 and 2 are suspect. Therefore, it may not be appropriate to assign specific dates to these modes. Instead, the variation in average thickness between these clusters may have resulted from different manufacturers. In other words, the glass from Cluster 1 and Cluster 2 cannot be securely dated and may have resulted from any one of the modifications done to the house that are listed above.

Cluster 3, however, proved to be highly relevant to understanding the glass deposit. Initially, it was suspected that the large variability in the data set may present a problem in statistical testing. This was not the case. In fact, this cluster yielded a date of 1879 (+/- 6 years) which places the glass perfectly within the known dates of construction for the Miles farmhouse. This also fits within Schoen's (1990) chronology. He predicted that glass dating between 1870 and 1880 would have an average thickness of 0.0842in to 0.0901in. At an average of 0.088in, the glass from Cluster 3 could be dated from this time.

Conclusion

The above discussion provides for a complete interpretation of the glass fragments excavated from Test Unit 08-03, Level 1. Because the glass was collected on or near the surface, it can be assumed that the glass was deposited relatively recently. There appear to be no signs of erosion or disturbance that would refute this assumption. Due to the large aggregation of flat glass collected (a total of 303 from this level); the fragments were probably deposited at one time. The glass deposit contains fragments that date to the construction of the house as well as potentially modern glass. It would make sense that the deposit was created during the several modifications made to the structure over the years. Unfortunately, the specific event cannot be identified.

In addition to gaining an understanding of flat glass at the Isaac Miles Farm (13CD139), this study demonstrates a need for
caution in using flat glass to date historical sites. The original data set contained measurements from all 200 glass fragments. Had the raw mean from all measurements been compared to Schoen’s (1990) glass chronology, all the data would have been placed well outside the realm of possible dates for flat glass on the Plains. By ignoring the presence of clusters, a clear picture of the evolution of flat glass at the site would not have been discovered. This would be a terrible error to make on an early nineteenth century site on the Plains; especially if the site had a long occupation history resulting in a mixed assemblage.

Using flat glass to date archaeological sites can be extremely useful. However, it is important to understand the history of glass manufacture and the implications that accompany changes in production methods. Glass thicknesses also vary by region and by manufacturer. These facts can influence the nature of glass thickness and cause false conclusions to be drawn. A proper examination of flat glass thicknesses should include an intimate knowledge of the data set involved.

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