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TECHNOLOGY

DATING OF SOME HISTORICAL SAFRANBOLU HOUSES WITH DENDROCHRONOLOGICAL METHODS

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Abstract

Safranbolu, listed in the World Heritage Cities of UNESCO in 1994, is famous for its historical wooden houses with high cultural and architectural value. The aim of this study is to determine scientifically the construction and restoration date of these houses using dendrochronological method. For this purpose 10 historical wooden buildings were selected to determine their dendrochronological properties. 10 wooden material samples of 3 cm thickness were taken from each building and cross sections of them were sanded. Measurements were performed in Istanbul University Faculty of Forestry Dendrocronology Laboratory, by using overhead lightening Carl Zeiss microscope and ECLUND measuring device with an accuracy of 0,01 mm beginning from the innermost ring to the outermost one. The CORINA program was used in dendrochronological studies. The data obtained date back to sequentially 1894, 1891, 1893, 1883, 1953, 1822, 1961, 1933, 2000, and 1805 years. Some of them are restoration dates of the buildings. Dating of the buildings include a wide variation because the samples do not have the latest year rings.
Keywords: Historical Safranbolu Houses, Dendrocronology, Dating.

1. Introduction

Safranbolu is a sub-provincial centre in the north-western Black Sea region, located at the cross-section of the 41°16' northern latitude and 32°41' eastern longitude. The environs of Safranbolu have been an area of settlement ever since the Paleolithic Age. Safranbolu dating back to the Ottoman Era reflects the Turkish social life of the 18th and 19th centuries to the present. The settlement of Safranbolu consists of three sections as "Bağlar", "Eskiçarşı" and "Kıranköy" [1]. The settlement plan of historical city of Safranbolu is shown in Figure 1. The places marked with a bold ring on the map show the historical wooden houses of Safranbolu dated with dendrochronological methods.

What make Safranbolu distinctive both in Turkey and all over the World are the historical wooden houses reflecting the traditional Turkish architectural style. These houses are worthwhile with regard to both their urban locations and architectural styles. Historical Safranbolu houses, still surviving at the present time, are the works of the art of the Turkish urban culture formed for more than hundreds of years. There are nearly 2000 traditional Turkish wooden houses built in the 18th, 19th and at the beginning of the 20th centuries [2].

From the general appearance of the city to the houses themselves it can be seen that these houses are the works of art requiring cultural background, cultural wealth and highly craftsmanship. In Safranbolu no houses are jerry-built. All houses are open to garden with 3 storeys, 6-8 rooms and planed according to the needs of large volumed families and built aesthetically [3].

In 1994, UNESCO's taking Safranbolu in the list of the World Heritage cities certified that Anatolian culture is both original and has qualifications to be an inspiration source for the people from all over the world [4].

Gassner, G. ve Chrıstıansen-weniger, F. (1937), made a dendroclimatological research and they fixed the dry and rainy years with respect to the year ring growth of Anatolian pines [5].

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Kuniholm, P. I and Striker, C. L (1976), made a dendrochronological study with respect to the archway cross beam connections under the dome of St. Irene church [6].
A doctorate thesis titled "Gordion and Dendrochronological Studies in Anatolian Plateao" was written by Kuniholm (1977) and with respect to this thesis a juniper chronology dating back to 806 was arranged [6].

In the content of " Agean Dendrochronology Project" so many dating applications and a main graph ranging back to 7000 years were made by Kuniholm and Striker (1983), Kuniholm (1991, 1992, 1995a, 1995b, 1996); Kunihol P. I and et all (1996) [7-13].

Aytuğ, B. (1984b), made a study on formation of "Sülük Gölü" (Lake Leech) and determined that the formation of this lake was between 1702 and 1703 and it made a significant contribution to dendrojeomorphology [14].

Aytuğ. B and Güven, K. C (1993), determined that air pollution had an effect on the year rings of redpines and it made a significant contribution to dendrochronology [15].

A dendrochronologic study was made on pinenut trees in İstanbul by Akkemik (2000a) and he stated that rain fall had a proportionally positive effect and especially summer heat had a negative effect on it [16].

Akkemik. Ü and Güzel. S (2003) put down the date of some historical houses in the suburbs of Kastamonu [17].

Akkemik. Ü and Dağdeviren. N (2004), put down the date of the Balkapanı Inn in İstanbul and stated that the Inn was damaged in 1766 by the earthquake and afterwards it was restored [18].

Although there are lots of historical wooden houses in open air Museum City of Safranbolu, there is no academic study on dendrochronology of these houses. The aim of this study is to determine scientifically the construction and restoration dates of these wooden houses by using dendrochronologic methods and make a scientific contribution to the history, culture and improving tourism of Safranbolu.

2. Material and Methods

2.1 From Which Buildings the Materials Were Taken

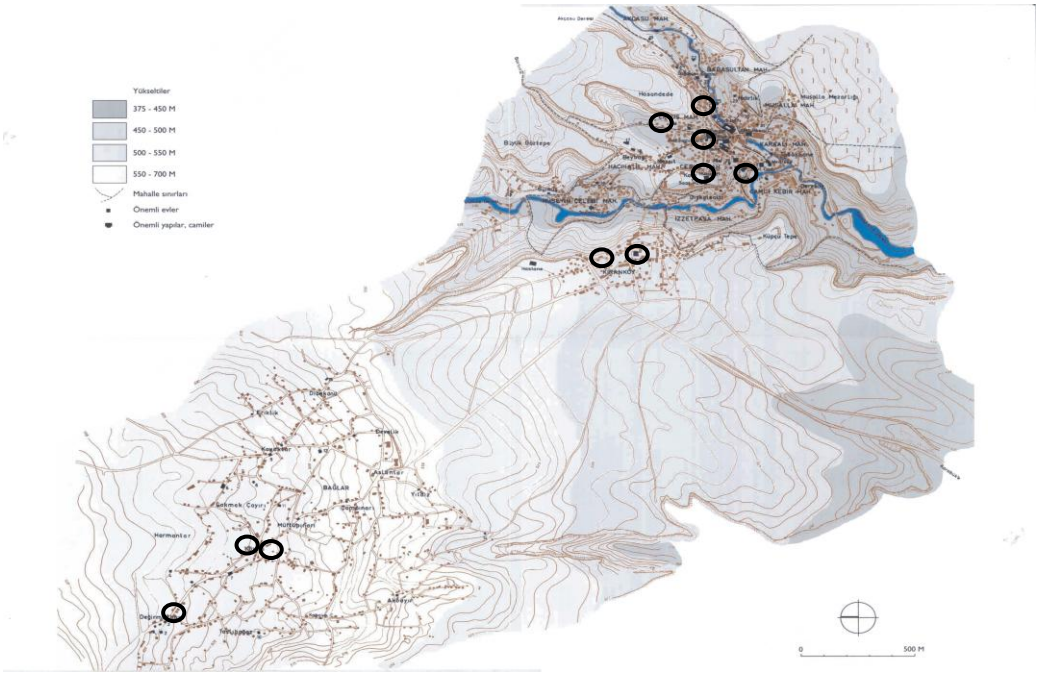

Figure 1. The settlement plan of city of Safranbolu

2.1.1 Places where the samples were taken belong to the house numbered 1

The house in Figure 2. is in Safranbolu Eski Çarşı Celal Bayar Caddesi Akçasu Mahallesi No: 24 and not suitable for accommodation. 10 samples were taken from that building these are balcony pillar, supporter, beam materials.

Figure 2. Front view of the building numbered 1.

2.1.2 Places where the samples were taken belong to the house numbered 2

The house in Figure 3. is in Eski Çarşı Dışkalealtı sokak No: 17 with 2 storeys. There are barns, a huge fireplace for kitchen range and a granary on the ground floor. 10 samples were taken from this building. These samples were stair, supporter and window frame materials.

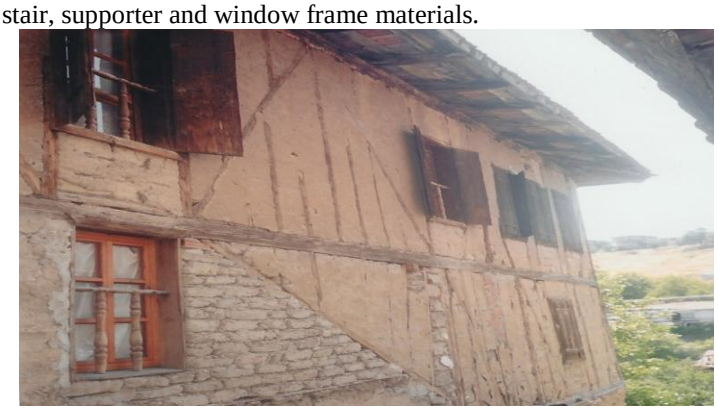

Figure 3. Side view of the house numbered 2.

2.1.3 Places where the samples were taken belong to the house numbered 3

Figure 4. belongs to the house with 3 storeys in Safranbolu Eskicarsi Celal Bayar cad. Eflani sokak No: 2 and it has still been accommodated. There is a depot for heating materials (firewood) and a warehouse on the ground floor. Food for the winter is stored on the first and second floor. 10 samples were taken; these samples were supporter, beam, roof and window frame materials.

Figure 4. Front view of the house numbered 3.

2.1.4 Places where the samples were taken belong to the house numbered 4

Figure 5. belongs to the house with 2 storeys in Safranbolu Baglar Mah. Degirmenbasi sokak No: 35. This house is semi damaged and is not accommodated.There is a warehouse and a depot on the ground floor.10 samples were taken from the building.These were supporters, beam, roof and window frame materials.

Figure 5. North view of the building numbered 4.

2.1.5 Places where the samples were taken belong to the house numbered 5

The house with 3 storeys in Figure 6. is in Safranbolu Baglar mah, Hacibey sok. No: 30.It is possible to see the best samples of Safranbolu wooden architecture in that building.These were supporter, beam, sofa and window frame materials.

Figure 6. North view of the house numbered 5.

2.1.6 Places where the samples were taken belong to the house numbered 6

The building in Figure 7. is in Safranbolu Kirankoy Inonu mah. Okul sok. No: 9 with 1 storey.10 samples were taken from that house .These were supporter beam window frame and roof materials.

Figure 7. Front view of the house numbered 6.

2.1.7 Places where the samples were taken belong to the house numbered 7

The house with 1 storey in Figure 8. is in Safranbolu Bağlar mah. Hacıbey sokak No: 29. It is the second extension built next to the Safranbolu Kız Meslek Lisesi (Vocational high school for girls). There are flights of stairs to go upstairs. There is a warehouse and a depot on the ground floor. 10 samples were taken from that building. These were supporter, beam and roof materials.

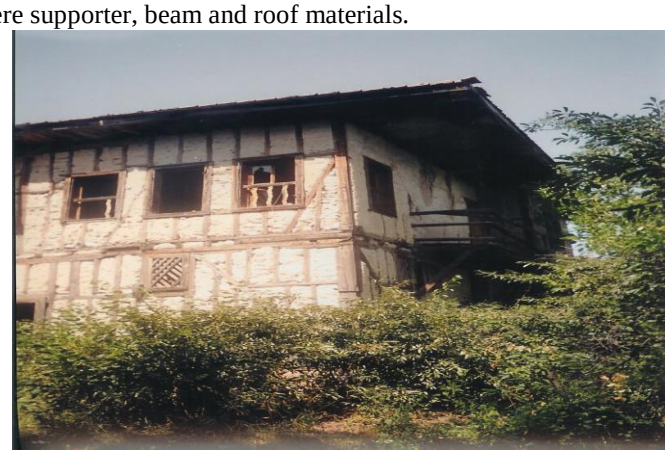

Figure 8. Side view of the house numbered 7.

2.1.8 Places where the samples were taken belong to the house numbered 8

The house with 2 storeys in Figure 9 is in Safranbolu Kıranköy Barış mah. Utku sokak No: 8. The building was subjected to fire and it has not been accommodated. There is a warehouse and a depot on the ground floor. 10 samples were taken from the building; these are supporter, beam, stair and roof materials.

Figure 9. Side view of the house numbered 8.

2.1.9 Places where the samples were taken belong to the house numbered 9

The house with 2 storeys in Figure 10. is in Safranbolu Eskiçarşı Çeşme mah. Cebeci sokak No: 9. The building was restored.10 samples were taken from that building; these were supporter, beam, pillar, stair and roof materials

Figure 10. Side view of the building numbered 9.

2.1.10 Places where the samples were taken belong to the house numbered 10

The house in Figure 11. is in Safranbolu Eskiçarşı Baba Sultan mah. No:11 with 1 storey and is not accommodated. Inner stair flights go upstairs.There is a warehouse and a depot on the ground floor.10 samples wre taken from that building.these are supporter ,beam,pillar,window frame and roof materials

Figure 11. Front view of the house numbered 10.

2.4 Methods For Measuring Materials

In order to have the year rings of the samples seen more clearly, cross section surface of Black Pine (karacam) samples were sanded with sanding machine so ring lines were demonstrated.To get the measurements easier overhead lightening Carl Zeiss microscope was used and the year rings were divided into 10-year sections.This measurements were performed from the innermost ring to the outhermost one. These measurements were performed using Eclund measurement device with 0.01sensitivity.The circles where the rings were seen clearly were measured from 2 different directions.These data were processed onto EXCEL programme directly. Data concerning the year rings of each sample were taken from EXCEL programme and copied into first of all Dshell programme *RW, afterwards into Coring programme *RWL,as extended individual files.

In order to find the similarities among the samples of the same period, EUY values were calculated. The correlation persentage of the curved lines is generally related to the directions of the rings occuring at the same years between two chronology.It can be said that if the rings occuring at the same year are at the same direction, they have concordant structures.If they are at the different direction, they have discordant sructures.For this basis the persentage of the curved lines moving at the same direction is calculated and the correlation persentage of the curves is found [19].

If Ai = (Xi+1 – Xi) Ai > 0; Eix = +1/2
Ai = 0; Eix = 0
Ai < 0; Eix = -1/2

Eix; shows the direction of the width difference between the rings of i year in x graph and the rings of the year after that(i).All these calculations were performed for the other graph too,and than the next action below was taken.

Correlation between the two graphs $E(x, y) = 1/(n-1)\ \Sigma\ (Eix + Eiy)*100$

The method developed by Eckstein and Bauch (1969) ın order to check whether calculated values G(x,y) were statistically significant or not was given below.

* For 0.95 reliability degree the sifnificance coefficient is = $50 + ((1.645*50) / \sqrt{n})$
** For 0.99 reliability degree the sifnificance coefficient is = $50 + ((2.326*50) / \sqrt{n})$
*** For 0.999 reliability degree the sifnificance coefficient is = $50 + ((3.09*50) / \sqrt{n})$

If the obtained E(x,y) values are over one of the calculated coefficients ,at that reliability degree the results are significant.

After these actions, dating actions were taken by using main Blackpine reference chronology with code 2PINI and made previously by Akkemik and Cherubini (2003) .Dating actions were taken by using Corina programme and than the samples taken from the houses were dated.Since some of the samples don’t have the latest year rings, fixed dates may not be the exact date of their usage and there may be some slight variations.

3. Result and Discussion

Researches on all taken samples, findings after the calculations, and dating actions were all given seperatetly for each house

3.1 Dendrochronologic Findings Belong To The House Numbered 1

With respect to the analysis made on the 10 samples taken from the houses, 7 of which suitable for the dating actions were selected and dendrochronologic actions were taken on them.

Findings obtained after comparing every sample with each other were given in Figure 12 .The correlation among the samples was quite high so their mean values were calculated (in Figure 12 in bold graph).The correlation persantage (EUY) between the individual graphs and their mean values was given in Table 1.This certified that since the correlation persentage between the graphs was high ,there was a significant concordation among the samples .The correlation of the samples with their mean value is significant at 0.999 reliability degree.

Table 1.EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 1

Samples	S-3	S-4	S-5	S-6	S-7	S-8	S-9	Building 1
S-3	1							
S-4	77.78**	1						
S-5	---------	74.43*	1					
S-6	---------	80.49***	48.84NS	1				
S-7	42.11NS	69.10**	51.55NS	55.88NS	1			
S-8	47.37NS	65.45*	66.67*	55.88NS	80.00***	1		
S-9	---------	68.42*	53.66NS	67.50*	54.84NS	54.84NS	1	
Building 1	73.80***	85.57***	67.44*	73.21***	73.21***	74.54***	81.25***	1

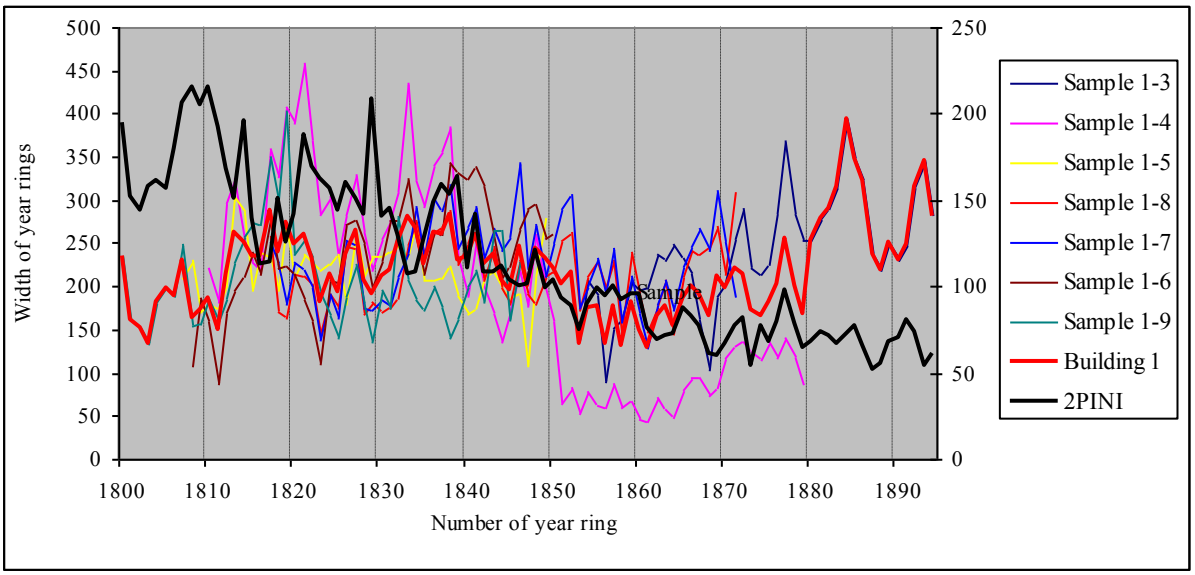

Figure 12. Correlation persentage values (EUY) of the curved lines of the house numbered 1.

After taking the mean values of the samples and being coded as Building 1, a comparison was made on the

main chronology of Karabük Blackpine coded 2PINI (EUY %65.4***) , Building 1 was dated back to 1800-1894.With respect to this result the wood used for the construction of this house dated back as the closest time to 1894. Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1894).

3.2 Dendrochronologic Findings Belong To The House Numbered 2

With respect to the analysis results of the 10 samples taken from the house numbered 2, 3 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 13. The correlation among the samples was quite high so their mean values were taken (in Table 2 in bold style).The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 2. This certified that since the correlation persentage between the graphs was high, there was a significant concordation among the samples. The correlation of the samples with their mean value is significant at 0.999 reliability degree.

Table 2. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 2

Samples	S-1	S-2	S-3	Building2
S-1	1			
S-2	85.71*	1		
SÖ-3	68.97*	66.67NS	1	
Building 2	87.5***	95.12***	82.5***	1

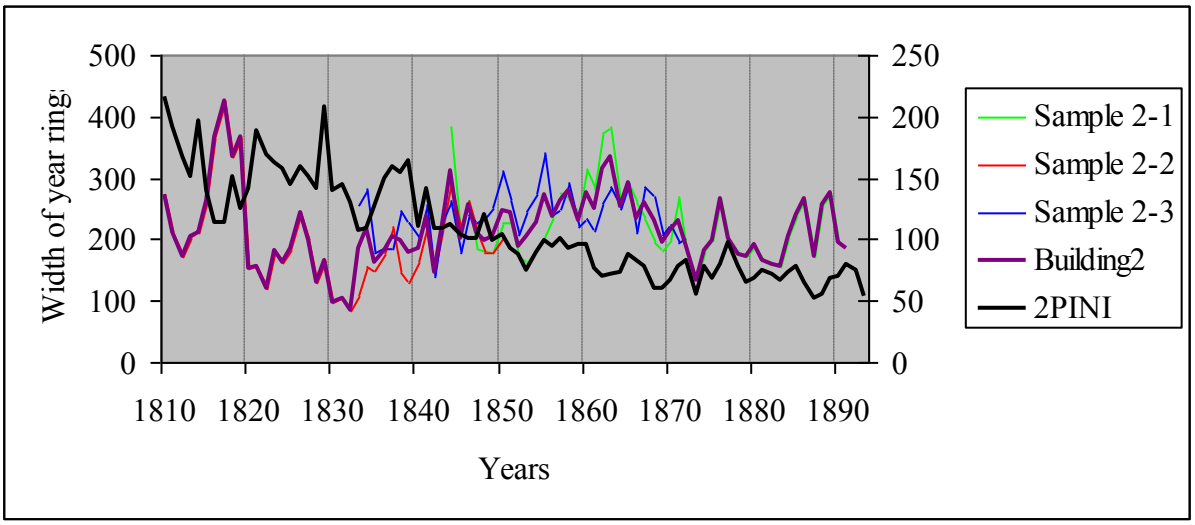

Figure 13. Correlation persentage values of the curved lines of the house numbered 2.

After taking the average values of the samples and being coded as Building 2, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %68.5***), Building 2 was dated back to 1810-1891.With respect to this result the wood used for the construction of this house dated back as the closest time to 1891.Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1891).

3.3 Dendrochronologic Findings Belong To The House Numbered 3

With respect to the analysis results of the 10 samples taken from the house numbered 3, 4 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 14. The correlation among the samples was quite high so their

mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 3. This certified that since the correlation persentage between the graphs was high, there was a significant concordation among the samples. The correlation of the samples with their mean value is significant at 0.999 reliability degree.

Table 3. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 3

Samples	S-1	S-2	S-3	S-5	Building3
S-1	1				
S-2	64.71*	1			
S-3	41.67NS	66.67NS	1		
S-5	60.71NS	67.65*	55.56NS	1	
Building 3	69.44*	86.36***	77.27**	76.47**	1

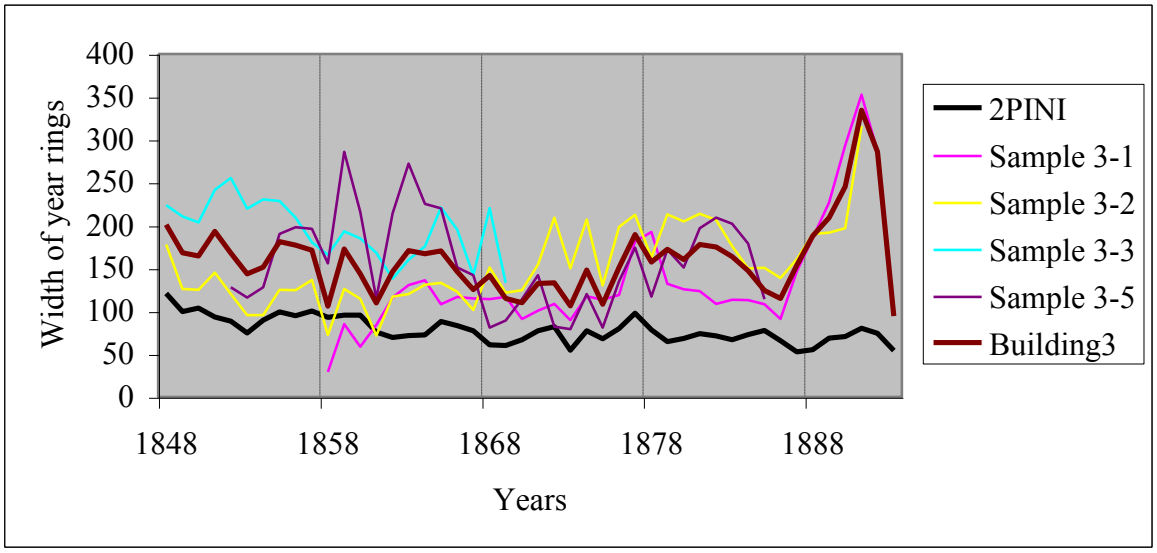

Figure 14. Correlation persentage values of the curved lines of the house numbered 3.

After taking the mean values of the samples and being coded as Building 3, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %67.8***), Building 3 was dated back to 1848-1893.With respect to this result the wood used for the construction of this house dated back as the closest time to 1893.Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1893).

3.4 Dendrochronologic Findings Belong To The House Numbered 4

With respect to the analysis results of the 10 samples taken from the house numbered 4, 6 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 15. The correlation among the samples was quite high so their mean values were taken.The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 4. This certified that since the correlation persentage between the graphs was high, there was a significant concordation among the samples. The correlation of the samples with their mean value is significant at 0.999 reliability degree.

Table 4. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 4

Samples	S-1	S-2	S-3	S-6	S-7	S-8	Building 4
S-1	1						
S-2	39.39NS	1					
S-3	57.14NS	54.84NS	1				
S-6	46.15NS	48.57NS	48.57NS	1			
S-7	56.25NS	25.78NS	50.00NS	58.82NS	1		
S-8	56.76NS	35.29NS	48.57NS	36.84NS	42.42NS	1	
Building 4	92.30***	71.05**	57.14NS	67.44*	63.88*	73.68**	1

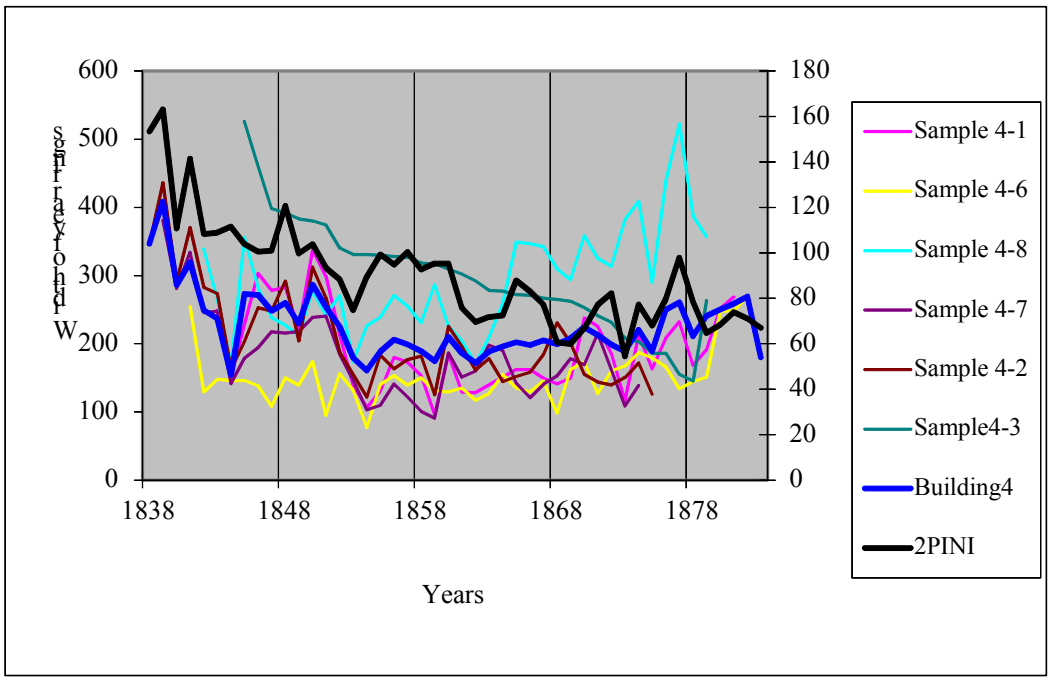

Figure 15. Correlation persentage values of the curved lines of the house numbered 4.

After taking the average values of the samples and being coded as Building 4, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %65.6***), Building 4 was dated back to 1838-1883.With respect to this result the wood used for the construction of this house dated back as the closest time to 1883.Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1883).

3.5 Dendrochronologic Findings Belong To The House Numbered 5

With respect to the analysis results of the 10 samples taken from the house numbered 5, 5 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings was given in Figure 16.The correlation among the samples was quite high so their mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 5. This certified that since the correlation persentage between the graphs was

high, there was, a significant concordation among the samples. The correlation of the samples with their mean value is significant at 0.999 reliability degree.

Table 5. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 5

Samples	S-1	S-4	S-5	S-7	S-8	Building 5
S-1	1					
S-4	66.67NS	1				
S-5	70.59*	77.27**	1			
S-7	63.41*	53.85NS	63.16NS	1		
S-8	66.67NS	52.38NS	47.06NS	57.14NS	1	
Building 5	77.27***	65.51*	89.00***	81.39***	66.66NS	1

After taking the average values of the samples and being coded as Building 5, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %72.2***) , Building 5 was dated back to 1899-1953.With respect to this result the wood used for the construction of this house dated back as the closest time to 1953. Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1953).

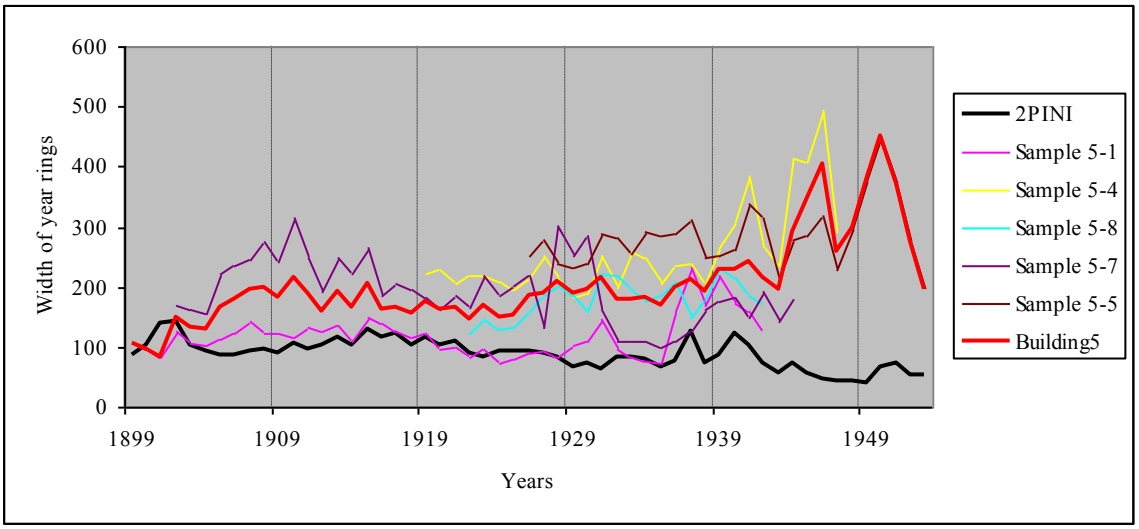

Figure 16. Correlation persentage values of the curved lines of the house numbered 5.

3.6 Dendrochronologic Findings Belong To The House Numbered 6

With respect to the analysis results of the 10 samples suitable for the dating actions were taken from the house numbered 6, 7 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 17. The correlation among the samples was quite high so their mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 6.This certified that since the correlation persentage between the graphs was high, there was, a significant concordation among the samples. The correlation of the samples with their mean value is significant at 0.999 reliability degree.

Table 6. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 6

Samples	S-2	S-5	S-6	S-7	S-8	Building 6
S-2	1					
S-5	-------	1				
S-6	50.00NS	62.50NS	1			
S-7	66.67NS	54.17NS	53.06NS	1		
S-8	66.67*	87.5**	78.38***	61.54NS	1	
Building 6	85.71***	87.50***	69.38**	64.15*	83.33***	1

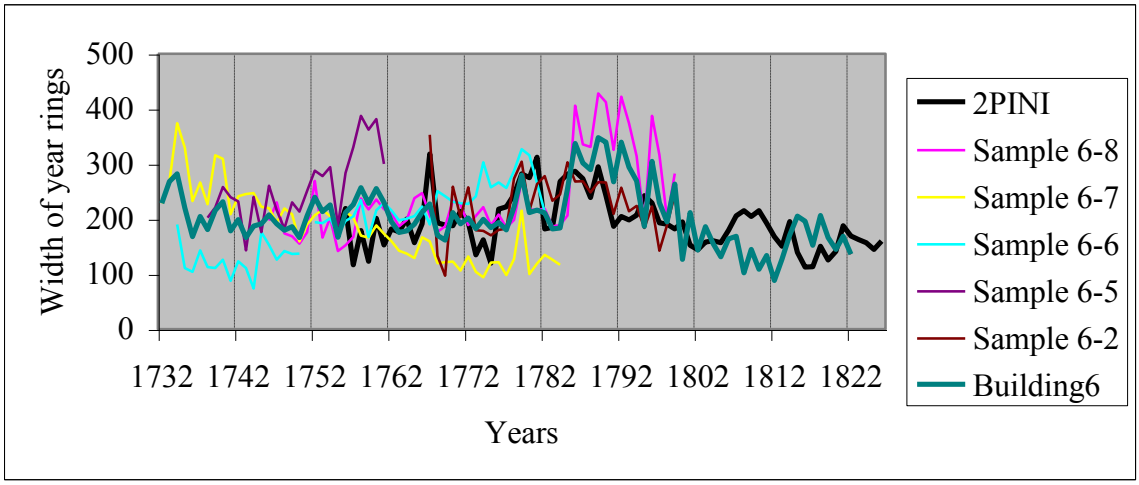

Figure 17. Correlation persentage values of the curved lines of the house numbered 6.

After taking the average values of the samples and being coded as Building 6, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %69.2***) , Building 6 was dated back to 1732-1822.With respect to this result the wood used for the construction of this house dated back as the closest time to 1953. Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1822).

3.7 Dendrochronologic Findings Belong To The House Numbered 7

With respect to the analysis results of the 10 samples suitable for the dating actions were taken from the house numbered 7, 5 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 18. The correlation among the samples was quite high so their mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 7. This certified that since the correlation persentage between the graphs was high, there was, a significant concordation among the samples. The correlation of the samples with the mean value is significant at 0.999 reliability degree.

Table 7. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 7

Samples	S-1	S-2	S-3	S-4	S-5	Building7
S-1	1					
S-2	65.71*	1				
S-3	60.60NS	62.50NS	1			
S-4	54.28NS	73.53**	75.00**	1		
S-5	65.71*	45.45NS	51.51NS	42.42NS	1	
Building 7	76.31***	71.42**	75.75**	73.52**	62.85NS	1

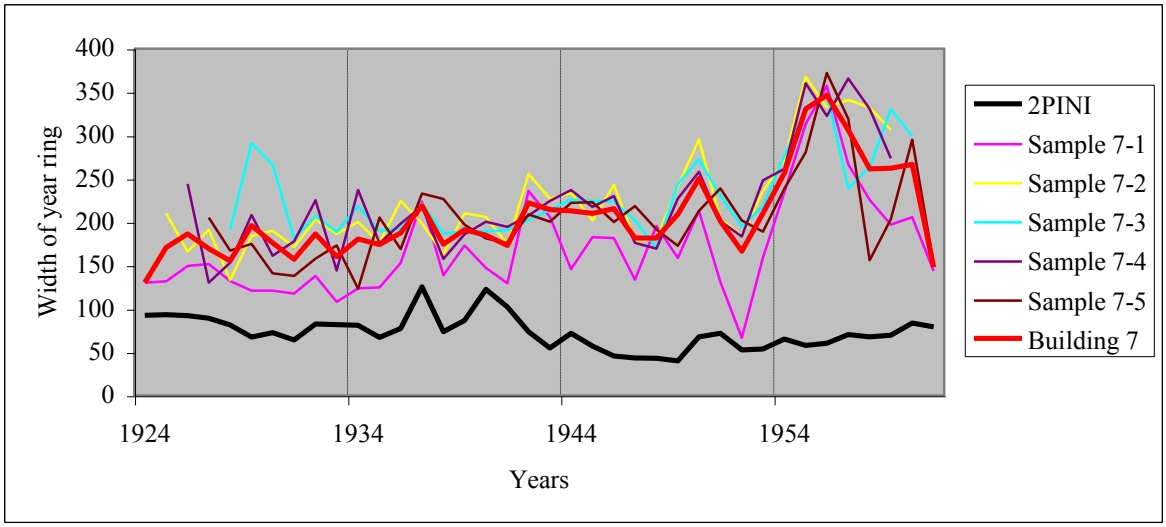

Figure 18. Correlation persentage values of the curved lines of the house numbered 7.

After taking the average values of the samples and being coded as Building 7, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %70.3***) , Building 7 was dated back to 1924-1961.With respect to this result the wood used for the construction of this house dated back as the closest time to 1953. Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1961).

3.8 Dendrochronologic Findings Belong To The House Numbered 8

With respect to the analysis results of the 10 samples suitable for the dating actions were taken from the house numbered 8, 6 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 19. The correlation among the samples was quite high so their mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 8. This certified that since the correlation persentage between the graphs was high, there was, a significant concordation among the samples. The correlation of the samples with the mean value is significant at 0.999 reliability degree.

Table 8. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 8

Samples	S-1	S-2	S-3	S-4	S-5	S-6	Building 8
S-1	1						
S-2	72.41*	1					
S-3	60.00NS	71.42*	1				
S-4	45.45NS	67.64*	51.72NS	1			
S-5	50.00NS	70.58**	65.21NS	44.83NS	1		
S-6	68.25*	65.85*	58.82NS	43.48NS	67.85*	1	
Building8	85.36***	75.00***	86.20***	70.73**	70.58**	63.63*	1

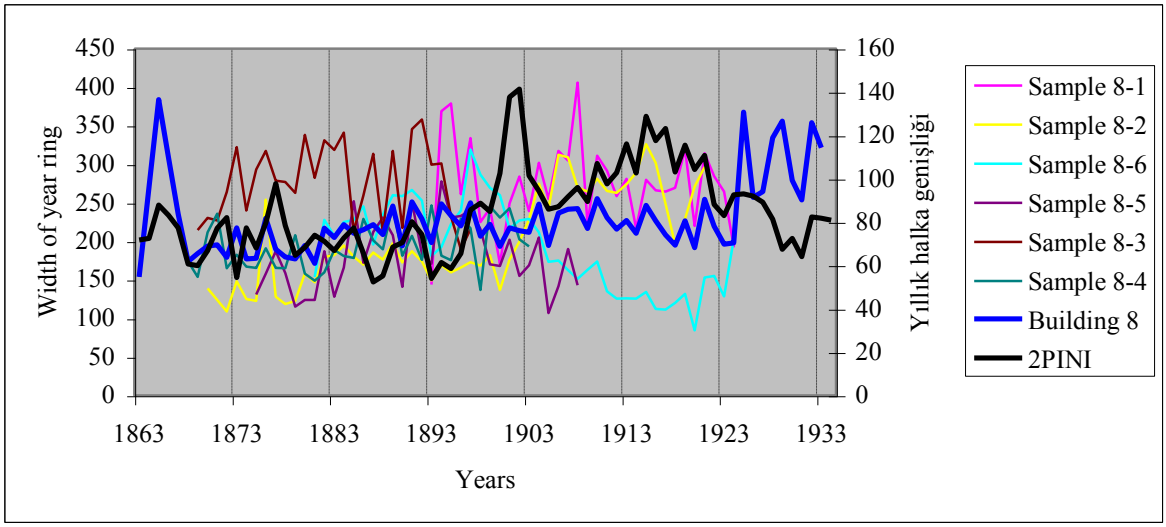

Figure 19. Correlation persentage values of the curved lines of the house numbered 8.

After taking the average values of the samples and being coded as Building 8, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %70.7***) , Building 8 was dated back to 1863-1933.With respect to this result the wood used for the construction of this house dated back as the closest time to 1953. Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1933).

3.9 Dendrochronologic Findings Belong To The House Numbered 9

With respect to the analysis results of the 10 samples suitable for the dating actions were taken from the house numbered 9, 7 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 20. The correlation among the samples was quite high so their mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 9. This certified that since the correlation persentage between the graphs was high, there was a significant concordation among the samples. The correlation of the samples with the mean value is significant at 0.999 reliability degree.

Table 9. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 9

Samples	S-1	S-2	S-3	S-4	S-5	S-6	S-7	Building9
S-1	1							
S-2	54.54NS	1						
S-3	44.44NS	73.33*	1					
S-4	53.33NS	76.19**	63.64NS	1				
S-5	64.86*	71.79**	75.00**	73.33**	1			
S-6	36.36NS	44.44NS	--------	---------	72.00*	1		
S-7	52.94NS	65.21NS	63.15NS	60.00NS	77.78**	50.00NS	1	
Building9	54.05NS	71.79**	87.87***	72.50**	83.63***	81.81***	81.48***	1

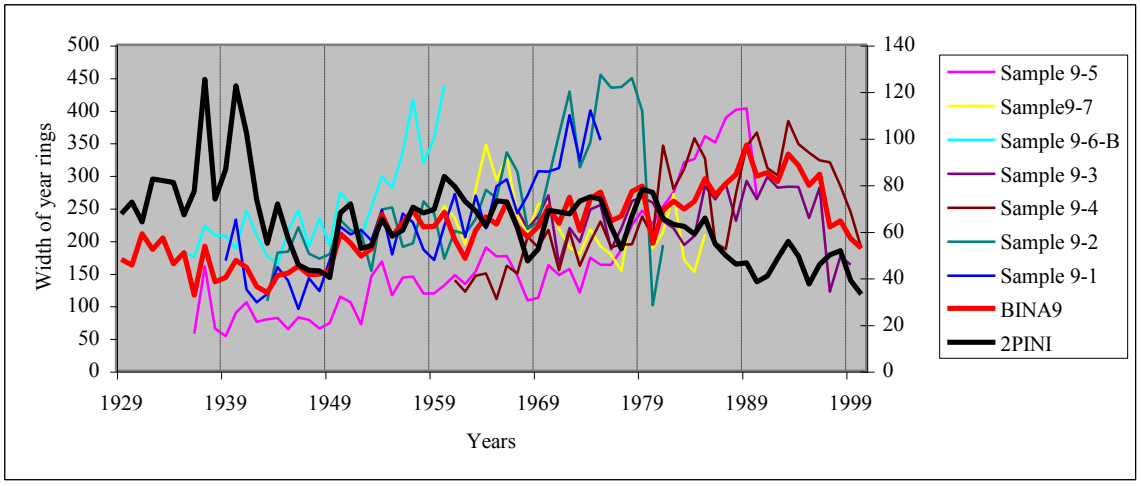

Figure 20. Correlation persentage values of the curved lines of the house numbered 9.

After taking the average values of the samples and being coded as Building 9, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %72.5**) , Building 9 was dated back to 1929-2000.With respect to this result the wood used for the construction of this house dated back as the closest time to 1953. With respect to this result it can be said that it was date of restoration rather than the date of consruction of the building.

3.10 Dendrochronologic Findings Belong To The House Numbered 10

With respect to the analysis results of the 10 samples suitable for the dating actions were taken from the house numbered 10, 7 of which were selected and dendrochronologic actions were taken on these samples. After comparing every sample with each other, the findings were given in Figure 21.The correlation among the samples was quite high so their mean values were taken. The correlation persentage (EUY) between the individual graphs and their mean values were given in Table 10. This certified that since the correlation persentage between the graphs was high, there was, a significant concordation among the samples. The correlation of the samples with the mean value is significant at 0.999 reliability degree.

Table 10. EUY (0.95, 0.99 ve 0.999) values of the samples belong to the house numbered 10

Samples	S-1	S-2	S-3	S-5	S-6	S-7	S-8	Building10
S-1	1							
S-2	------	1						
S-3	33.33NS	63.33NS	1					
S-5	79.31***	68.75NS	66.67NS	1				
S-6	55.56NS	85.71***	69.57*	66.67*	1			
S-7	78.57*	61.29NS	59.37NS	68.96*	52.97NS	1		
S-8	00.00NS	54.54NS	63.63NS	76.47*	59.09NS	54.55NS	1	
Building 10	82.75***	77.78***	84.37***	82.60***	65.78*	52.27NS	63.63NS	1

(*), (**), (***) signs indicated that by turns EUY values at 0.95, 0.99 ve 0.999 reliability degrees were significant. ;(NS) was insignificant.

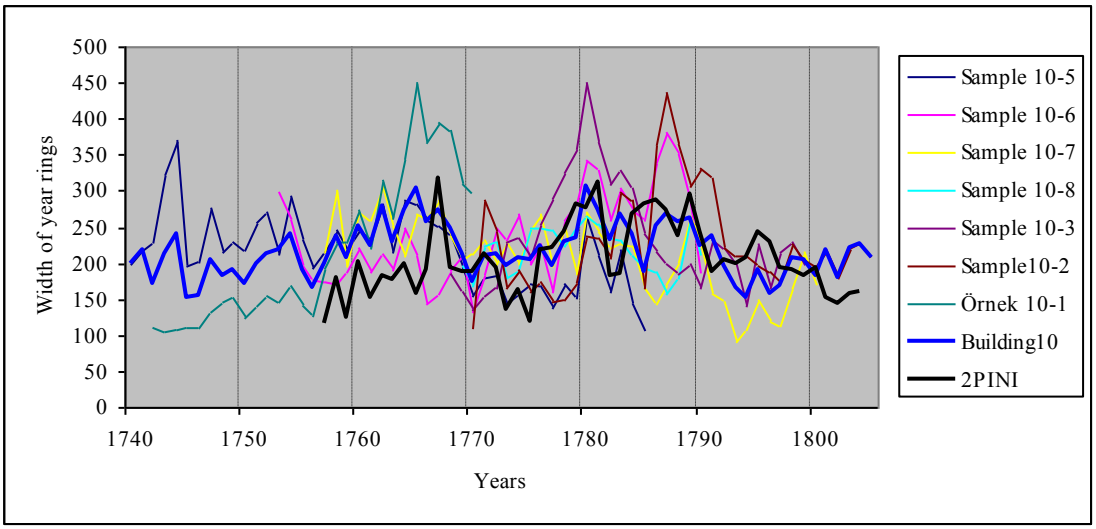

Figure 21. Correlation persentage values of the curved lines of the house numbered 10.

After taking the average values of the samples and being coded as Building 10, a comparison was made on the main chronology of Karabük Blackpine coded 2PINI (EUY %70.8**) , Building 10 was dated back to 1740-1805.With respect to this result the wood used for the construction of this house dated back as the closest time to 1805. Since the samples were finished and lack of the latest rings, it could be said that that building might have been constructed after that date (1805).

4. Conclusion

Buildıng 1 located in Eski Çarşı region Celal Bayar Street has got 3 storeys.The number of researched samples was 7 as seen on Table 1 the concordation among the samples was quite high.With respect to this correlation their mean value was taken. After making a comparison on the main chronology of Karabük-karaçam (Blackpine) coded 2PINI (EUY %65.4***), the house numbered 1was dated back to 1800-1894.This result certified that the construction date was about in 1896, the building and the fountain was built at the same time.

The house numbered 2 located in Kalealtı street has got 1 storey.The number of researched samples was three. After making a comparison on the main chronology of Karabük karaçam (Blackpine) coded 2PINI (EUY %68.5***) the building was dated back to 1890-1891.This result shows that it was built as the closest time in 1891.The house located in the same area with Hükümet Konağı built in 1904. Kalealtı Primary school 50 m.far from the house was built in 1908.The house numbered 2 and the other two buildings the construction date of which were very close to each other were also located in the same area.

Building 3 located in Eski Çarşı Çeşme region Celal Bayar caddesi Eflani sokak has got three storeys and it has still been accomodated. The number of the researched samples was three. The concordation among the samples was quite high so their mean values were calculated.
After making a comparison on the main chronology of Karabük-karaçam coded 2PINI (EUY %67.8***), the house was dated back to 1893.The closest construction date of that house could be in 1893.It is in the same location with Kadı Efendi fountain built in 1896.Also the location of this building and building 3 are very close.The contruction date of them is 1893-1891.There is no significant difference between the dates.

The house numbered 4 with 2 storeys is in Değirmenbaşı Street. 6 samples were taken.The correlation among the samples was quite high so their mean value was taken. After making a comparison on the main chronology of Krabük-karaçam (Blackpine) coded 2PINI (EUY %65.6***), the building was dated back to1838-1883. It proved that the closest construction date of the building could be in 1883.It could also be the date of restoration.

Building 5 is located in Bağlar region Hacı Bey Lane and it has got 4 storeys. 5 samples were taken the correlation among the samples was quite high so their mean values were calculated. After making a comparison on the main chronology of Karabük-karaçam (Blackpine) coded 2 PINI (EUY 572.2***), the building was dated back to 1899-1953. 1953 was the closest construction date of it. It could also be the date of restoration.

Building 6 with 1 storey is located in Safranbolu Kıranköy İnönü mah. Okul cad. 7 samples were taken, the correlation among the sample was quite high so their mean values were taken. After making a comparison on the main chronology of Karabük-karaçam (Blackpine) coded 2PINI (EUY %69.2***), the building was dated back to 1732-1822. 1822 could be the closest construction date of it.It is located in the same area with Abdi Çavuş fountain. The fountain was built in 1813. Their contruction date of the buildings was very close to each other.

Building 7 with 1 storey is in Bağlar mah. Hacı Bey sokak. 5 samples were taken. The correlation among the samples was quite high so their mean values were calculated.After making a comparison on the main chronology of Karabük- karaçam (Blackpine) coded 2PINI (EUY %70.3***), the building was dated back to 1924-1961.This proved that the closest construction date could be in 1961.It could be the date of restoration.

Building 8 with 2 storeys is located in Kıranköy Barış mah. Utku Sitesi. The number of taken samples was 6. The correlation among the samples was quite high so their mean values were calculated. After making a comparison on the main chronology of Karabük-karaçam (Blackpine) coded 2 PINI(EUY %70.7***), Building 8 was dated back to1863-1933. This result certified that the closest date of construction could be in 1933. It could be the date of restoration.

Building 9 with 2 storeys is located in Eski Çarşı Çeşme Mah. behind Arasna.The number of taken samples was 7. The correlation among the samples was quite high so their mean values were calculated. After making a comparison on the main chronology of Karabük-karaçam (Blackpine) coded 2 PINI(EUY %72.4***),Building 9 was dated back to 1929-2000.With respect to this result the year 2000 could be the date of the restoration not the construction date of the building. During the interview with the owners of the house they said that thay had the building restored in 2000.They also remembered that the house was subject to the fire three or four times.and it is thought that the building was constructed in 1925.

Building 10 with 1 storey is in Eski Çarşi in Baba Sultan Mah.7 samples were taken. The correlation among the samples was quite high so their mean values were calculated. After making a comparison on the main chronology of Karabük-karaçam (Blackpine) coded 2PINI (EUY %70.8***) it was dated back to 1740-1805.With respect to this result the closest construction date of the building could be in 1805.It is in the same location with İzzet Mehmet Pasha Mosque.The mosque was buılt in 1796.Their construction dates are very close to each other.

Since none of the samples contain the latest year rings, it prevents us from estimating the exact dating of constructions. It can be seen that there is a high correlation between the construction date of the buildings dated after being subject to dendrochronologic researches, and the construction date of the buildings.

All graphics obtained after being subject to the dendrochronologic actions can be used for the datings of the houses in the suburbs of Safranbolu, for the datings of the restoration of the buildings and the datings of the buildings as far as back to ancient times. It is vital that dendrochronologic studies of the historical wooden houses in the suburbs of Safranbolu should be made. With respect to this dendrochronologic research study construction date of the each historical house should be fixed and main chronology of Safranbolu should be established.

References

1. Yazıcıoğlu, H., (2003) Safranbolu'nun Tarihi Özellikleri,, http://www.altınsafran.com/hayat.htm.
2. Güney, R., (1998) Türk Ev Geleneği ve Safranbolu Evleri Kitabı, Yapı Endüstri Merkezi Yayınları s.367
3. Yazıcıoğlu, H., (2003) Safranbolu'nun Tarihi Özellikleri, http://www.altınsafran.com/evleri.htm.
4. Yazıcıoğlu, H., (2003) Safranbolu'nun Tarihi Özellikleri, http://www.altinsafran.com/koruma.htm.
5. Gassner, G. ve Chrıstıansen-weniger, F., (1948) Anadaolu çamlarında yıllık halkaları gelişmesi üzerinde dendroklimatolojik araştırmalar, Çeviren: Kerim Ömer Çağlar, Ticaret Dünyası Basımevi, İstanbul.
6. Kuniholm, P. I. ve Striker, C. L.(1976): The Tie-Beam System in the Nave Arcade of St Eirene: Structure and Dendrochronology, Istanbuler Mitteilungen Beireft,18.
7. Kuniholm, P. I., (1977): Dendrochronology at Gordion and on the Anatolian Plateau, Unpublished Ph.D.Dissertation (University of Pensylvania).
8. Kuniholm, P. I., Striker, C.L., (1983) Dendrochronological İnvestigations in the Aegean and Neighboring Regions, 1977-1982, Journal of Field Archaeology 10, pp. 411-420.

9. Kuniholm, P. I., (1991): A 1503 Year Chronology for the Bronze and Iron Ages: 1990-1991Progress Report of the Aegean Dendrochronology Project, VII. Arkeometri Sonuçları Toplantısı, 27-31 Mayıs 1991, Çanakkale S:121-130.
10. Kuniholm, P. I., (1992) Dendrochronological Wood from Anatolia and Evirons, Trees and Timber in Mesapotamia, Bulletion on Sumerian Agriculture, Vol: VI, s. 97-98.
11. Kuniholm, P. I., (1995a) Dendrochronology, American Journal of Archaeology, Vol.99, No: 1 s. 99-102.
12. Kuniholm, P. I., (1995b) Aegean Dendrochronology Project December 1995 Progress Report, Cornell University.
13. Kuniholm, P. I., (1996) Long tree-ring chronologies for the eastern mediterranen , archaeometry , the proceedings 16th International Symposium on Archaeometry s. 401-409.
14. Aytuğ, B., (1984b.) Sülük Gölü'nün Oluşumu, TÜBİTAK Arkeometri Ünitesi Bilimsel Toplantı Bildirileri IV, Ankara.
15. Aytuğ, B., ve Güven, K. C., (1993) Hava Kirliliğinin Kızılçamlar Üzerine Etkisi, Uluslararası Kızılçam Sempozyumu, 18-23 Ekim 1993, Orman Bakanlığı Bildiriler Kitabı, s. 767-773.
16. Akkemik, Ü., (2000a) Dendroclimatology of Umbrella pıne (Pinus pinea L.) in İstanbul (Turkey), Tree-Ring Bulletion Vol.56: 17-20.
17. Akkemik, Ü. ve Güzel, S., (2003): Kastamonu yöresindeki Bazı Ahşap Yapıların Dendrokronolojik Yöntemlerle Tarihlendirilmesi. Anadolu Universitesi Bilim ve Teknoloji Dergisi.
18. Akkemik, Ü. and Dağdeviren, N. (2004): Using Dendrochronological Methods to Date the Wooden Materials Used in Balkapanı Han, İ.Ü.Orman Fakültesi Dergisi Seri A Cilt 54 Sayı 1: 45-54.
19. Eckstein, D. ve Bauch, J. (1969): Beitrag zur Rationalisierung eines Dendrochronologischen Verfahrens und zur Analyse seiner Aussagesicherheit, Forstwissenschaftliches Centralblatt 88 (4) S: 230-248.