English Translation of:

Anagama: Building Kilns and Firing

By Furutani Michio

First Print Edition

Translated by Shiori Noro
Edited by Dick Lehman and Odin Maxwell

<u>Safety Warnings</u>

If you build an anagama, take the following warnings to heart and use them as a guide during your construction. Being aware of the dangers will help you build a better kiln, and protect your safety.

All forms of construction are dangerous. Kiln building is no exception and quite likely, exposes a kiln builder to more dangers than typical forms of construction. Bricks are heavy and rough. Working with them can easily lead to injuries due to accidents or conditions caused by repetitive motions (e.g., hammering).

Some of the processes described in this book will be impossible to undertake depending on where you live. For example, the author describes a technique for building a kiln frame using fresh bamboo. Fresh bamboo is not readily available in many parts of the world and as a result, alternative techniques are required. Do your research, look into books that explain how to build kilns of all types, how to work with masonry products, texts on general construction, and references for any of the various topics involved in building a kiln.

If you do not have general construction experience, seek out someone who does for advice and help. *Do not think that books alone will be enough to guide you.* When you crawl into a small anagama, there is easily 5000 lbs (2267 kg) of bricks and mortar directly over you. If the structure is weak or poorly built, collapse of the kiln could easily cause death. At a minimum, serious and extensive bodily injury is a certainty.

While we believe this translation is a complete and correct translation of Furutani's book: *Anagama: Building Kilns and Firing*, errors are possible both in the translation itself, and in the techniques described in the original. Double check any plans, techniques, and procedures you decide to use against traditional knowledge on the subject.

Finally, this is not a full list of all dangers inherent in construction of a kiln. Seek professional advice at each step to ensure you are following appropriate safety procedures. Seek inspection by local authorities responsible for construction projects.

<u>Limitation of Liability</u>

If you use this book as a kiln building guide, you agree and understand that you do so at your own risk, that you are aware that the techniques described in this book have not been evaluated by professional kiln builders or masonry engineers, that you are responsible for all precautions required to protect your safety and the safety of others working on the project, and that <u>neither the translators nor the author are liable if you or those working on your project are injured, maimed, or killed</u>.

Preliminary Notes

Regarding the Translation:

The Japanese language does not always convert easily to understandable English. Our foremost goal with this translation has been accurately expressing Furutani's ideas. By the same token, Furutani's widow strongly emphasized her desire that the translation mirror the original text – word-for-word when possible. Working within these constraints, we have left Furutani's original usage in tact as long as it was reasonably understandable, opting to edit for clarity when a word-for-word translation made the text too difficult to understand in English. In all cases, we have attempted to remain true to Furutani's concepts and wisdom.

Paragraph order tracks with the original on a paragraph by paragraph basis. However, sentences within paragraphs were occasionally reordered. If you are fluent in Japanese and discover an error, please let us know immediately so we can make corrections and provide updates. We will of course give you credit for your assistance.

With the exception of names of places and people, all Japanese terms used throughout this book have been italicized. The first time a term appears in the text, it is defined in a footnote and all definitions have been collected in a glossary at the end of the book. We are aware that the frequent use of Japanese may be somewhat cumbersome at first, but there are many instances where there is no suitable "drop in" English replacement. Once you become used to the terms however, it simplifies matters a great deal. For example, it is much easier to use a word like "*shizenyu*" than a phrase like "smooth and glossy natural ash glaze".

Regarding Measurements:

Several old Japanese length measurements are used extensively throughout the book. These are *ken*, *shaku*, *sun*, and *bu*. The author uses a figure of 30 cm as being equivalent to 1 *shaku.* For the sake of consistency with the original, we have used this as the basic conversion factor in converting length to units more familiar in the West. The conversions used in this book are as follows:

	Japanese	**U.S.**	**Metric**
1 *ken*	6 *shaku*	5.9 ft	1.8 m
1 *shaku*	1 *shaku*	11.8 in.	30 cm
1 *sun*	0.1 *shaku*	1.2 in.	3 cm
1 *bu*	0.01 *shaku*	0.12 in.	0.3 cm

Also note, Furutani occasionally provided metric conversions within parentheses in the text. In order to avoid confusion regarding what is and what is not in the original, all translated conversions are contained in footnotes. Where conversion from Old Japanese to metric occurs within the text, those are Furutani's conversions.

Regarding Anagama Glaze Effects:

Furutani uses a number of terms to describe the various effects anagama firing can impart to pottery. Dick Lehman traveled to Shigaraki to speak with Furutani's widow, Kazuya his son, and others to develop a better understanding of the meaning of various terms Furutani used to describe ash glaze effects, and for which no English synonyms exist. Mr. Lehman's research appeared as a feature article in the March, 2004, issue of Ceramics Monthly: “Toward a Vocabulary for Wood-Fired Effects”.

In order stay true to Furutani's text, we are presenting the meanings Furutani attributed to these terms. It is important to understand however, that individual potters sometimes use these terms in individual ways. Because this is a translation of Furutani's work, the terms which follow are defined as Furutani used them.

One final but critical comment is necessary. Although it is possible for the effects described below to appear singularly on a piece of pottery, it is more often the case that they appear in some *combination*. Indeed, it is often true that it is the *interaction* between these effects, which creates moving landscapes on pottery. The firing effects are:

***Bi-doro*:** From the Portuguese “vitrol” meaning “glass”. This refers to glossy streams of natural-ash glaze (*shizenyu*) which terminate in a shiny bead of glass. They may flow over areas on which little or no natural-ash glaze has developed. Sometimes, the streams of glaze drip over areas where the underlying ash-glaze has a contrasting matte finish. Furutani did not refer to streams of glaze with a matte texture as *bi-doro*. Instead, depending on the qualities of such a drip, he would have used the terms *haikaburi*, *shizenyu*, or *youhen*. *Bi-doro* refers specifically to smooth and glassy drips.

***Haikaburi*:** Literally: “ash-covered”. In wood-fired kilns, wood ashes fall on the pottery during firing and melt into a natural-ash glaze. *Haikaburi* is one type of natural-ash glaze which has a matte texture as its fundamental characteristic. This matte texture results when ash deposits pile up on a piece but do not fully melt into a glossy surface. *Haikaburi* and *shizenyu* occupy different points on the natural-ash glaze continuum. *Haikaburi* is simply less melted. It may be helpful to imagine *haikaburi* as being the precursor to *shizenyu* (*shizenyu* being a type of natural-ash glaze which has fully melted and begun to stream down the sides of the pottery).

***Hi iro*:** Literally: “fire color”. This is perhaps similar to “flashing” in the West, but Furutani's examples of *hi iro* seem to have additional characteristics. *Hi iro* refers to changes in the color of the clay body itself due to the interaction between the flames and minerals in the clay. *Hi iro* pottery does not have a buildup of ash glaze. In fact, if ash glaze does develop, the *hi iro* tends to be obliterated. Furutani developed specialized kilns and firing techniques to attain *hi iro* effects.

***Hibuse*:** Hibuse is a term reserved for certain fire-effects that are produced in noborigama kilns. Noborigama kilns can be used to produce glazed pottery. However, because noborigama kilns are fired with wood, there is a potential for unwanted effects to appear in the glaze when wood ashes fall on the pottery. In order to protect the glazed pottery, <u>unglazed</u> pottery is placed at floor level right next to the “firebox” (in reality, this is an open space traveling the width of the chamber into which wood is thrown – it is not physically separated from the loading area). The unglazed “guard” pots are placed in front of the glazed ware and stand between the burning wood and the glazed pottery, thereby protecting the glazed pieces. The unglazed "guard" pots are greatly affected by heat and ash from the wood burned in the chamber. As a result, these pots may develop effects akin to *bi-doro*, *haikaburi*, *koge*, *shizenyu*, and/or *youhen*. For pottery fired in noborigama kilns, these effects are collectively referred to as "*hibuse*". Please take note however, *hibuse* is not used to describe these fire-effects for pottery produced in anagama kilns.

Iga**:** Unglazed high fired ware that appeared first in the 16th century in the Iga area of Japan. Furutani used this term in an manner individual to his own work. He built a unique kiln in Iga and fired it in a unique manner (see page 109). Usually, the pottery he fired in the Iga kiln, was made of clay mined in the Iga region. However, Furutani also sometimes referred to pottery made out of Iga clay but fired in one of his Shigaraki kilns, as Iga pottery. Finally, Furutani would refer to pieces as Iga pottery when the pieces were stylistically similar to Iga pottery and possessed Iga firing effects. The stylistic characteristics of Iga pottery include lugs ("ears") attached to the pieces and thick, abundant, flowing *shizenyu* effects.

Koge**:** Pots near the firebox may be covered with embers during the firing. Burying pots in embers causes cooler firing temperatures for those pots (or the buried portions of those pots). When natural-ash glaze is <u>not</u> allowed to develop on the pieces buried in embers, burial in embers causes the clay to develop dark charcoal-colored or pastel-hued qualities. On the other hand, if *haikaburi* or *shizenyu* is allowed to develop <u>prior</u> to burying the piece in embers, and the firing temperature is sufficiently high, the buried portions of natural-ash glaze will develop a coal encrusted surface. Note that a piece which is partially buried may exhibit *koge* on the buried portion and *haikaburi* or *shizenyu* on the exposed portion.

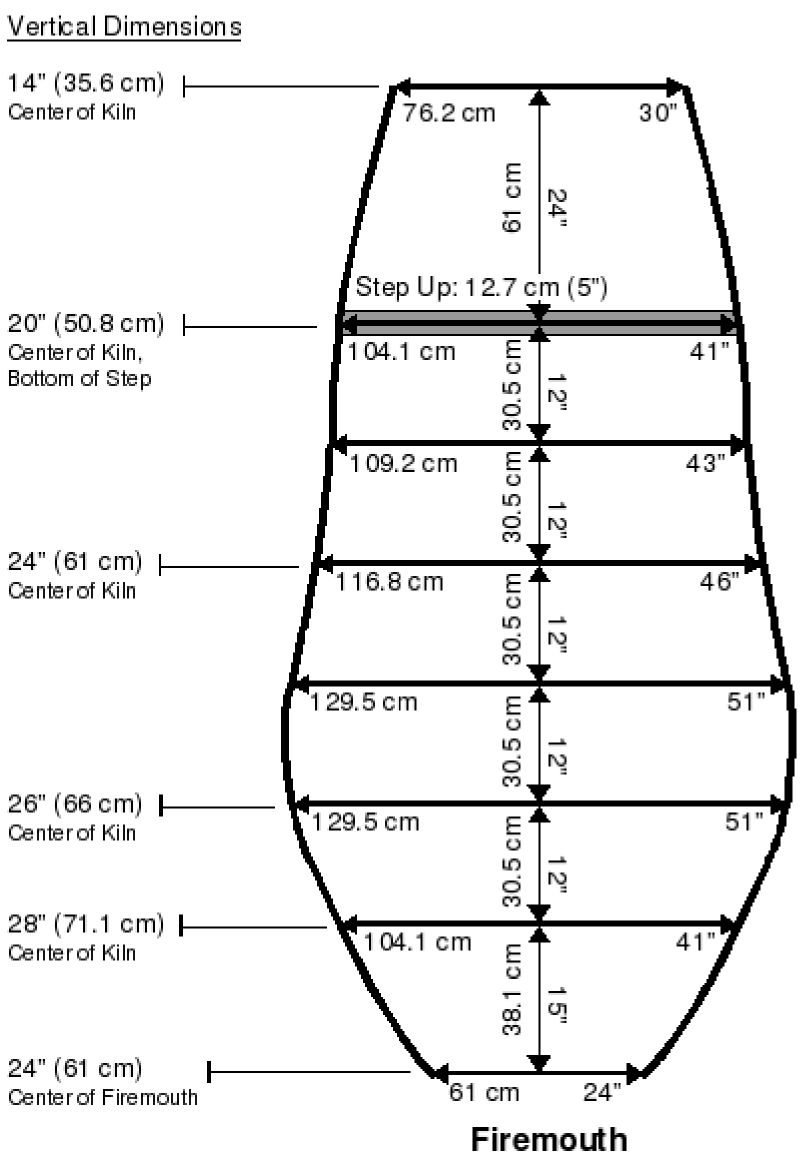
Shizenyu**:** Literally: "natural glaze". In the case of wood-fired kilns, a natural <u>ash</u> glaze develops when ashes fall on the pottery and melt. *Shizenyu* usually develops in the hotter parts of the kiln and refers to natural-ash glazes which are fully melted and glassy. *Shizenyu* and *haikaburi* occupy different points on the natural-ash glaze continuum. *Shizenyu* is simply more melted, glossy, and shows more streaming than *haikaburi*.

Youhen**:** Literally: "kiln change". This term refers to pieces which undergo unexpected changes in color and/or texture during the firing. Note that textural changes in natural-ash glazes are almost always accompanied by color changes. This effect can be seen in the transition zones between *shizenyu* and *haikaburi* or *haikaburi* and *koge*.

Kiln Diagram

Not only did Dick Lehman help complete the language of wood firing, he also braved severe conditions to take measurements of the kiln Furutani shows being built in his book. In his own words:

> *All the local Shigaraki cats had used this kiln as a litter box (for at least two years) before I got in there to measure it, and it was an experience that I'll never forget.*



NOTE: The gray box represents a step up.

Bibliography

We made use of many resources in writing this translation. This included information contained in books, as well as information contained on the internet. Sadly, since beginning this project in November of 2001, most of our web resources have disappeared due to the ephemeral nature of the internet. Rather than fill this book with useless links, we have decided to relegate internet links relevant to this book, to the website devoted to this book:

http://www.anagama-west.com

Hopefully, we will be able to maintain an index of internet reference materials with updated rather than dead links.

The following books are referenced in the translation. Note however, all of these books contain relevant practical or historical information and the complete texts, not just the quoted paragraphs, are important:

- Frederick L. Olsen, The Kiln Book: Materials Specifications & Construction (3rd ed. 2001)
- Isamu Mizoguchi, *Nanban, in* Wood Firing: Journeys and Techniques (The American Ceramic Society 2001) (*collected articles*)
- Louise A. Cort, Shigaraki, Potter's Valley (1st Weatherhill ed. 2000)
- Richard L Wilson, Inside Japanese Ceramics, A Primer of Materials, Techniques, and Traditions (1st Paperback ed. 1999)
- S. Azby Brown, The Genius of Japanese Carpentry (1st Paperback ed. 1999)
- Sen Sôshitsu XV, The Japanese Way of Tea (1998)
- Jack Troy, Wood-Fired Stoneware and Porcelain (1995)
- Penny Simpson et al., The Japanese Pottery Handbook (1979)
- Tsugio Mikami, The Art of Japanese Ceramics (1st English ed. 1972)

Translation Begins After This Page

COLOR PLATE: Shigaraki *Tsubo*[1]

1 A *tsubo* is a vessel comprised of a round body and a comparatively smaller mouth. Though often made from clay, *tsubo* can be made from any number of materials (e.g. Lacquer or metal).

The clay from Shigaraki contains less iron than that of the other *rokkouyou*[3]. This lack of iron contributes to a clay that matures at very high temperatures.

Other types of pottery do not develop the beautiful *hi iro*[4] caused by the flame itself nor the streams of natural-ash glaze [characteristic of Shigaraki pottery]. Many people love the pottery produced in my country because of the masculine charm these effects impart to the pieces.

The kilns from each of the pottery producing regions are unique – they create singular and highly individual pottery. A small difference in the slope of the kiln or the size of the firemouth creates a wide range of differing effects.

Anagama kilns[5] are probably the most difficult kilns to handle and require much patience, practice, and experience to master.

When I first opened my studio, *Houraigama*[6], I built an anagama kiln and fired it several times. Controlling the fire was difficult – one time the fire passed through the kiln too quickly and escaped mostly through the chimney. In that case, the fire left no marks on the ware. In another firing, the kiln never reached a temperature high enough to mature the pottery. It was a disaster.

Furutani Michio[7] has been building anagama kilns for over twenty years. Throughout his research, he has sought *hi iro* and natural-ash glaze effects unique to his own work. I have observed Mr. Furutani's pottery from its early stages and I can now say, that after much research and effort, he has recently achieved his goal. Every year, Mr. Furutani presents his pieces in Tokyo. In *Heisei* Third[8], Mr. Furutani won the *Taisho*[9] in the *Nihon Kogeikai Kinki* Exhibition[10].

I have heard that Mr. Furutani spent many years researching kilns. He has constructed, deconstructed, and reconstructed more than 30 kilns. Further, he has kept careful record of the effects caused by alterations in the slope of the kilns as well as changes to other design variables.

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2 Shimizu Uichi is a "Living National Treasure" of Japan.

3 The six famous ancient "kilns" of Japan. This refers to the pottery producing regions of Seto, Tokoname, Shigaraki, Echizen, Tanba, Bizen. Louise A. Cort, Shigaraki, Potter's Valley 20 (1st Weatherhill ed. 2000); Tsugio Mikami, The Art of Japanese Ceramics 115 (1st English ed. 1972).

4 Literally: "fire color". This is perhaps similar to "flashing" in the West, but Furutani's examples of *hi iro* seem to have additional characteristics. *Hi iro* refers to changes in the color of the clay body itself due to the interaction between the flames and minerals in the clay. *Hi iro* pottery does not have a buildup of ash glaze. In fact, if ash glaze does develop, the *hi iro* tends to be obliterated. Furutani developed specialized kilns and firing techniques to attain *hi iro* effects.

5 The phrase "anagama kiln" is used here for purposes of readability. One should note however, that this is internally redundant because "*gama"* actually means "kiln" ("*ana"* means "hole"). One last note, "kiln" as word by itself is "*kama*" - the "k" changes to a "g" in *anagama* because it "sounds better".

6 This was the name of Shimizu Sensei's studio.

7 Japanese names follow the Japanese pattern, i.e., last name first, followed by the given name.

8 *Heisei* third is the year 1991. This calendar system is based on the identified emperor's reign, starting with his first full year in power. In this case, 1991 was the third full year of *Heisei's* reign.

9 Literally: big prize.

10 This is a regional industrial art exhibition centered in the Kinki region. The Kinki region covers Osaka, Kyoto, Kobe, and surrounding areas.

Building an anagama requires an incredible amount of hard work, and although some may dream about doing it, few ever do.

Mr. Furutani is one of those few and I would like to give him credit for his efforts.

Mr. Furutani wrote this book from an artist's point of view explaining in detail how to build, load, and fire anagama kilns.

It must have been a very difficult decision for him to reveal all of his secrets.

Because of the wealth of information presented in this book, those who seek to be potters will find it very precious.

I applaud Mr. Furutani.

March 21, 1994
Shimizu Uichi

Introduction by Furutani Michio:

I admired Kyoto pottery and for five years, I studied its fundamental techniques with Uchida Kunio Sensei. One day, I felt haunted by a desire to experience other types of pottery. I set out by bicycle without any plans or money. I met famous potters, craftsmen at pottery centers, and various other people during my journey. [Along the way], I developed a deep romance for the pottery of the region in which I was born and raised: Shigaraki.

Upon returning to Shigaraki after my two year journey, I took up the challenge of building an anagama. I had no knowledge of how to build an anagama – I had only a pottery shard I found in the ruin of an old kiln. With trial and error as a guide, I have built my anagama kilns in my own way, using my discretion and personal preferences. For 20 years, I have built these kilns as if in a dream or a state of perfect selflessness. Those years, and my 30-plus anagama kilns, have come and gone quickly.

One kiln I fired just once. I used a different kiln for more than 10 years. Another kiln I built after I woke up one day with a new idea and thought: "this is it!" Once, during a trip to a museum, I met an old Shigaraki piece and immediately built yet another kiln. For a time, I was injured and could not use my [regular] kilns so I built one I could fire even on crutches. Sometimes, I would find that my work had turned out to be exactly the opposite of the way I had hoped it would be. Sometimes, these unexpected results would excite me. By changing the firing conditions or rebuilding the kilns, I was able to move toward the work I envisioned.

During my journey, I met Ms. Ayako Tsutsumi, a potter from Kasama, Ibaraki prefecture. She strongly encouraged me to write this book. [Her encouragement led me] to begin writing it two years ago despite the fact that writing is not my strongest skill.

This book focuses on building and firing anagama kilns. It is rooted in my experiences and although I cannot explain everything logically, I will be happy if my small experiences help those who intend to build an anagama, or those who are already working with one.

I sincerely thank Living National Treasure Shimizu Uichi Sensei, who made too much of my little book in his introduction, for his kind words.

I am also deeply thankful to Mr. Ryozo Takai and the staff members at the *Shigaken Shigaraki Yougyo Shikenjo* for providing me with related material for this book. Additionally, I want to thank the Shigaraki Ceramic Cultural Park for the assistance and advice I was given. To Ayako Tsutsumi, who went to great trouble concerning the diagrams appearing in this book, I wish to express my profound gratitude.

May 1994
The Author

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Chapter 1: Shigaraki's Ancient Kilns

A. The Advent of the Kiln

It is believed that pottery made during the *Jomon*[11] and *Yayoi*[12] periods was pit-fired. Presently, this method is still practiced in some parts of southeast Asia. In pit-firing, a shallow hole is dug in the ground and then lined with branches or other firewood. Dry pottery is laid on its side over this fuel to capture heat. The pottery is then covered with dried weeds and twigs.

Most of the heat generated by the fire during a pit firing is lost. The temperature will rise to 600 - 700 ºC[13] at most. Out of necessity, potters had to find a way to prevent heat from escaping.

The next advance in pit firing involved digging a shallow hole, lining it with with fuel, laying the pottery over this fuel, and piling more fuel over top. The pottery was thus sandwiched between the burning fuel sources.

Efficiency was still poor even when firing in this manner. Eventually, ancient potters came up with the idea of firing in rectangular holes dug into the slope of a hillside. These holes were similar to the type farmers used for storing seed potatoes. The entrance was blocked during firing to prevent heat from escaping – it is thought that anagama kilns evolved in this way.

CAPTION: Pit Firing (Shigaraki Ceramic Cultural Park)

11 8000 – 300 BC.
12 300 BC – 300 AD.
13 1112 – 1292ºF.

Following the covered-hole type kiln, the next [advance involved] building a tunnel which could be closed [at the entrance]. Because fire naturally flows upward, the tunnel was dug at an incline in order to provide sufficient draft through the kiln. This allowed heat to stream upwards and fire the kiln – it was the prototype of anagama kilns.

It is thought that the advent of anagama kilns was sparked by strategies intended to cure the heat-loss-deficiencies inherent in pit firing.

In my country, anagama kilns did not evolve naturally from pit-firing techniques. It is said that kilns were brought [to Japan] from the Korean peninsula, possibly from the Kudara region. There were two anagama styles: one type was fully-underground and the other type was half-above-ground.

The fully-underground kilns were dug into the slope of a hill. The old anagama kiln ruins which have been discovered to date, have a slope between 2 *sun* 5 *bu* and 3 *sun* 5 *bu*[14]. In other words, for every 1 *shaku*[15] [of horizontal travel] along the inclined tunnel dug into the slope, the rise[16] was approximately 2 *sun* 5 *bu* to 3 *sun* 5 *bu*[17]. At the end of the tunnel, a chimney-like structure was dug out thus creating the the original fully-underground style of anagama.

Through trial and error, the fully-underground anagama kilns later evolved into the half-above-ground style. Presumably, a trench would be dug and then a ceiling framework constructed with branches. This framework was then be covered with clay.

Fully-underground kilns evolved into the half-above-ground style, I can say, because the underground anagama kilns have a problem with moisture and repair is almost impossible. If the kiln is built above ground, the kiln can be repaired and its use may continue.

CAPTION: Ancient Kiln Remains in Nakaide

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14 2.5 – 3.75 in. (6.4 – 9.5 cm). Note, several old Japanese linear measurement units are used quite extensively throughout this book: *shaku*, *sun*, and *bu*. There are 10 *bu* per *sun* and 10 *sun* per *shaku*. Furutani used 30 cm as a conversion factor for *shaku*. We have adopted that conversion factor, consequently, 1 *shaku* = 11.8 in. (30 cm). 1 *sun* = 1.2 in. (0.3 cm). 1 *bu* = 0.12 in. (0.3 cm).

15 11.8 in. (30 cm).

16 In other words, the vertical travel.

17 2.5 – 3.75 in. (6.4 – 9.5 cm).

If it is true that kilns built partly above ground are easier to repair, why didn't the underground anagama kilns immediately evolve into a fully-above-ground style instead of the half-above-ground style? I assume it is because the half-above-ground style is easier to build.

Anagama kilns can be made with straight sidewalls up to half the kiln height. One can avoid building the side-walls altogether by digging out the bottom half and then building only the ceiling. I think this is the reason kilns built partially above ground replaced tunnel kilns.

The *waritake*[18] style kiln was the next anagama advancement. This style of kiln is built half above ground level and has contiguous anagama chambers. It is divided into separate chambers by partition walls placed every several meters[19] through the kiln. Each partition wall has openings at the bottom to let the fire pass through to the next chamber. In this way, each successive chamber stores heat. Given its configuration, it is natural to think that *waritake* kilns were the predecessor to noborigama kilns.

Jagama[20] kilns are similar in construction to w*aritake* kilns. This style of kiln is unique to Japan and can be seen only in Tachikui, Tanba. *Jagama* kilns are built on a mountainside and their extreme length gives them the appearance of a snake.

I will digress for a moment to speak about Tanba's *jagama*. Some *jagama* kilns exceed 30 m[21] in length. *Jagama* kilns have side-stoking ports spaced a little less than a meter[22] apart along the body of the kiln giving them the appearance of the "eight-eyed-eel decoration". When pottery is loaded into the kiln, an open space for the fire is left below[23] each side-stoking port. Rather than having partition walls, vases (*tsubo*) and jars (*kame*) are densely packed across the width of the kiln after the side-stoking ports.

Each piece fired in a *jagama* has a very distinct front and back. The difference between the landscape on the side facing the fire, and that on the side facing away from the fire, is very distinct. This is how the *shizenyu* landscape of Tanba pottery is born.

CAPTION: Tanba *Jagama*

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18 "Cut Bamboo".

19 1 meter = 3 ft., 3.4 in.

20 "Snake kiln". For more information, see Isamu Mizoguchi, *Nanban, in* WOOD FIRING: JOURNEYS AND TECHNIQUES (The American Ceramic Society 2001) (*collected articles*).

21 98 ft. 5 in.

22 39.4 in.

23 This space is left completely open for the entire width of the kiln thereby providing an area into which wood can be thrown and burned.

Firing proceeds according to the conditions of the kiln. The temperature in each section is raised by the passing flames and once one section has reached temperature, stoking simply moves to the next. Unlike the prolonged firing required by Shigaraki's anagama kilns, this method results in a very short firing time.

Also, it is said that in Tanba's *jagama* kilns, sheafs of rice straw tightly bound so that they are the same circumference as the stoking ports, are thrown into the kiln in addition to firewood.

In some of the ancient work from Tanba, the pottery appears to have a white glaze. The glaze looks like *hagi*[24] and forms rope shaped streams over the *bi-doro*[25]. It is the melted rice straw ash which creates the look of *hagi* glaze.

Because *jagama* kilns are fired in this manner, the kilns hold heat poorly. I have heard that the lower chambers can be unloaded while the top chambers are still firing. Tanba's *jagama* kilns represent a very wise and logical use of the inherent tendency for fire to rise.

In contrast to Tanba's *jagama* kilns, Shigaraki's anagama kilns capitalize on the ability of kilns to hold heat. As a result, anagama kilns take a long time to fire. Additionally, Shigaraki's and Tanba's clay compositions are different. The very different *shizenyu*[26] and *yakishime*[27] effects of the finished pottery [from these two regions], demonstrate these differences.

Also of note, in Bizen, there is a large kiln which exceeds 50 meters[28] in length.

In a historical timeline of kilns, noborigama kilns appeared later in time and there are many theories surrounding the advent of noborigama technology. Noborigama kilns were imported from the Korean Peninsula during the *Momoyama* period[29]. They spread rapidly all over the country and [potters] began to fire them everywhere.

CAPTION: Tanba *Tsubo*

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24 A white crackled and/or crawled glaze. With *hagi* ware, the color changes over time as it is used.

25 From the Portuguese "vitrol" meaning "glass". This refers to glossy streams of natural-ash glaze (*shizenyu*) which terminate in a shiny bead of glass. They may flow over areas on which little or no natural-ash glaze has developed. Sometimes, the streams of glaze drip over areas where the underlying ash-glaze has a contrasting matte finish. Furutani did not refer to streams of glaze with a matte texture as *bi-doro*. Instead, depending on the qualities of such a drip, he would have used the terms *haikaburi*, *shizenyu*, or *youhen*. *Bi-doro* refers specifically to smooth and glassy drips.

26 Literally: "natural glaze". In the case of wood-fired kilns, a natural ash glaze develops when ashes fall on the pottery and melt. *Shizenyu* usually develops in the hotter parts of the kiln and refers to natural-ash glazes which are fully melted and glassy. *Shizenyu* and *haikaburi* occupy different points on the natural-ash glaze continuum. *Shizenyu* is simply more melted, glossy, and shows more streaming than *haikaburi*.

27 After a piece is formed out of clay, it is fired "as is" without the addition of glaze.

28 164 ft.

29 1573 – 1603 AD.

Page 5

There are many differences between anagama and noborigama kilns. The main structural difference is that in an anagama, the firebox[30] and the ware chamber are not separated. The very first room in a noborigama is the firebox. The ware chambers follow the firebox in order: first chamber, second chamber, etc., and are clearly separated from the firebox. This is the greatest distinction between anagama and noborigama kilns and it is this difference that is responsible for the many differences between their fired results.

For example, although noborigama kilns require a large amount of time to reach temperature, they cool slowly and as a result, noborigama kilns are efficient. [In contrast,] it is easy to make an anagama's temperature rise if the conditions are favorable. However, it is unavoidable that anagama kilns cool quickly.

In noborigama kilns, the chamber temperature does not fall drastically when the firemouth is opened during firing. With anagama kilns, when the firemouth is opened during firing, the temperature immediately becomes uneven and irregular.

This is one of the many ways in which noborigama and anagama kilns are structurally and characteristically different.

In modern times, coal fired downdraft kilns have emerged (this same structure can be fired with crude-oil). Gas kilns have also appeared as well as electric kilns which use electrically generated heat. I would like to give a rudimentary explanation of how the shapes of these contemporary kilns relate to flame movement using the diagram [on Page 6].

CAPTIONS
Top: Noborigama at Shigaraki Ceramic Cultural Park
Bottom: Noborigama in Shigaraki

30 We have chosen "firebox" because there is no other efficient English replacement. In the context of this book, "firebox" simply refers to that portion of the anagama chamber where firewood is burned. It is not actually a separate structure from the main kiln chamber.

If pottery is stacked inside a chimney and a fired [i.e., a fire is burned below the pottery,] the kiln can be thought of as an updraft kiln. If this chimney is laid on its side so that the heat is drawn across the kiln, it becomes a cross-draft kiln. In a downdraft style kiln, the flame first rises and then the chimney's draft pulls the flame down [through the kiln] before allowing it to escape. A kiln which is built at a slant, with the pottery stacked in the middle and a fire burned at the lower end, is an anagama. Noborigama kilns can be thought of as a combination of the anagama and downdraft style kilns.

It is clearly understandable why downdraft kilns produce the most even temperature distribution among these kiln styles. It is said that updraft kilns are the least efficient. In the case of the cross-draft style, the upper portion of the kiln has a good temperature distribution but the lower end has a very poor temperature distribution.

These four fundamental patterns of flame movement apply to all modern kilns.

In my country, at least until the appearance of coal, crude-oil, gas, and electrically fired kilns, pottery was continuously fired in the various kinds of kilns I described.

B. Shigaraki's Ancient Kilns

In ancient Oumi (Shiga Prefecture) starting in the *Sueki* period[31], immigrants from the Korean peninsula traveled over the mountains through Echizen bringing many significant cultural changes with them. 1250 years ago (*Tenpyou* 14[32]) Emperor Shoumu built the Shigaraki-no-Miya castle and it is evident that the roof tiles were fired nearby[33]. There is a theory that the roots of Shigaraki's ceramics industry began with the construction of this castle. However, it is still unknown [precisely] where the roof tiles were fired and the precise [location] of the kiln ruin is also unknown.

CAPTION:
Kiln Styles

a) Downdraft system
b) Updraft system
c) Slant-draft system
d) Cross-draft system

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31 5th Century AD.
32 742 AD.
33 For more detailed history, see also: LOUISE A. CORT, SHIGARAKI, POTTER'S VALLEY 11 (1st Weatherhill ed. 2000).

A seed jar[34] was found underneath the foundation stone of the central pillar from the *Kamakura* period[35] tower ruins at the Gamougun Hinomachi Kudara temple in Shigaraki. This seed jar is thought to have contained the relics of a Buddha. The ruins of the kiln used to fire this jar have also not yet been found. What the discovery of this seed jar would lead one to believe however, is that pottery has been regularly fired in the Shigaraki region since the *Kamakura* period.

Although the date of the initial appearance "old Shigaraki ware" is not yet precisely known, the regular firing of Shigaraki ware can be considered as beginning with anagama kilns. When [Shigaraki's] anagama period ended, its noborigama period began. The shift from anagama to noborigama kilns in Shigaraki occurred during the *Edo* period[36].

Dating [Shigaraki's ceramics history] becomes more precise around the *Goinoki* kiln[37] period. There is a pass between Shiga and Mie prefectures called the Goinoki pass. The *Goinoki* kiln is a kiln ruin in the Goinoki pass which dates from the *Muromachi* period[38]. The kiln was often used to fire *tsubo* and people in Shigaraki call this kiln: *Tsubogama*. The remains definitely indicate that this kiln was an anagama. Although *Tsubogama* is many times larger than my current kilns, I have used it as a model for my own anagama kilns. It is sometimes called "*Iwagama*" because it was carved into a layer of clay.

CAPTION: A View of Shigaraki

34 These were small to medium sized jars used to soak seed rice before planting. Louise A. Cort, Shigaraki, Potter's Valley 61 (1st Weatherhill ed. 2000).

35 1185 – 1333 AD.

36 1603 – 1868 AD.

37 Additional information can be found at: Louise A. Cort, Shigaraki, Potter's Valley 368 (1st Weatherhill ed. 2000).

38 1333 – 1573 AD.

The *Goinoki* kiln site is presently in Shiga prefecture which formerly was the Oumi region. However, this region was named "Iga" when much pottery was being fired there. So, *Goinokigama* is an ancient kiln of the Iga area. If somebody asked whether it should be called an ancient kiln of Shigaraki or Iga, the answer is that it is from both areas and cannot be clearly defined as being from one or the other. In fact, there are many kilns which lay on the border between Shiga prefecture and Mie prefecture. The *Goinokigama* demonstrates that prior to the *Momoyama* period[39], Shigaraki ware and Iga[40] ware were fired in the same areas under the same conditions. Consequently, it is extremely difficult to differentiate between early Iga and Shigaraki pottery.

Shigaraki also holds the remains of an anagama built partially above and partially below ground level. The *Nakaide* kiln[41] remains in Miyamachi are close to the ruins of Shigaraki no Miya castle. *Nakaide* kiln had a central wall which supported the ceiling of the kiln. This design divided the kiln into two parallel chambers with the central wall channeling fire into the left and right chambers. The fire traveled through the kiln separated in this manner until rejoined at the chimney. It is believed that this kiln was built during the same period as *Goinokigama*. The *tsubo* shards still remaining at the kiln site indicate that this kiln was in use for a long period of time.

CAPTIONS:
Top Right: *Nakaide* Ancient Kiln
Bottom Left: *Momoyama* Period *Mimitsuki Iga Hanaire*[42] (Attached Ear Iga Flower Vase)
Bottom Right: *Nakaide*, First Kiln (Distributed by Shigaraki Educational Committee)

39 1573 -1603 AD.

40 Unglazed high fired ware that appeared first in the 16th century in the Iga area of Japan. Furutani used this term in an manner individual to his own work. He built a unique kiln in Iga and fired it in a unique manner (see page 109). Usually, the pottery he fired in the Iga kiln, was made of clay mined in the Iga region. However, Furutani also sometimes referred to pottery made out of Iga clay but fired in one of his Shigaraki kilns, as Iga pottery. Finally, Furutani would refer to pieces as Iga pottery when the pieces were stylistically similar to Iga pottery and possessed Iga firing effects. The stylistic characteristics of Iga pottery include lugs ("ears") attached to the pieces and thick, abundant, flowing shizenyu effects.

41 Additional information and pictures can be found at: LOUISE A. CORT, SHIGARAKI, POTTER'S VALLEY 346, 353 (1st Weatherhill ed. 2000).

42 *Hanaire* are vessels for flower arrangement. Materials include metal, porcelain, pottery, bamboo, and wood.

During the *Momoyama* period[43], Shigaraki ware and Iga ware became characteristically different. Tea masters from the capital visited Iga and Shigaraki. Sen Rikyu[44] and Takeno Jouou[45] came to Shigaraki, examined numerous vessels, and then took them back to the capital to use as tools for the tea ceremony. Furuta Oribe[46] came to Iga and commissioned tea tools made to his own design. It is at this point that the Shigaraki and Iga styles became differentiated.

Todo Takatora[47] was a governor of Iga *han*[48] and Tsutsui Sadatsugu[49] was a *samurai* of another *han* who was very interested in tea. Todo, Tsutsui, and other *samurai* tea people, worked to establish Iga as a tea center. If someone speaks of Iga pottery, the image of tea ware [immediately comes to mind]. In this way, the differentiation between Shigaraki tea utensils and those made in Iga was accentuated.

As I explained earlier, before the *Momoyama* period[50], it is difficult to distinguish between Shigaraki and Iga ware because they had so much in common. There is a saying in the tea ceremony world: "Iga has ears, Shigaraki does not have ears." Even this, however, has an exception. *Namazume hanaire*[51] is an Iga vase that does not have ears. In many ways, the ancient Shiga and Iga works cannot be clearly distinguished.

To date, the ruins of old anagama kilns used for firing old Shigaraki ware between the *Muromachi* period[52] and the *Momoyama* period[53], have been found in Shigaraki at Miyamachi, Nakaide, Kouyama, Goinioki, Kinose, Hanshi, Chokushi, Sungoe, Maki, Urushihara, Nagano, Kamagatani, Minamimatsuo, and many other places.

That is the general outline of how kilns evolved from their historical origins into their contemporary forms. This description was meant to provide some background to the pottery environment for the place in which I live: Shigaraki.

CAPTION: *Nakaide* Ancient Kiln (at *Shigaraki Miyamachi*)

43 1573 -1603 AD.

44 Lived 1502-1555, Tea Master. Shogun Hideyoshi ordered Sen Rikyu to commit *Seppuku* (ritual suicide). For more detail see: SEN SÔSHITSU XV, THE JAPANESE WAY OF TEA (1998).

45 Lived 1552-1591, Tea Master. For more detail see: SEN SÔSHITSU XV, THE JAPANESE WAY OF TEA (1998).

46 Lived 1544-1615, Tea Master.

47 Lived 1556-1630.

48 *Han* were regional divisions used before the prefectural system came into being. Prefectures are called *ken*.

49 Lived 1562-1615.

50 1573 -1603 AD.

51 *Namazume Hanaire* is the name of a specific *hanaire*. Tea master-samurai Furuta Oribe (1544-1615) gave it this name because he felt that parting with it, would be as painful as ripping out his fingernails. *Namazume* literally means "raw fingernails".

52 1333 – 1573 AD.

53 1573 -1603 AD.

My home, Shigaraki, is the location of one of the *rokkouyou*[54] and it has a long history as a ceramic center. Growing up here, I have naturally been touched by the weight of this history. Shigaraki's historical ceramic environment caused me to look toward the anagama. It was unavoidable.

Anagama kilns are historically the oldest, and systematically the most primitive structure. As such, it is the ancestor to the various modern kiln types. Anagama-fired pieces are born out of a battle between clay and fire. From ancient times to the present, anagama kilns have produced strong, rustic, and mysteriously beautiful pieces. Even the kilns themselves are beautiful. Where does the secret of this wonderful beauty and longevity come from?

Modern society focuses on capturing the scientific, logical, and economic aspects of life. In this process, many things have been forgotten. Anagama kilns recall fundamentally human values such as a sense of spirit or soul. To a certain degree, the very reason anagama kilns exist, is rooted in the fact that they possess defects in logic and ignore efficiency.

Gas and electric kilns are simple to control, logically designed, and ubiquitous. However, many young potters have become interested in anagama kilns. They have been building their own anagama kilns and experimenting with firing these kilns. I am very pleased with this trend and I hope this book will be useful in some small way. In the next chapter, I will start a detailed explanation of the anagama kilns I have built.

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54 The six famous ancient kilns of Japan, i.e., Seto, Tokoname, Shigaraki, Echizen, Tanba, Bizen. LOUISE A. CORT, SHIGARAKI, POTTER'S VALLEY 20-22 (1st Weatherhill ed. 2000).

Chapter 2: Anagama Kilns I Have Built

a. Description of Anagama Kilns

As I described earlier, anagama kilns are somewhat like a pit-fire with cover designed to capture the heat rising from the fire. Additionally, anagama kiln structures are fundamentally similar to noborigama kilns as well as the original tunnel-kilns dug into mountainsides. Each of these kiln types has a slope. This slope allows heat rising from a fire burning at the lower end to cause a temperature rise in the kiln chamber or chambers.

B. Pros and Cons of Anagama Kilns

In analyzing the positive and negative aspects of anagama kilns, it makes the most sense to compare anagama kilns to noborigama kilns. Let's do just that:

i. The Firebox and Firing Chamber

The most basic structural difference between anagama and noborigama kilns, is that in an anagama, the firebox and the loading space form a single chamber. A large noborigama may have up to 15 chambers. Each noborigama chamber has a narrow area devoted to fire and in this sense, the loading space and firebox comprise a single chamber just as with anagama kilns. However, there is a precise dividing line between a noborigama kiln's firebox and its loading spaces. This difference in construction results in many differences in the fired results.

CAPTION: Anagama Kilns Combine Firebox and loading Space in One Chamber
(Shigaraki Ceramic Cultural Park)

ii. Firing Rhythm

Because of the noborigama's huge capacity, it may only need to be fired once or twice a year. On the other hand, anagama kilns have a small capacity and can be fired once or twice a month – this can be very handy.

In noborigama kilns, all of the chambers should be filled before firing. [In order to fill all the chambers of a noborigama,] I would have to load the kiln with much pottery of a type I am not seeking[55]. Although it is possible to load and fire fewer than all of the noborigama chambers, the real purpose of a noborigama kiln is to make [efficient] use of the excess heat by firing all chambers.

In contrast, a trained potter can fully define the limits of an anagama's atmosphere and thereby fire only the pieces desired. This is an advantage of anagama kilns.

iii. Stoking Techniques

In taking on the challenge of firing an anagama for the first time, one will find that it is the most difficult kiln to handle. This can be an advantage and alternatively, it can be a disadvantage depending on the technique of the person handling the kiln.

For example, in noborigama kilns, it is relatively simple to raise the temperature in a particular area of a chamber – all one must do is throw firewood near the area which needs extra heat. This convenient method cannot be used in anagama kilns. [Note however], even with noborigama kilns, skillful technique is required. Some noborigama kilns are eight meters[56] wide. Wood is fed into both sides of the kiln and it may have to be thrown as far as four meters[57].

CAPTION: In Noborigama Kilns, the Firebox and loading Space is Divided (Shigaraki)

55 The author is implying in this passage that the fired results from most parts of noborigama kilns are not the results he is searching for. However, in order to efficiently fire a noborigama, its entire volume must be filled. This would result in production of a large amount of filler pottery and a relatively small proportion of pieces with fired effects that would appeal to the author.

56 26.2 ft.

57 13.1 ft.

In contrast, an anagama has only one firemouth and it is located at the front of the kiln. [Stoking the kiln] feels more like "dropping wood" than throwing. One advantage anagama kilns have, as that even untrained people can easily place wood into the correct spot.

Note, noborigama kilns are generally large and hold a lot of heat. As a consequence, missing the correct moment to stoke will not cause the temperature inside the kiln to rise or fall significantly. Even opening the stoking port will not cause the temperature inside the kiln to fall drastically.

Remember that in an anagama, the firebox and loading chamber are one and as a result, the kiln has little ability to hold heat. Right after opening the firemouth, the temperature immediately becomes uneven and if the timing for throwing wood is off just a little bit, an anagama's temperature drops drastically. By the same token, if the timing is well met, throwing just one piece of wood is exquisitely efficient at causing the temperature to rise.

Consequently, if one has a good understanding of the type of wood to burn, the size to cut it, the amount to use, and how to time the throwing, anagama kilns are very easy to handle.

In noborigama kilns, the firing must proceed "by the manual" to a certain degree. With anagama kilns, each person has a unique technique. Even with the same kiln, if different people fire the kiln, it will produce a completely different atmosphere and completely different finished results.

iv. Visually Monitoring the Firing Progress

In an anagama, the pottery sits near the firemouth literally within reach. With a practiced eye, one can avoid relying on hunches and instead, fire by observing the ware from the firemouth using visual confirmation to control the final results.

CAPTION: Looking at a Side Stoking Port from Inside a Noborigama.

By looking into the kiln, one can see how much *shizenyu* covers the pieces, how much it is flowing, and the extent to which feldspar contained in the clay has burst to the surface. All these effects are visible and seeing them allows one to understand the conditions inside the kiln. This is a positive aspect of anagama kilns.

v. Temperature Control

When evaluating the temperature of noborigama kilns, potters typically rely on cones or pyrometers combined with visual checks of the color through peep holes. In anagama kilns, the pottery sits right behind the firemouth. When compared to noborigama kilns, this is very convenient in many ways.

The greatest difficulty in firing anagama kilns is the temperature difference between the front area near the fire, and the space in the back of the kiln. Generally, there is a large temperature difference between the front and back of the kiln. This can be adjusted through firing technique, the structure of the kiln itself, and well planned loading of the pottery. These techniques are fundamental when firing anagama kilns.

Even though the structure of anagama kilns is apt to cause an uneven firing temperature, one who can control and adjust the temperature well can fire pottery close to his or her aim. No other kiln can provide this sense of joy.

vi. Duration of Firings

There is normally little difference in the length of firing time between an anagama and an ordinary noborigama. In my case, I usually fire for four and a half days. Some potters take as long as 12-13 days to fire – each person's methods for deciding when the firing is complete are unique.

CAPTION: Cat's Hole [i.e., Peep Hole].

vii. Economic Comparison

Let's compare a single firing from a noborigama to that of an anagama. It is almost pointless to make the comparison because anagama kilns are so much less efficient. Suppose one noborigama can fire 1500 pieces at once. Depending on its size, an anagama can fire approximately 50 pieces. Therefore the ratio is about 30 to 1 – it can even be worse.

We do not consider economic efficiency very much when designing anagama kilns. [Accept that] there is a large economic difference on a per piece basis between noborigama and anagama kilns.

Even with anagama kilns, when aiming for a certain level of quality in each firing, one must thoroughly research and investigate kiln design and make something akin to a manual to guide firing at first. In this way, efficiency can be improved considerably.

viii. What is the Kiln's Purpose?

Noborigama kilns are for glazed ware. Anagama kilns are for unglazed or *shizenyu* pottery. This is the main difference between the purposes for these kilns.

The functional limitations of these kilns is based, I would say, in their characteristic structures.

In summary, the differing personalities of noborigama and anagama kilns are rooted in the differences between their structures.

C. Why Choose Anagama Kilns?

Paradoxically, I may say that anagama kilns have no good points. [However,] I believe that I can come close to making pottery with a landscape that is almost impossible to achieve by studying the structure of anagama kilns, types of clay, loading patterns, and firing methods. The reason I fire anagama kilns is the everlasting potential of this search. This reason alone thoroughly covers all of an anagama's demerits.

CAPTION: Many Pieces Can Be Stacked Inside a Noborigama.

Early in my career as a potter, I built one noborigama. Although noborigama kilns have large chambers, there are few prime firing spots within the chambers capable of developing the results I desire.

Even with anagama kilns, at least large ones, it is likewise true that only certain areas of a kiln will be suitable for producing the desired work. Having built many anagama kilns and gained experience with each, [I believe that] to a certain extent, it is possible to achieve the final result one desires.

In the example of noborigama kilns, it is impossible to produce a single type of atmosphere even if one makes the attempt. However, with anagama kilns, if *youhen*[58] pottery is desired, it can be achieved to a certain extent with planning. By changing the design of the kiln itself, a single atmosphere can be created within the kiln which will produce *youhen* pottery. Anagama kilns possess such potential.

Think about whether the kiln itself, or the pottery is your priority. This will determine your choice of kiln. With noborigama kilns, the kiln is the priority and the pottery must conform to the kiln. With anagama kilns, the structure of the kiln can be altered to fit one's goals for the pottery. Because different results are possible, I can say that anagama kilns are “pottery priority kilns”.

[In terms of my personal kiln choice], the answer appeared after I fired various anagama designs using various firing techniques.

CAPTION: The Hidden Potential of an Anagama Kiln's Interior.

58 Literally: “kiln change”. This term refers to pieces which undergo unexpected changes in color and/or texture during the firing. Note that textural changes in natural-ash glazes are almost always accompanied by color changes. This effect can be seen in the transition zones between *shizenyu* and *haikaburi* or *haikaburi* and *koge*.

For some people, it is natural to think that anagama kilns are harder to handle and other kilns are easier to fire. I am not completely obsessed with anagama kilns. However, an anagama is the most suitable kiln for the pieces I most wish to make. Anagama kilns listen to me and accept what I say. In this way, they are easy to care for.

However, anagama kilns are powerfully unique when compared to other kilns. In order to survive this unique kind of kiln, the clay itself must be strong enough to endure the stress. I will explain about clay in a later chapter but for now, suffice it to say that Shigaraki clay has a strong willed and wily character that is well suited to the personality of anagama kilns. I am attracted to the interesting charm and strength of Shigaraki clay and I will continue to use anagama kilns to fire Shigaraki clay.

D. Anagama Kilns I Have Built

i. The First Anagama I Built

I have built anagama kilns of various designs. I cannot recall the exact number, but I have built close to 30 kilns for my personal use. Numbered among these was one noborigama – all the others were anagama kilns.

Here are examples [of issues I faced with my anagama kilns]: the kiln may be good but no matter what is tried, the particular *hi iro* effects sought do not result. The four variables: clay, kiln design, how the kiln is fired, and how the ware is stacked, should produce the effects sought [when in balance]. However, with failures I sometimes cannot guess which of the four variables is the culprit.

In the case of failed *hi iro*, the first thing to do is to change the clay. If changing the clay does not produce a satisfactory result, rethink the method of firing.

In my case, when I was technically immature, I would think that I had changed the firing plan, however, I had many experiences in which my changes had very little effect on the results. At long last, I finally realized that I had to modify the kiln structure itself.

CAPTION: Shigaraki Clay Mine

I would change the slope of the kiln, the height of the ceiling, or the width of the kiln – I tried many things and [in the process,] discovered that a very small change in the kiln's structure could have a dramatic effect on the finished pieces. For example, I found that some kiln structures are best suited for obtaining *hi iro* while others are best for *youhen* pottery. I categorize my kilns by structure and build different kilns for different reasons.

My first kiln was a copy of the ancient *Goinoki* anagama kiln structure[59]. I was also constructing a noborigama while I was building this anagama but I fired the anagama first. Unfortunately, I could not achieve the result I was looking for in my first firing.

Thinking back, I realize that my only experience had been with gas and electric kilns. Aside from lacking familiarity with wood-firing, my first experience with dancing flames shooting more than 10 *shaku*[60] out of the chimney filled me with fear and dread. So much so in fact, that I put out the fire and caused the failure.

The noborigama was a condensation of the knowledge I had learned on my journey[61] [around Japan]. My goal was to fire several types of pieces in this kiln at once. I hoped to make glazed pieces in the *hagi* style as well as the *yakishime* pottery of Shigaraki and Bizen. This kiln had characteristics of both anagama and noborigama kilns – it was intended to achieve my goal of firing various types of pottery. Essentially, I took a noborigama's firebox and made it three times the normal size – this allowed it to serve as an anagama as well.

CAPTIONS:
Left: The Noborigama I Built
Right: Pillar of Fire from a Chimney

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59 Additional information regarding the *goinoki* kiln can be found at: Louise A. Cort, Shigaraki, Potter's Valley 368 (1st Weatherhill ed. 2000).

60 9.7 ft (3 m).

61 See Author's Introduction at Page vii.

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The first chamber[62] of the noborigama portion was made in the Shigaraki style. However, the second chamber was different from the usual Shigaraki noborigama kilns. I intended to put glazed ware in the second chamber so I built the side-stoking space[63] of the kiln floor lower down to prevent ash from covering the pieces. Finally, I made the third chamber long so that the pieces would pick up *hi iro* easily.

The kiln was comprised of a firebox, then the first, second, and third chambers. I made this kiln to make four different styles of pottery.

I filled the kiln with glazed work similar to *hagi* ware and with pottery made from red clay. I was experimenting with the red clay in an attempt to get pieces close to Bizen pottery. I was sure I would get four kinds of pottery. However, the results were completely unlike my expectations.

The kiln temperature was pretty good but I could not focus on any one thing in particular.

The damage I received from my [first] anagama and my noborigama decided my future path. When I looked at the natural ash glazed mortar[64] or *tsubo* shard from the Goinoki kiln ruin, I thought, "if people in ancient times could fire such things in anagama kilns, why can't I?" Counter-intuitively, the greater damage done by my anagama caused me to become interested in anagama firing.

CAPTIONS:
Top: Sideview Diagram of the Multipurpose Noborigama[65]
Bottom: First Piece from the Noborigama Firing

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62 In the diagram, the anagama portion is the firebox and is in the lowest and leftmost position of the diagram. The "first chamber" is the first chamber *after* the anagama portion, the second is the tallest chamber and the third is the lower and longer room at the rightmost end of the diagram.

63 This is the place in which wood thrown through a side-stoking port burns.

64 As in "mortar and pestle".

65 Although Furutani used "first" in describing the kiln, it was also his only noborigama.

Although my first noborigama reached temperature, the pieces were mediocre half-measures for which I felt no interest.

The pieces I fired in my copy of the *Goinoki* anagama were absolutely wrong. However, I became obsessed with the violently erupting deep red fire and an ardent admirer of the imperfections [inherent] in anagama kilns.

In a noborigama, unglazed pottery called "*hibuse*[66] of noborigama" can be fired right next to each chamber's stoking ports at floor level – this is the place where *haikaburi*[67] pieces can be made. [When I started] however, nobody in Shigaraki was talking about anagama kilns, although *shino*[68] ware was being fired in anagama kilns in Mino. Instead, almost all unglazed ware was fired in noborigama kilns.

ii. Improvements to My First Anagama

While building my second anagama, that is, my third kiln, I changed the slope to achieve higher temperatures. My first anagama was a miniature of the *Goinoki* kiln. For my reconstruction, I made the slope a little steeper and built the kiln fully above ground level.

When I copied the ancient kiln, I thought the anagama ambiance would transmit to my pieces a little. I didn't build a chimney but instead, made something like *fukidashi*. *Fukidashi* are similar to the *sama ana*[69] of noborigama kilns. At the back part of the kiln where the walls come closer together, I made several side-by-side holes and then added the *endou*[70] extension. The roof over the back of the kiln had eaves to prevent rain [from getting into the kiln] and I built many parallel lines of *fukidashi* below the point of the eaves[71].

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66 *Hibuse* is a term reserved for certain fire-effects that are produced in noborigama kilns. Noborigama kilns can be used to produce glazed pottery. However, because noborigama kilns are fired with wood, there is a potential for unwanted effects to appear in the glaze when wood ashes fall on the pottery. In order to protect the glazed pottery, unglazed pottery is placed at floor level right next to the "firebox" (in reality, this is an open space traveling the width of the chamber into which wood is thrown – it is not physically separated from the loading area). The unglazed "guard" pots are placed in front of the glazed ware and stand between the burning wood and the glazed pottery, thereby protecting the glazed pieces. The unglazed "guard" pots are greatly affected by heat and ash from the wood burned in the chamber. As a result, these pots may develop effects akin to *bi-doro*, *haikaburi*, *koge*, *shizenyu*, and/or *youhen*. For pottery fired in noborigama kilns, these effects are collectively referred to as "*hibuse*". Please take note however, *hibuse* is not used to describe these fire-effects for pottery produced in anagama kilns.

67 Literally: "ash-covered". In wood-fired kilns, wood ashes fall on the pottery during firing and melt into a natural-ash glaze. *Haikaburi* is one type of natural-ash glaze which has a matte texture as its fundamental characteristic. This matte texture results when ash deposits pile up on a piece but do not fully melt into a glossy surface. *Haikaburi* and *shizenyu* occupy different points on the natural-ash glaze continuum. *Haikaburi* is simply less melted. It may be helpful to imagine *haikaburi* as being the precursor to *shizenyu* (*shizenyu* being a type of natural-ash glaze which has fully melted and begun to stream down the sides of the pottery).

68 Pottery which was made in Mino during the Momoyama period (1573 – 1603 AD). The technique was imported from China. See Robert Yellin's Japanese Pottery Guide (links to his site at http://www.anagama-west.com).

69 Openings at the bottom of the kiln chambers' back walls which vent fire and smoke.

70 The sloping flue which connects the kiln to the chimney. See diagrams on pages 7 & 8.

71 The translators presume that this may have looked similar to Fig. 4-20 in Frederick L. Olsen, The Kiln Book: Materials Specifications & Construction 54 (3rd ed. 2001).

At the ruins of the *Goinoki* kiln, the chimney was at the back where the kiln narrowed. It consisted of a 30 cm[72] hole in the hillside. For this reason, I did not think that a permanent chimney was built. The slope of a kiln decides its chimney height – despite the fact that the *Goinoki* kiln did not have a steep slope, I thought it did not have a tall chimney.

In my case, I did not have experience building kilns. I did not even know how big of a chimney I had to build. When I looked at the *Goinoki* kiln ruins, I thought: "even that kiln could fire with almost no chimney." In my kiln however, as one might expect with such a minimal chimney, the draft through the kiln was very weak and it was hard to bring the temperature up.

In Shigaraki's big noborigama kilns, there are many chambers and the kiln itself acts as a chimney. As a consequence, Shigaraki's noborigama kilns' *fukidashi* pull strongly enough to cause a draft. Because the temperature of noborigama kilns rises well enough without a chimney, I thought that a chimney was not necessary. [However,] anagama kilns have only one chamber and this does not provide a sufficiently powerful draft by itself.

As I wrote previously, I only fired my first anagama and my noborigama one time. The reason the firings didn't go well was because of the relationship between chimney height and draft.

A few of the pieces I fired in my second anagama were acceptable to me. These pieces instilled in me a little confidence that perhaps, I could learn to manage firing anagama kilns. As a result, I decided to continue working with anagama kilns and over time, became wholly immersed in the anagama world.

CAPTIONS
Left: This Piece Encouraged Me to Continue Firing Anagama Kilns
Right: Area Near a Noborigama's *Fukidashi* (Shigaraki)

72 11.8 in.

iii. The Third Kiln

I built my third kiln without a firebox – it looked like a noborigama chamber. In that time I was deeply interested in clay. I got clay from various places intending to experiment with pottery fired using crude-oil and wood. For this reason, I built a crude-oil/wood-fired kiln. The kiln itself was small and did not hold many pieces – about four large vases.

Because the firebox and loading chamber were combined, one could call this an anagama. However, it was more like a single chambered noborigama. This unusual kiln was very convenient for experimenting with clay and other aspects of pottery.

CAPTIONS:
Top: Diagram of Third Kiln
- (a): Top View
  - Top Arrow: Side Stoking Port
  - Bottom Arrow: Entrance
- (b): Side View
  - Only Arrow: Side Stoking Port
  - (GL = Ground Level)

Middle: My Third Anagama
Bottom: *Chawan*[73] from My Third Kiln

73 Rice bowl or tea bowl.

There was *bi-doro* over one part of a *chawan*[74] from the first firing. I finally felt as if I had made something that looked like Shigaraki pottery. Even though the firing did not reach a high enough temperature, the pieces from the first firing were highly impressive to me. I remember that I was very pleased.

Later, in the second firing I got better results than I had in the first one.

The main purpose of my third kiln was to experiment with clay and I fired it many times.

iv. The Fourth Kiln and Those After

Somewhere around my fourth or fifth kiln (or one thereafter), I built a kiln specially designed for people with a physical disabilities.

I will talk about my memories of this kiln more fully in a later chapter. I had injured my legs and I had to walk on crutches – I could not stack and fire my [regular] anagama kilns. Fortuitously, I acquired several lids from high-fire electric kilns. They were approximately 30 cm[75] wide and 120 – 130 cm[76] long. I came up with the idea of building a kiln using the lids so that it could be stacked from the top.

First I made the slope. Then I decided how tall to make the kiln based on the pieces I would put inside. The ceiling was not arched like [usual] anagama kilns – I laid the electric kiln lids across the side-walls and then attached a chimney. It was fired from the lower end of the kiln so it was structurally similar to anagama kilns. A diagram of the kiln would show a kiln which looked like a refrigerator laid on its side with a chimney standing on it. It was a strange kiln. I stacked it from the top just like an electric kiln and then set the lids in place.

CAPTION:
My "Injured Leg" Kiln
- (a): Side View
  - Leftmost arrow: Blower
  - Middle arrow: Height of Kiln
  - Rightmost arrow: Electric Kiln Lids
- (b): Top View
  - Leftmost arrow: Ash Pit
  - Rightmost arrow: *Sama Ana*

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74 Rice bowl or tea bowl.
75 11.8 in.
76 47.2 – 51.2 in.

I made many improvements to this kiln. I could make the kiln height higher or lower according to the pieces I was firing. It produced very good *bi-doro* and became a very interesting kiln.

The firebox of this kiln was small to begin with and there was no room to spare. In general, if too much wood is placed in any kiln, embers will build up and not burn completely. In this situation, although the temperature will rise to a certain level, it will not rise enough. On the other hand, if wood was fed into a kiln too slowly, the kiln will start cooling.

I used a blower at the lower end of this kiln, aiming it at places that were not burning well in the same manner as a bellows. The forced air allowed the temperature to rise efficiently. I was able to create an Iga atmosphere with interesting effects.

The disabled-person anagama performed unexpectedly well. In my later innovation using the blower, I came up with the idea of building an ash pit under the floor. The ash pit extended about 1 m[77] into the kiln from the firemouth, approximately 2/3 the length of the kiln. It was 15 cm[78] wide acted as an inlet for secondary air.

I became greedy – I began thinking that if I made this kiln a several meters longer, I would be able to fire many more pieces. Next to the first kiln, I built a kiln very similar in structure except that its length was 5 m[79]. I placed some tens of lids on the kiln and fired it from the lower end.

CAPTION: Sideview of Improvements to the Kiln for Disabled People
Left Arrow: This Mark "❍" Indicates Small Side Stoking Ports
Right Arrow: Electric Kiln Lids

77 39.4 in.
78 5.90 in.
79 16.4 ft.

This was a very interesting and unique kiln – sort of like loading pottery in a ditch. Side-stoking was necessary because the kiln was a bit long. The temperature would not be satisfactory if it was fired only from the lower end. To get the kiln to temperature, I fired from the bottom and then side-stoked into gaps between the pottery just like the Tanba *jagama*.

This book is meant as a guidebook for anagama kilns so I will stick to that topic. The special kilns I mentioned here are perhaps a bit of a tangent from anagama kilns, however, they are still wood-fired kilns. Note however that I am not obsessed with any particular type of kiln whether it be anagama or noborigama. I think any kind of wood-fired kiln is good as long as it allows me to achieve the pieces I am seeking.

v. My Current Anagama Kilns

Currently, there are three anagama kilns at my studio and these complement each other well. The anagama I use most often is located on the right-hand side – its loading and firing are unique.

The center kiln, a copy of the *Goinoki* kiln, is a very orthodox anagama. Although I have repaired and partially rebuilt it, I have not altered its fundamental shape and I have been continuously firing it to the present time. This is a purebred anagama approved by Shigaraki's ancestors – it has been shown in many magazines. I placed a plaque on the kiln, naming it "*Yoigama"*. This is a pun: "*goi"* (as in *Goinokigama*) means "fifth". My kiln is "*yoi"* which can mean either "fourth" or "good".

CAPTIONS:
Top: Top View of *Yoigama*
left arrow: Small Opening
right arrow: *Sutema*[80]
Bottom: Three Kilns

80 Literally, "wasted space". Extensive discussion to come later at pages 42, 87 and 140.

The kiln on the left is slightly smaller in size. I built it when I decided to write this book in order to take pictures of the building process and it is my newest anagama. The firing results are extremely good and many pieces born of this kiln are suitable for exhibition.

Chapter 3: Anagama Design

A. Anagama Construction

Many variables affect the characteristics of anagama kilns. Some of the important variables include the shape of the floor, the floor area, the slope of the kiln, and the ceiling height.

i. Top View

Of the kilns I built, I have found that the outline of a candle flame is the most suitable shape for anagama kilns. A candle flame becomes very thin at the tip – similar in shape to that of an upside-down scoop. [There are a number of advantages to] constructing the kiln floor in the shape of a candle flame: the kiln's temperature rises easily during firing, temperature control is simple, the kiln will fire pieces gently, and there is little unevenness of temperature.

Since ancient times, many anagama kilns have been built with a floor shaped like the outline of a candle flame. However, not all anagama kilns take the candle flame shape. [For example], looking at Shigaraki's ancient anagama kilns: one had an inflated body; another had a large firemouth (like a catfish head) with a thinner body portion. In contrast, a kiln for firing large urns was a little wider in the back. The floor shape varies depending on the type of pottery being fired so I cannot make broad generalizations about anagama shapes.

Take the Nakaide Kiln for example. It had a central wall which created twin parallel kilns. I assume that the ceiling fell often because it was a tunnel structure, and that the central wall was built as a preventative measure[81]. Although this wall divided the fire, I believe that the idea to split the fire originated in finding a solution to a collapsing ceiling.

CAPTION:
Ideal Flame-shaped Anagama: Section Names

|-- *Endou* --|-- *Sutema* --|-- loading Space --|-- Firebox --|

Leftmost Arrow: Chimney
2nd Leftmost Arrow: *Sama Ana*
Middle Arrow: *Sutema* Entrance
2nd Rightmost Arrow: *Sama Ana*
Rightmost Arrow: *Takiguchi*[82] (Small Opening)
No arrow, words inside picture on the right side: Entrance

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81 Nakaide Kiln was "10 m [32.8 ft.] long and 4 m [13.1 ft.] wide at its widest point. The gradient of the floor is 30º. A wall built down the center of the ware chamber, using clay over a core of large rocks, to thickness of sixty centimeters [23.6 in.], divides the chamber in two, left and right. This special design would seem to have been developed in order to construct a long and broad kiln on a foundation of sandy soil." Louise A. Cort, Shigaraki, Potter's Valley 346 (1st Weatherhill ed. 2000).

82 *Takiguchi* means "firemouth". As will be developed later, these holes in front to either side of the entrance are used to inlet air in situations where the flame flowing through the kiln is pulling to one side or the other. Wood is not actually stoked through them.

I did not have to discover the candle-flame-shaped floor through trial and error – many ancient anagama kilns were shaped like this. A specialist could explain [the efficiency of] this shape logically. In my case however, I came to understand it after I built many kilns.

In terms of measurements, the average anagama is 3 – 4 m[83] long and has a width of 2 – 3 m[84] at the widest point. Setting aside whether my [kiln design] alterations resulted in improvements, I used my experiences to experimented with many kiln [designs, some of] which easily fired *youhen* and *hi iro* pottery. Presently, I have different anagama kilns for the different types of pottery I fire.

I will explain later in the chapter what I have discovered in my work concerning these kilns and discuss how to build kilns according to the pottery one prefers.

ii. Side View

What is the shape of the lengthwise cross-section of an anagama? The ceiling is streamlined like an arrow's flight – this shape is common to any kind of kiln. The diagram below shows the usual ceiling in lengthwise cross-section. The end point of the ceiling curve is about 2/3 – 3/4 of the kiln length from the firemouth. At that point, the ceiling and the floor become almost parallel.

CAPTION:
Ideal Flame-shaped Anagama: Name of Each Part

Angle above main heading: Kiln Slope: 2 *sun* 8 *bu*[85] ⇦ (the number is inside the angle)

GL = ground level

|-- *Endou* --|-- *Sutema* --|-- loading Space --|-- Firebox --|

Arrows, from the left: Chimney; *Sama Ana*; Color Peep Hole; Entrance; *Sutema* Firemouth; *Sama Ana*; Color Peep Hole ; Pyrometer Hole; Shelf; Shelf Post; *Takiguchi* (Small Opening); Upper Firemouth; Preheating Firemouth

83 9.8 – 13.1 ft.

84 6.6 – 9.8 ft.

85 3.3 in. (8.4 cm).

iii. Cross-section

The cross-section of the kiln shows its arch shape. The entrance door also forms an arch shape.

Assuming that the height of the ceiling remains constant, as the width of the kiln increases, the curve of the arch becomes flatter until it practically becomes a flat ceiling. This creates a weakness in the ceiling and the kiln will collapse more easily.

The strongest arch is shaped like the cross-section of a tunnel, i.e., a half-circle. This is the best shape when focusing on kiln strength. However, with this type of arch, the ceiling would take on a hemispherical shape. If the kiln arches were build exactly like a half-circle, the loading process would become complicated. This complication can be avoided by making the arch a little flatter than a perfect half circle.

The shape of the arch should be chosen with care because when it comes to frequency of kiln repairs, it is the arch that needs to be repaired most often.

There are two ways to approach arch construction: the arch can be started at ground level, or alternatively, it can be elevated on brick side-walls. However, one must consider the pottery that will be fired because these two different methods result in drastically different kiln sizes and ceiling heights.

If side-walls are built below the arch, the ceiling will be higher. A high ceiling causes the flames to be soft and produces a good atmosphere for *hi iro* pottery. On the other hand, it is easy to get *youhen* and *shizenyu* pieces if the arch begins at ground level.

iv. Kiln Structure

Because the kiln is built on a slope, the ceiling and all the mass from the back of the kiln presses on the firemouth.

CAPTION: An Anagama Kiln's Interior Hides its Potential

The front part of the kiln must be strong enough to sustain this weight. If the vertical side-walls are built first, this can result in a very dangerous situation. One must build the front wall so that it slopes into the kiln somewhat – this allows the front wall to support the weight of the kiln behind it. The entrance arch must be fit into the front wall.

The most difficult part of building a kiln is deciding what form the entrance, i.e., the firemouth, at the front of the kiln should take. Moreover, the area around the kiln's firemouth reaches the highest temperatures. This, coupled with the fact that the firemouth is difficult to build, makes the entrance the most likely point of failure. Consequently, it must be built with extra care.

If the side-walls are built too high in the beginning, it greatly affects the strength of the kiln. If possible, do not build the side-walls too high but instead, start building the arch at a lower point. This makes a strong kiln.

I will explain the simple diagrams below. I think it is difficult to understand the kiln building process if one does not understand what the finished result should look like.

v. Ash Pit

Ash pits are built by digging a pit directly below the firebox to a depth of about 50 – 60 cm[86]. In the area over the ash pit, firebricks are laid at the same level as the kiln floor leaving a 2 – 3 cm[87] gap between the bricks. This gap allows extra air to enter the firebox.

CAPTION:
Angle of the Front of the Kiln
(a) Weak
(b) Strong

86 19.7 – 23.6 in.
87 0.8 – 1.2 in.

The wood in the firemouth burns much better with an ash pit because it allows secondary air to enter the firebox. [As a result,] the kiln temperature will rise easily.

However, when the ruins of various ancient anagama kilns were excavated, no ash pit remains were found. None of the ancient anagama kilns were built with ash pits.

In recent times, most people who build anagama kilns have built them with ash pits. I presently do not build ash pits into any of my anagama kilns because, although ash pits have positive aspects, they also have negative consequences.

On the positive side, ash pits help the wood burn easily and allow the kiln temperature to rise easily. Even an anagama which has trouble reaching temperature can attain high temperatures if an ash pit is installed. On the negative side, if one is seeking *haikaburi, youhen*, *shizenyu*, or *iga* pottery, the effective quantity of ash distributed to the pottery is halved because the ashes fall through the grate into the ash pit. Consequently, when these types of pottery are sought, I think the anagama kiln should be built without an ash pit.

On the other hand, if one is seeking *hi iro*, I presume that an ash pit would work fairly well. It is worth experimentation.

B. Size of Anagama Kilns

i. Width, Height, Depth

The widest anagama I built was 1 *ken*[88] (approximately 2 m[89]) wide, but it is possible to build larger kilns. In Shigaraki, the widest is approximately 4 – 5 m[90] wide.

CAPTION:
Diagram of Ash Pit
  (a) Side
  (b) Top

88 1 *ken* = 6 *shaku*, i.e., 5.9 ft (1.8 m).
89 6.6 ft.
90 13.1 – 16.4 ft.

If the width exceeds 1 *ken*[91], the ceiling becomes fairly high and the kiln becomes very large. As I explained previously, this can cause many problems.

With small anagama kilns, the minimum width is approximately 4 *shaku* (120 cm[92]). If the kiln is smaller than this, the size of the firebox becomes too small and it won't work as a kiln. I think that in general, a width of 2 m[93], more or less, is appropriate.

Not only does the ceiling height affect the volume of the kiln, there is an exceptionally close relationship between ceiling height and the type of pottery that results. Because the kiln shape follows the outline of a candle flame, if the distance between the firemouth and the back of the kiln changes, it is natural that the ceiling height also changes in response. When designing a kiln, the ratio of width to ceiling height changes depending on what the kiln is designed to do.

If the kiln is 1 *ken* (approximately 2 m[94]) wide, an appropriate depth is between 1.5 *ken* (approximately 3 m) and 2 *ken* (approximately 4 m[95]). My typical kiln has a greatest width of 1 *ken* (2 m[96]) with a depth of 1.5 *ken* (3 m[97]).

An anagama kiln's firemouth is also its entrance. Because anagama kilns are fired only from one firemouth, as the length of the kiln increases less flame reaches the back of the kiln. As a result, the temperature is lower in the back of the kiln. In order for the heat to reach the back of the kiln evenly, the firebox should be spacious. A spacious firebox can be achieved by pushing the loading space toward the back of the kiln[98]. In this way, the flames will extend, more or less, to the back of the kiln and make it easier to raise the temperature there.

CAPTION: My 1 *ken*[99] Width Anagama

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91 5.9 ft (1.8 m).
92 47.2 in.
93 6.6 ft.
94 6.6 ft.
95 9.8 – 13.1 ft.
96 6.6 ft.
97 9.8 ft.
98 This is a fairly literal translation of Furutani's explanation. Perhaps however, it would be more appropriately expressed in English from the perspective of the front of the kiln rather than the back, *i.e.*: A spacious firebox can be achieved by leaving more space at the front of the kiln during loading.
99 5.9 ft (1.8 m).

Among the kilns I have built so far, kilns with a length between 1.5 *ken* (3 m) and 2 *ken* (4 m[100]) provide a reliable and consistent temperature rise. If the kiln becomes much deeper than this, firing the pottery located at the back of the kiln becomes technically difficult and there is a risk that the pieces in the back will be under-fired.

As kiln length becomes relatively shorter, it becomes much easier to raise the kiln's temperature. A kiln could be built with a length equal to its width, but then the kiln would have a dome shape. In kilns where the length and the width are the same, there is no room for error in the firing rhythm or the kiln's firing conditions. It is very easy to over-fire all the pottery in such kilns and the characteristics of anagama firing are lost. Therefore, I think that the most appropriate kiln ratios are a width of one unit, and a depth between 1.5 and 2 units.

ii. Wall Thickness

Let's think about the thickness of the ceiling and side-walls of anagama kilns.

The ceiling will absorb more heat as its thickness increases. If the ceiling is too thick, the temperature will not rise easily. Even if a large amount of firewood is burned, the heat absorbed by the walls is greater than the heat used in making the kiln temperature rise. As a consequence, the kiln's temperature will not rise quickly. By the same token, if the walls are thick, the kiln's heat does not dissipate easily and it will not cool quickly. Thicker walls are sometimes better depending on the pieces one wishes to make. Thick walled kilns are good for slow cooling and if one wishes to make pottery requiring a slow rise in temperature coupled with a long period of cooling, thick walls should be used.

I was talking with people who fire *shino* ware. They explained that *shino* needs a slow rise in temperature and a long period of cooling. Consequently, they make their kiln walls very thick.

CAPTION: An Anagama Kiln's Firemouth Is also Its Entrance (Shigaraki Ceramic Cultural Park)

100 9.8 – 13.1 ft.

When making Shigaraki style pottery, the temperature should rise quickly. Further, because it is not necessary to be too sensitive about cooling, thick walls are not necessary.

In my kilns, the ceiling arch is as thick as the length of medium grade JIS[101] firebrick. I plaster an approximately 1 *sun* (3 cm[102]) thickness of refractory mortar over the firebrick. No matter how large or small an anagama is, or whether it is built half-above-ground or completely above ground, I think this is the best thickness for the ceilings of anagama kilns.

Ancient Shigaraki potters said that a ceiling thickness of 7 – 8 *sun*[103] is enough. I think it is worth listening to this advice. Presently however, there are many kinds of refractory products available. Depending on the pottery one is seeking, insulating firebricks can be placed over standard firebricks to more effectively prevent heat loss. I think it is worth trying at least once.

As I explained above, a disadvantage with thick ceilings is that they make it difficult to raise the kiln's temperature. Note, it is not always true that thick side-walls are useful in preventing the kiln's interior from losing heat.

Essentially, air does not conduct heat well and I can say that air itself is an excellent insulating material. There is no reason to make the side-walls thicker than necessary. If the walls are too thin, the kiln becomes weak. It is necessary to maintain a minimum thickness at the base of the kiln to maintain strength.

The point here is that the side-walls do not relate very much to whether the kiln temperature rises or falls – it is the ceiling thickness that is related to heat retention. When thicker side-walls are preferable, it is to provide kiln strength.

CAPTION: The Ceiling is One Brick Length Thick

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101 Japanese Industrial Standard. JIS bricks are 230 mm long, 114 mm wide, and 65 mm thick. In other words, approximately 9 x 4.5 x 2.5 in.

102 1.2 in.

103 8.3 – 9.5 in. (21 – 24 cm).

COLOR PLATE CAPTION: Shigaraki – *Mizusashi*

Aside from wall thickness, one must also consider issues regarding the brick characteristics. However, I will talk about this in the chapter about building the kiln.

C. Orientation of Anagama Kilns

Where is the most appropriate place to build an anagama and what kind of natural conditions should be considered? In general, it should face south so it can get lots of sunshine. There should be an abundance of clay nearby and a flowing stream to provide a convenient source of water. In the past, I traveled about researching old kilns. I discovered that old kiln ruins were located in places such as this.

The appropriate place to build a kiln today, just as in the past, is one which meets each of these conditions.

i. South Slope and Wind

Why is the appropriate orientation of the kiln site south facing? Because the direction of the blowing wind is favorable for firing[104].

If the kiln site faces south and there is a big mountain to the north[105], there is no fear that a north wind will blow directly into the kiln. If there is no mountain to the north and a strong north wind blows, the north wind will blow into the chimney and cause the kiln to backfire. Such conditions make firing extremely difficult.

To that end, eliminating the risk that wintertime north winds will blow down the chimney and cause backfiring is one of the fundamental criteria for selecting a building site.

CAPTION: My Kiln Site

104 This would of course change if the prevailing winds in your area blow from a different direction.

105 It is important to understand that term used in the original suggests that the "mountain to the north" is crouching over the kiln or hanging onto the back of the kiln. From a practical standpoint, if the "mountain to the north" is some distance away, it will not shelter the kiln.

With my kiln, there is a mountain to the north of the kiln and a river to the south. Even if a south wind blows, it is only a breeze. The prevailing winds usually blow from east to west[106].

Generally speaking, even if the kiln faces southward or northward, it is affected by other environmental conditions such as mountains, rivers, and forests. I cannot absolutely say what type of place is the best. The most important consideration is that the kiln be oriented to prevent backfiring.

ii. Sunny and Dry

The reason good sun exposure is necessary is that the firewood must be dried. When wood is cut into firewood, it should season for a half year or more. To the extent possible, the firewood should be stacked near or surrounding the kiln. When the kiln is fired, a large amount of labor is required to carry the firewood so it is good if the anagama site itself gets lots of sunshine.

iii. River and Humidity

First, river water is needed as a fire precaution. A very tall pillar of fire blows out of the chimney. The kiln can be fired with peace of mind if there is a river nearby.

When looking at the ruins of old kilns, in most cases, they are located with a flowing stream a short distance from the firemouth. Considering this fact, aside from fire precautions, I have discovered that the environment at the kiln site should be appropriately humid. It is not good if the location is as arid as a desert.

On the other hand, geographically, if there is water nearby and a mountain behind, I presume that too much humidity could affect the kiln and also cause significant problems.

CAPTION: Good Sun Exposure at the Kiln Site is also Good for Drying Wood

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106 OM Comment: I built my kiln with the firemouth at the west end of the kiln. In my area, the winds shift frequently but come mostly from the north or the south, sometimes from the west, and almost never from the east. The orientation I chose was a compromise between these directions. I have had no issues with backfiring even during very heavy wind (60 knots (31 m/s)), however, I did have one backfire during a firing with one of those rare east winds. It pays to find a source of weather data for your area and get an idea of the prevailing winds. See http://www.anagama-west.com for some internet resources.

Several years ago, I built a tunnel kiln similar to the *Momoyama* period[107] tunnel kilns. Around the time I built this kiln, I heard that Koyama Fujio Sensei taught that in order to get Shigaraki *hi iro* effects, it is important to consider not only the relationship between fire and clay type, but also that moisture plays a large role in creating *hi iro* effects. I became very interested in that theory and besides, I had been wanting to take up the challenge, at least once, of building an old style anagama (in other words, the type built by simply digging a tunnel in the ground) for quite some time. I thought it was the perfect moment to try this and so, choosing a location based on the conditions and characteristics of the soil, I built the kiln in a place with high ground moisture to recreate the conditions of ancient anagama kilns.

In my first attempt, I tunneled into the clay soil to certain point. However, the soil quality was poor and so much ground water seeped through the walls that the kiln collapsed before I could set a fire inside to make it firm. The ground was wetter than I calculated so it was a failure.

I tried again at the site of the collapsed kiln using an excavator to do the digging. To make this a completely-underground style kiln, I laid bricks, built a ceiling, and then backfilled with the excavated soil. Because bricks were used, it was a little different from the ancient kilns. Still, it was a fully underground style anagama. In order to allow the surrounding moisture to directly affect the floor of the kiln as well as the kiln's interior, I did not lay bricks on the floor. Instead, I laid fire resistant sand on the floor to create the same conditions present in ancient anagama kilns. I fired my pieces and it is true that the *hi iro* was extremely beautiful. However, although this kiln still exists in Shigaraki Hata, I learned that the winter cold and the moisture have shortened the life expectancy of this kiln.

CAPTIONS:
Right: Stream Near Goinoki Kiln
Left: Fully Underground Style Anagama (Shigaraki Hata)

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107 1573 – 1603 AD.

iv. Conditions of the Kiln Site

When building the kiln, no difficulties will arise if a place which meets each of the conditions I described above can be found. However, it is presently very difficult to find a place which meets all of these kiln site conditions.

Broadly speaking, the island of Japan has a spine of mountains running through the center of Honshu[108]. The mountain slopes face southward on the Pacific Ocean side. However, on the Sea of Japan side, for example in Fukui[109], there are few sites which meet all the anagama conditions. It is presently a reality that if an anagama is going to be built, one must think carefully when choosing a place in one's locale. As I explained previously, the main problem to avoid is having wind blow down the chimney and cause the kiln to backfire. If that condition is met, I believe the other problems can be solved.

Controlling the environment artificially, for example, by placing the kiln in a large building or using a blower to force air into the kiln, makes it impossible for me to be cool[110]. Long ago when a kiln site did not meet all of the conditions, for example, in the case of a noborigama when the chimney was not pulling well, a large orange lacquer ware fan similar to the type used in festivals was used. In order to prevent backfiring, I have seen one person wield the thick handled fan with both hands while another person stoked the kiln.

D. Chimney

i. Circumference and Height

The area of the kiln's firebox determines the circumference and height of the chimney. As the capacity of the firebox becomes larger, the chimney circumference must become wider, and the height taller. If the firebox is smaller, the chimney circumference and height should be adjusted accordingly.

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108 Honshu is the main island of the Japanese archipelago.

109 A city on the Sea of Japan.

110 The context implies that the use of “cool” is along the lines of “nice and cool” or “refreshing”. In other words, these artificial environmental controls are uncomfortably hot rather than infuriating.

In order to increase the chimney's pulling power, its circumference and height can be increased. Note however, these dimensions are dependent on the relationship between the location of the kiln and the kiln shed's roof[111]. For instance, where the smoke must be expelled at a high level, if the chimney's diameter is too wide it will develop too much draft. This will make it difficult to raise the kiln's temperature.

In this situation, making the chimney narrower and lower will decrease its pulling power. The relationship between the chimney's circumference and height can be adjusted to alter the chimney's pulling power[112].

In addition to adjustments to the dimensions of the chimney, one can use a damper in the *endou* to physically control the chimney's pull. It is fundamentally better to build a chimney which pulls slightly too well because it is easier to make fine adjustments.

My kilns have a width of 2 m[113] and a length of approximately 3 m[114]. The diameter of the chimney is about 1 *shaku* (30 cm[115]). I use *toukan*[116] from Tokoname for the chimney. In order to make my chimney about 3 – 4 *shaku*[117] higher than the eaves of the kiln shed roof, I stack 2 – 3 *toukan* on top of each other. With this height, I have no fear that fire will spread from the chimney to the roof.

Brick chimneys are cold at the beginning of the firing cycle and consequently, have little pulling power at that point. As the chimney warms up, its pulling power increases but brick chimneys take a lot of time to warm up.

CAPTIONS:
Left: Iga Kiln's Chimney
Right: Shigaraki Kiln's Chimney

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111 Plainly, the chimney must be tall enough to clear the roof line sufficiently to minimize the risk of setting the kiln shed on fire.

112 In other words, if a tall chimney is required but a relatively weaker draft is appropriate for the kiln, make the chimney taller and *narrower*. If a tall chimney is not required for the same kiln, it can be shorter and wider.

113 6.6 ft.

114 9.8 ft.

115 11.8 in.

116 Fired ceramic pipe sections. As one might imagine, these come in many lengths and widths. From the diagram at page 90, it appears that the author used *toukan* which were slightly longer than the height of an oil drum – probably in the neighborhood of 4 ft. (1.2 m). Also note, in recent times *toukan* have fallen out of favor as a chimney material. Even Furutani had switched to brick chimneys toward the end of his career.

117 35.4 – 47.25 in. (90 – 120 cm).

The *toukan* from Tokoname are thin and heat up surprisingly quickly even with weak heat. As a result, the chimney has extremely effective pull even when the kiln temperature is lower.

Although my chimney's are already in place, I have never recorded data regarding their diameters before. In my case, I use 1 *shaku*[118] diameter *toukan* and I have rarely had a problem.

I'd like to turn to the subject of dampers. Many people fail because they believe that the relationship between the chimney and the damper is difficult.

A damper is a type of kiln equipment which can be used to forcibly reduce the chimney's pulling power. The damper acts as a sort of lid which can stop the chimney's pull.

Structurally, there are two kinds of dampers. The first type involves blocking the *endou* and is simply made with a high-fire kiln shelf, such as one made of carborundum[119]. This type physically blocks the chimney's draft (gate damper). In the other type, an air hole is built into the base of the chimney (passive damper). This hole is almost the same size as the inside circumference of the chimney. It is plugged with bricks or other things and as necessary, these bricks can be removed to increase the size of the opening. In this method, the chimney's draft can be reduced by inletting air.

Gate dampers are easy to adjust and operate because their effects appear directly. On the other hand, when compared to gate dampers, it seems that passive dampers have a soft affect on the draft.

Below are some good points and bad points regarding dampers.

First of all, a positive aspect of dampers is that they allow the chimney to be adjusted and controlled when it is creating too much draft. If the damper is used once while the temperature is very high, the chimney's pulling power weakens because the chimney itself cools. There is no problem if the one-time operation results in a successful temperature adjustment. However, when the damper is open and shut several times, the temperature of the chimney will fall drastically. This reduces the chimney's draft and if a return to the pre-adjustment draft level is desired, it is very difficult to achieve. As a result, the chimney may pull too weakly.

CAPTION: Gate Damper of an Anagama (Shigaraki Ceramic Cultural Park)

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118 11.8 in. (30 cm).

119 Silicon dioxide.

If the damper is adjusted many times, even if the firing produces exactly what one aimed to achieve, the process of operating the damper does not relate to the fired results. It is impossible to tell which operations were good and which were bad. Even good pieces are simply accidental and one learns nothing for the next firing. This is a negative aspect of dampers.

Many people think dampers are very important for proper kiln function and build them not only in anagama kilns, but in many kilns. An unexpectedly high number of firings fail because of damper operation.

Once or twice, I built dampers into my anagama kilns. If the chimney pulled too strongly, the temperature would not rise. I would shut the damper and made other adjustments. However, whether my pieces fired nicely or poorly, I did not understand how the damper affected my results nor did I really understand the relationship between the damper operation and my pieces. So, in order to avoid getting lost, I decided to avoid dampers altogether. Besides, I believe that ancient anagama kilns did not have dampers.

ii. Purpose of the Chimney

The chimney serves a very important role in that it causes proper flame flow, draws air into the fire allowing it to burn effectively, discharges smoke, and contributes to a rise in temperature inside the kiln. If the chimney pulls too much, it draws too much heat out of the kiln and the temperature will not rise. However, if it does not pull strongly enough, the inside of the kiln will become starved of oxygen. In this case, the wood will not burn completely and the kiln temperature also will not rise.

CAPTIONS:
Damper Diagram
Left Arrow: Gate Damper
Right Arrow: Passive Damper

A chimney that does not have enough pull is particularly troublesome. If it is the case that the chimney is the cause of the problem, i.e., too little pulling power, I will explain the solutions in the later chapter “How to Fire”. The emergency solution for this problem is to wrap two layers of corrugated galvanized metal to the top of the chimney and secure these with wire. The chimney will suddenly start pulling strongly because of the added height of the corrugated metal extension. Then, some other day when the kiln is cool, more *toukan* should be added to the chimney.

In my kilns, I already explained that I use 2 to 3 *toukan* with a diameter of approximately 1 *shaku*[120]. For a larger kiln, the amount of fuel needed for a firing would also increase [if the draft was increased] and I would have to consider this matter in all its aspects once more. One way I might solve this, is to adjust the slope and lengthen the *endou*. Alternatively, I might need to make the chimney wider and taller.

iii. *Sutema* (Fire Playing Space)

The *sutema* is a chamber for the fire to “play” which is located immediately behind an anagama kiln's main chamber.

Looking at ancient kilns, it seems that almost none used a *sutema*. Instead, the kiln connected directly to the chimney. The *sutema* has a very deep relationship to the efficiency of the chimney's pulling power.

There are considerable amounts of under-fired fragments scattered around ancient kiln sites. I think that without a *sutema*, ancient kilns frequently under-fired pottery.

CAPTION: Corrugated Sheet Metal Wrapped Chimney

120 11.8 in. (30 cm).

In my earlier kilns, I also did not build *sutema.* After having built many kilns, I suddenly decided to make an extra chamber, like a noborigama, right behind the end of the anagama chamber. I built a quasi-noborigama tail because I wanted to fire pieces with a *hi iro* effect similar to that of noborigama fired pottery. If the tail had been made a little bigger, and several others were joined to it, the kiln would have become a noborigama. Looked at another way, it was a kiln adopting only the good points of noborigama kilns and omitting the negative aspects. It was an anagama with a *sutema* attached.

By attaching this tiny chamber, the *sutema*, the flame does not directly exit the kiln through the chimney. It stays in the *sutema* first and then flows outside. Consequently, various adjustments to the size of the firemouth, for example, enlarging or reducing it, will not directly or extremely affect the firing. This allows firemouth adjustments to be made while minimizing decisively serious failures.

Anagama kilns do not look very handsome with a *sutema* attached to the end, but the *sutema* stabilizes the firing process. As a result, I have attached a *sutema* to all my subsequent kilns. I think it is likely that I am the first person to build a *sutema* in an anagama and now, I can no longer detach them from my kilns.

When I built my *iga* kiln, I went to great lengths to make the *sutema* invisible from its outside appearance. I made a partition inside the kiln in order to form the *sutema.* Consequently, there is no hint that this anagama has a *sutema* when viewed from the outside.

CAPTIONS:
Top: My Kiln which Shows Its *Sutema*
Bottom: Under-fired Shard from Ancient Goinoki Kiln

My volume of my *iga* kiln's *sutema* is equal to that of a small chamber large enough to fit six to eight slightly large size apple boxes[121]. There seems are no problems as long as the *sutema* is not too large. However, it is not true that as the volume of the *sutema* increases, its effectiveness also increases. A volume just under half that of the anagama itself is appropriate.

The flame streams through the *sutema* on its way to the chimney. [*Endou* length] depends on the kiln's location[122]. In my case, the *endou* extends 1 – 2 m[123] from the *sutema* to the chimney located outside the kiln shed. The length of the *endou* varies depending upon the conditions of the kiln site. As long as it is in the range of 2 – 3 m[124], more or less, the *endou* does not seem to affect the chimney's pulling power. Take note however, the *endou* is often buried underground and as time goes by, the mortar between the bricks deteriorates. If sand surrounding the *endou* becomes extremely dry, it often happens that it will flow into the *endou* and block it. If this phenomenon goes unnoticed, people often exert much effort trying to figure out why, for apparently no reason, the chimney has suddenly stopped pulling. Ensure that the *endou* is well maintained.

Where the anagama chamber meets the *sutema*, the *sama ana*[125] should be 20 – 25 cm[126] tall. In ancient noborigama kilns, there was a single large hole between chambers [which were analogous to an anagama's *sutema* and main body]. I tried that sort of structure but as one might expect, it was difficult to fire and [the single hole] did not contribute to efficiency.

CAPTIONS:
Left: My Shigaraki Kiln, from *Sutema* to *Endou*.
Right: *Sutema* of My Iga Kiln

121 Based on the translator's actual measurement of a Japanese apple box, this is probably a box approximately 18 in. long (45.7 cm), 15.5 in. wide (39.4 cm), and 12 in. tall (30.5 cm).
122 Understand that in this case, the *endou* connects the kiln to the chimney. The chimney is located outside the kiln shed so the placement of the kiln will determine how long the *endou* must be to connect to the chimney. See diagrams on pages 7 & 8.
123 3.3 – 6.6 ft.
124 6.6 – 9.8 ft.
125 "*Sama ana*" should be read as plural.
126 7.9 – 9.8 in.

In building the *sama ana*, the left and right holes should be wider and the central holes narrower. It is harder for the chimney to pull the flames flowing on the left and right sides of the kiln. The size of the *sama ana* greatly affects the structure of the kiln.

Construct the *sama ana* between the *sutema* and the *endou* as shown in the diagram below. In this way, the flames will flow through the kiln in balance, filling the width of the kiln without clustering in one area.

When the *sutema* is built, [two different situations should be] compared. If there is only one hole to guide the flame into the *sutema*, the flame will cluster. However, if there are *sama ana*, the flame will be cut and scattered. There is a great difference in the kiln's abilities depending on whether *sama ana* exist or not.

It is better to make many small holes for the *sama ana* than to make fewer large ones. These many holes cut the flames beautifully, distribute the flames well, and allow the flames to pass through to the chimney evenly.

The *sutema* can be likened to the intestines of the human body in that both store nutrition using warmth, then absorb the nourishment before finally discharging waste. The *sutema* plays a very important role. If a *sutema* is built without *sama ana*, the *sutema* simply becomes part of the *endou* and causes heat loss. In such a situation, the *sutema* is like a person who has diarrhea – all the nutrition discharges outside his body.

Returning to our earlier discussion regarding dampers, note that when a damper is used to block the chimney, it forces a state of constipation on the kiln. Analogously, if a person eats more food in this type of situation, the constipation worsens. Likewise, the kiln's condition will also become abnormal. With both anagama and noborigama kilns, the temperature inside the kiln rises as more heat is stored. If heat input is equal to that which passes through the chimney, the temperature will not rise. The *sutema* efficiently stores heat because it prevent the flames passing through the kiln from exiting without leaving calories behind[127].

CAPTION: Make *Sama Ana* Wider on the Sides than in the Center.

127 Again, fairly literal translation, perhaps better rendered in English as: The *sutema* allows the kiln to fire efficiently because it traps heat inside the kiln chamber rather than allowing it to escape through the chimney.

As I explained before, I was initially trying to fire pottery in the *sutema*. However, it can produce *hi iro* pottery only in the first firing because of the moisture present. After that, it can only be used as a *sutema*.

It is possible to side-stoke the *sutema* in a manner similar to noborigama kilns using wood split to a small size to raise the temperature. However, the finished product is completely different from what I envision because of the lack of moisture. Consequently, I cannot fire pieces [in the *sutema* with the finished results] I desire.

The *sutema* has the shape of an oil drum laid on its side and *hi iro* pottery can be fired in its first firing. After that, it can only be used as a *sutema*. The shape of this kiln suggests that "hammerhead shark" might be a good name for it.

Anagama kilns will rise in temperature without a *sutema*. However, the firing rhythm is difficult and advanced technique is required. Errors in the firing rhythm can be dealt with by attaching the *sutema* so that even immature potters can fire such anagama kilns. I think that for kilns which have difficulty gaining temperature, assuming no major defects, almost all problems can be resolved by attaching a *sutema*. Not everyone who fires anagama kilns builds a *sutema*, but recently, I have built a *sutema* into all my anagama kilns. Many people who have visited me and examined my kilns have also built a *sutema* once they saw its effectiveness.

CAPTION:
Sutema Shape Varies According to Kiln Structure.
Words inside (a): *Sutema*
Words inside (b): *Sutema*

Chapter 4: Building the Kiln

A. Materials

Firebricks are the most essential kiln building material. Rather than use new bricks, I always build with used bricks.

A long time ago, people could dig up high-fire clay and make as many bricks as they wanted. For example, *gairome*[128] clay could be found in Iga – essentially, *gairome* is a clay that can be used to make firebricks. People used wooden molds to shape this type of rough clay into firebricks. Today however, materials merchants perform all the production and sales [of bricks].

The kiln building materials I will discuss here are not new bricks made in a press. The surface of new bricks is smooth and consequently, when the arch is built, the bricks will not grip each other well and the work will not proceed smoothly. Naturally, when a kiln building expert uses new bricks to build a kiln, the finished appearance is more beautiful. However, I build my kilns in my own original fashion. It is much easier to use old bricks because the old kiln's mortar remaining on the bricks provides a rough surface.

CAPTION: Wooden Mold for Homemade Bricks

128 Literally, "frog's eye". A couple definitions: "[C]lass of kaolinic, vitrifiable secondary clay only partially decomposed through transport. Consequently, it tends to include much mineral debris from the parent rock, including quartz, feldspar, and sericite mica." RICHARD L WILSON, INSIDE JAPANESE CERAMICS, A PRIMER OF MATERIALS, TECHNIQUES, AND TRADITIONS 44 (1st paperback ed. 1999).

PENNY SIMPSON ET AL., THE JAPANESE POTTERY HANDBOOK 52 (1979), defines gairome as "ball clay".

Instead of mortar, I use "kiln-clay"[129] (a slightly poor quality of clay) to fill the spaces between the bricks.

I use the old style *kure*[130] kiln-building methods in construction.

[With this method], kiln-clay is wedged until it is soft and then formed into 10 – 15 cm[131] diameter balls – about the size of a softball. These lumps are slammed onto the rows of bricks – [the power used in throwing] is similar to throwing a ball. Then, another layer of bricks is laid [over top]. This method is very rough and I never build delicately as if the kiln-clay was [commercial] mortar, that is, lay one brick, trowel on mortar, place another brick, etc.

It is better to use old bricks when building kilns with my methods. The burnt clay surface of used bricks and the mortar which remains attached, provides a rough surface. The kiln-clay clings well to these bricks and this stabilizes the kiln.

Another reason I build with used bricks is based on the famous saying: "First the kiln must be fired, otherwise the pottery cannot be fired." Firing pottery in a kiln built with new bricks or under-fired bricks takes longer – I feel that new bricks are still under-fired. I am aware that new bricks have been fired already, but compared to old bricks which have been fired many times, I think that new bricks are under-fired.

When using bricks that have been fired many times, the only under-fired part of [a new] kiln is the mortar. However, this is easily handled and the kiln will fire well.

CAPTIONS:
Top: Old Noborigama Built with the Old *Kure* Method (Iga Mukai Kiln)
Bottom: Used Large Sized Bricks

129 If you are ever in Japan and searching for this substance, we found a couple names for it: *hyodo, kamatsuchi*. *Hyodo* is more of a dialect, *kamatsuchi* is standard Japanese.

130 This refers to the kiln building techniques employing hand-made bricks. Also note, hand-made bricks are significantly larger than manufactured bricks. The kiln building process, as the reader shall see, can include the old techniques even though modern materials are used.

131 3.9 – 5.9 in.

Furthermore, there are many types of bricks. Bricks in the range of SK34-36[132] are highly resistant to high temperatures. When firing a kiln built with these bricks, the bricks must first be heated – this requires a large amount of energy. Because these bricks absorb a lot of heat, a large amount of firewood is required just to heat up the bricks.

In contrast, bricks of the SK32[133] type, when previously used and well-fired, enable the kiln temperature to rise easily.

It is common sense to use high-fire bricks such as SK34s around the burner ports in gas or oil fired kilns. In anagama kilns, the part of the kiln which gets the most heat is the ceiling area near the firemouth. Note however, unlike [gas or oil] burners which focus heat on a certain point, the anagama kiln's area of highest temperature does not receive concentrated heat. Consequently, it is not necessary to use different kinds of bricks in different areas.

The next issue is clay, in particular, the kiln-clay I discussed earlier. I used to go to a clay pit and dig up surface clay which contained a little iron, a lot of impurities, and other foreign matter. This low quality clay was not for sale and I was able to have it for free. Today however, it is hard to find clay to dig and use as kiln-clay. Companies sell clay they have named "kiln-clay" so I buy it from the merchants.

The kiln-clay is wedged with water until it becomes soft and is then placed between the bricks to serve as mortar. A long time ago, people used to wedge kiln-clay by stepping on it – hard work. Today, the commercial kiln-clay is already wedged, soft, and sold in plastic bags. It is very convenient now.

Kiln-clay which is too sticky will crack easily. If the kiln-clay is too sticky, I often add silica sand to it. I get my sand from a factory which sifts and dries rough clay – I can get the leftover high-silica sand for free. Finding the appropriate softness and stickiness of kiln-clay is not too hard for me because of my experience building many kilns. To avoid failure, the safest and easiest thing to do is to use commercial kiln-clay.

CAPTION: Bags of Commercial Kiln-clay

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132 These are hard firebricks. SK stands for "Seger Cones". In other words, SK 34 bricks deform at cone 34 (3182°F, 1750°C)) and SK 36 deform at cone 36 (3254°F, 1790°C). The normal operating range of SK 34 bricks is (2552°F, 1400ºC).

133 SK 32 are hard firebricks with an operating temperature of 2462°F (1350ºC). They will deform at cone 32.

Kilns crack because excessive heat causes expansion and contraction. Cracking may also result from the manner in which the kiln is built. For example, if the kiln-clay mortar is too thick, when the kiln expands it will often crack. In other cases, if the bricks are not laid correctly, [for example] if the mortar joints travel in long straight [vertical] lines, the kiln becomes susceptible to cracking.

In either event, as long as the cracks are small, there is not too much to worry about. Try to use less kiln-clay, avoid straight lines in the mortar, and try to lay bricks in an alternating pattern.

Toukan are needed for the chimney. Other materials required are: kiln shelves cut into triangular fragments, brick fragments, tile fragments (used on the kiln exterior), pottery shards, and roof tile fragments. These are handy for building many parts of the kiln.

Of course, drawn plans are necessary as well. One should also estimate the number of firebricks and other materials necessary. For reference, my estimation of material requirements follows.

CAPTIONS:
Top View
<-- 8 *shaku* 5 *sun*[134] --> <-- 3 *shaku*[135] -->
Width is 4 *shaku*[136]
Sideview
Slope = 2 *sun* 8 *bu*[137]
Height = 2 *shaku* 5 *sun*[138]

134 8.4 ft. (2.6 m).
135 3 ft. (90 cm).
136 3.9 ft. (120 cm).
137 3.3 in. (8.4 cm).
138 2.5 ft. (75 cm).

Standard Quantity of Kiln Building Materials:

- ☐ Large size bricks for the foundation (30 x 23 x 10 cm[139]): approx. 100
- ☐ JIS[140] used bricks: approx. 1000
- ☐ Kiln-clay approximately 2½ tonnes[141]
- ☐ *Toukan* sections for the chimney (1 *shaku*[142] diameter): 3
- ☐ Oil drums: 3
- ☐ Outdoor tile or used roofing tile: approximately 100 kg[143]
- ☐ Kiln shelf fragments: small amount
- ☐ [Wooden] Posts (approx. 3 *sun*[144] square)
  - 12 *shaku*[145] length: 3
  - 6 *shaku*[146] length: 2
- ☐ *Mousou*[147] Bamboo:
  - 16 *shaku*[148] length: 1
  - 6 *shaku*[149] length : 3
- ☐ 1.5 *tsubo*[150] (5 square meters[151]) of stringers
- ☐ Flat vinyl tape[152]: 2 rolls
- ☐ Vinyl packing rope (circumference of about 5 *bu*[153]): 1 roll
- ☐ Sand for the floor: 1½ tons[154]
- ☐ Plywood: 1
- ☐ Plywood panel 3 *bu*[155] thick: 1
- ☐ Brick pieces: small amount
- ☐ Wire to tie chimney: small amount

These are the fundamental quantities of material needed to build a kiln.

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139 11.8 x 9.1 x 3.9 in.

140 Japanese Industrial Standard. JIS bricks are 230 mm long, 114 mm wide, and 65 mm thick. In other words, approximately 9 x 4.5 x 2.5 in.

141 Although not expressly stated as a metric tonne, we presume that is what the author meant. In U.S. measurements, 2½ metric tonnes is 5511 lbs.

142 11.8 in. (30 cm).

143 220 lbs.

144 3.9 in. (10 cm).

145 11.8 ft. (3.6 m).

146 5.9 ft. (1.8 m).

147 *Mousou* refers to a type of bamboo in the sense that “maple” refers to a type of tree. This is the most common type of bamboo available in Japan. The full word is *mousoudake*, *dake* meaning “bamboo”. This type of bamboo originated in China and as an interesting side note, it is a type Pandas like to eat. Importantly for kiln building, it is elastic.

148 15.7 ft. (4.8 m).

149 5.9 ft. (1.8 m).

150 In this context, *tsubo* refers to an old Japanese measurement of area.

151 6 square yds.

152 Note – this is not sticky tape but rather, flat banding material commonly used in mailing packages.

153 0.6 in. (1.5 cm).

154 See footnote 141, 1½ metric tonnes is 3307 lbs.

155 0.4 in. (9 mm).

B. Slope

When considering the slope of the kiln, it is not necessary to distinguish between kilns built fully-above ground or those built partially below ground. The slope is the same for both.

When engineering the slope, it is good to dig the slope into a hillside that has not been dug up before. If possible, it is also better to avoid engineering the slope by building up a pile of soil above the natural ground level. In situations where the slope cannot be made without piling up a dirt mound, it is important to let the pile absorb rain and rest for a long time before firing the kiln. The soil must be stabilized sufficiently before firing begins.

The kiln slope varies according to the type of kiln one wishes to build. For example, the kiln's slope will vary depending on whether one is hoping to make a kiln which creates *shizenyu* pottery, or a kiln with a focus on *hi iro*, or one designed for *youhen*.

The "slope" is determined by measuring the vertical height gained for each unit of horizontal measure. For example, we say it like this: going 1 *shaku*[156] horizontally and 3 *sun*[157] vertically, is a 3 *sun*[158] slope; traveling horizontally 1 *shaku*[159] and vertically 2 *sun* 5 *bu*[160] is a 2 *sun* 5 *bu*[161] slope.

[To measure the slope,] first choose the spot the kiln will be built. Then hammer in stakes to use as markers: a short one near the back of the kiln chamber right in front of the *sutema* (which is close to the chimney) and a taller one where the firemouth (entrance) will be. String a line from the *sutema* stake to the firemouth stake and use a level to make sure the line is level.

CAPTIONS:
Left: Using a Level
Right: Measuring the Slope

156 11.8 in. (30 cm).
157 3.5 in. (9 cm).
158 3.5 in. (9 cm).
159 11.8 in. (30 cm).
160 3 in. (7.5 cm).
161 3 in. (7.5 cm).

When the string is level and taut, measure the distance between the point at which the string is tied on the taller stake, and the point at which the stake meets the ground. Next, measure the length of the string itself and record the data. From this information, the slope can be calculated[162].

Suppose the length of the string is 10 *shaku*[163], and the measured portion of the firemouth stake is 3 *shaku*[164], this kiln's slope is 3 *sun*[165].

It is better to dig down in order to arrive at the desired slope. For example, if the actual measured slope of the hillside is 4 *sun*[166], and a 3 *sun*[167] slope is desired, carve out the area nearer the chimney. One thing to avoid is piling up dirt at the firemouth area in an attempt to bring the slope up to 3 *sun*[168]. When balancing the kiln, either dig at the chimney end to make the slope flatter or at the firemouth end to make it steeper.

I will explain how to choose a slope pitch to achieve various results in a later chapter. Remember that in general, the slope of anagama kilns ranges between 2 *sun* 5 *bu* and 3 *sun* 5 *bu*[169].

If a person plans on building a 3 *sun*[170] slope kiln but it comes out to be 2 *sun* 8 *bu*[171], the kiln's slope will not match the rest of the plans and the chimney or firemouth height will require adjusting. Adjusting the chimney or firemouth height has the same effect as adjusting the slope and one can more or less compensate for small discrepancies. However, the slope should be well measured in the very beginning.

As I said above, if the slope is slightly off, one need not be too worried. However, if the intended 3 *sun*[172] slope becomes a 4 *sun*[173] slope, this extreme deviation is difficult to fix later.

At this time, I would like to explain the actual process of building a kiln. Note that in the pictures showing the process, I tore down the body of an old kiln and built a new one on the same site. Consequently, the *sutema* and the chimney are from the previous kiln and I simply reused the preexisting chimney and *sutema*. I want you to understand that the pictures in this book are showing only the construction of the main body of an anagama.

CAPTION: Demolition of the Prior Kiln

162 Note that these two data points assume that the string tied to the *sutema* stake is tied to the stake at the point where the bottom of the *sama ana* will be.
163 9.8 ft. (3 m).
164 3 ft. (90 cm).
165 30%.
166 40%.
167 30%.
168 30%.
169 25-35%.
170 30%.
171 28%.
172 30%.
173 40%.

Follow your written plans and adjust the floor until the desired slope is created. To achieve a 2 *sun* 8 *bu*[174] slope, as I explained before, go horizontally 1 *shaku*[175] and then vertically 2 *sun* 8 *bu*[176]. Here, where the length of the kiln is 10 *shaku*[177], go horizontally 10 *shaku*[178] and vertically 2 *shaku* 8 *sun*[179].

In the firemouth area, pound in a stake which is located 10 *shaku*[180] from the point just below the *sama ana* which vent into the *sutema.* Note that this stake must be located along the line that divides the kiln symmetrically along its long axis. Measure 2 *shaku* 8 *sun*[181] up from the ground on this stake – ensure the stake is plumb. A 10 *shaku*[182] pole should extend from the point just below the *sutema* vents and perfectly meet the 2 *shaku* 8 *sun*[183] point of the firemouth stake.

When using a level on the horizontal pole, if the firemouth end is higher than level, dig out the area around the firemouth stake (which is planted so that it is plumb) until it is adjusted correctly. When correctly adjusted, the 10 *shaku*[184] pole will be level. On the other hand, if back of the kiln is higher, then the 2 *shaku* 8 *sun*[185] mark at the firemouth must be raised by piling up soil in the firemouth area to make the correction[186].

CAPTIONS:
Diagram Top: Slope Diagram
Slope = 2 *sun* 8 *bu*[187]
<-- 10 *shaku*[188] -->
vertical notation = 2 *shaku* 8 *sun*[189]
GL = ground level
Bottom Left: Measuring the Foundation
Bottom Right: Measuring the Kiln's Slope

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174 28%.
175 11.8 in. (30 cm).
176 3.3 in (8.4 cm).
177 9.8 ft. (3 m).
178 9.8 ft. (3 m).
179 2.8 ft. (84 cm).
180 9.8 ft. (3 m).
181 2.8 ft. (84 cm).
182 9.8 ft. (3 m).
183 2.8 ft. (84 cm).
184 9.8 ft. (3 m).
185 2.8 ft. (84 cm).
186 Note, please recall the warnings about soft ground beginning on page 52. Adding dirt to the firemouth end should only come into play <u>if the *sutema* and chimney are already built</u>. If they are not already built, dig down at the back of the kiln to adjust the slope. Presumably, Furutani suggest adding dirt in this passage because the *sutema* was already built and as a result, could not be lowered in order to flatten the slope.
187 28%.
188 9.8 ft. (3 m).
189 2.8 ft. (84 cm).

By keeping the 10 *shaku*[190] pole level in this way, the slope will be 2 *sun* 8 *bu*[191]. That is all there is to engineering the slope.

C. Foundation

It is said that long ago, if the ground at the kiln site had been previously dug up in some way, people used freshly cut pine tree posts in the foundation of noborigama kilns. The posts were buried deep underground where the heat could not reach them. Freshly cut pine posts become very strong after being buried in moist soil. Although other materials are presently used as pilings for modern houses, long ago, fresh pine posts were used to build a strong foundation.

Just like a house, anagama kilns need a well-built foundation too. The base of the kiln can weaken if the foundation is inadequate. Because of the extremely high temperatures, a weak foundation can be dangerous and source of accidents.

If the kiln is built in a place like Shigaraki with its granite soil, there is nothing to worry about concerning the soil quality. In some places [however], the soil quality can be a problem.

After engineering the slope, measure out and mark off the widest part of the kiln floor – make certain that the kiln remains symmetrical along the long axis. Repeat this step at a number of points so that a contour of the kiln can be drawn on the ground. Then, dig a foundation trench along this foundation contour line.

The depth of the foundation varies according to the size of the kiln. Large kilns require a deeper foundation for a strong kiln.

CAPTION:
Foundation Diagram
GL= Ground Level
Left Arrow: Floor Sand
Right Arrow: Layer of Bricks or Stones

190 9.8 ft (3 m).
191 3.3 in (8.4 cm).

The kiln here is small so the foundation trench should be 30 – 40 cm[192] wide and deep. In this case, do not dig the trench fully on the outside of the kiln's outline. Instead, the trench should follow the kiln's outline so that the outside edge of the foundation trench is a little wider than the kiln's outline. Throw hard red brick fragments, cobble stones, or fragments of the mortar used in stone walls into the trench.

It is not necessary that the buried material be refractory. When the kiln is fired, the heat does not penetrate downward so there is almost no possibility that the quality of buried material will directly affect the kiln's heat holding capability[193].

It is especially important that the foundation underneath the end points of the arch be very strong. If the slope has been engineered with piled up dirt, or the ground is moist, or long ago the soil was soft, place stones or bricks under the foundation – to help with stability, this material should cover an area wider than the the foundation area. Then use a vibrating packer or a post to pack the ground. It is not necessary to do this in a place like Shigaraki.

I once built a kiln in Kanto at the request of a friend. Kanto's has loam soil as a result of layers of volcanic ash. We feared that the kiln would settle after it was built. Also, a kiln will sometimes warp when it is heated. A strong foundation must be built under these circumstances.

The dimensions of foundations strong enough to carry the kiln's weight vary widely depending on the quality of the ground.

After packing the soil, pour a layer of fine sand approximately 5 cm[194] thick. It is preferable to use silica sand because it has a fairly high heat resistance. If silica sand is not available, use refined sand of the type mixed with cement.

CAPTION:
Foundation Diagram
Top Arrow: Floor Sand
Bottom Arrow: Bricks or Stones
GL=Ground Level

192 11.8 – 15.7 in.
193 See however, “Story of Terror” at page 190.
194 2 in.

This sand will be needed when the large *shoji* bricks are laid for the foundation. The sand helps to stabilize the bricks and keeps them firmly planted.

The width of the foundation must be wider than the width of the arch walls. The floor of the kiln is only used to set pottery on so it is not necessary to make the floor extra strong. However, the foundation should be very sturdy under the arch and the side-walls of the kiln – just like the foundation of a house.

I usually use bricks known in Shigaraki as *shoji* bricks for the foundation. These bricks are about the same size as five firebricks stacked together on their widest face. They are similar to the hand made bricks that were used in Shigaraki in earlier times – only smaller.

The larger *shoji* bricks perform better than regular size bricks in the foundation. With regular size bricks, they must be laid side-by-side and inevitably, the layers will warp or separate. Large *shoji* bricks make a stronger foundation. I think these materials are very suitable because when available, the work goes smoothly and easily. Further, the kiln becomes structurally stable and can be used for a long time – a good kiln.

There is a ruin of a noborigama near my home. When many potters were making *hibachi*[195] about 40 years ago, each household fired their kiln building bricks in noborigama kilns. The clay was wedged by stepping on it, molded in wooden brick forms, and then hammered with a wooden mallet. The bricks were dried in the sun and then fired in noborigama kilns.

CAPTION: *Shoji* [bricks]

195 Traditional *hibachi* are ceramic utensils used for boiling water or as room heaters. Do not confuse these with the "Hibachi" brand charcoal grills. For an example, see "Charcoal Brazier" in PENNY SIMPSON ET AL., THE JAPANESE POTTERY HANDBOOK 85 (1979). Also see: LOUISE A. CORT, SHIGARAKI, POTTER'S VALLEY photo plates 239-41 (1st Weatherhill ed. 2000).

These bricks were about three times larger than *shoji* bricks – equivalent to 15 regular size bricks. They were used for noborigama kiln foundations.

It is a lot of work to fire [a kiln made of] merely sun-dried bricks. If the kiln is made of raw bricks, it is said that the walls will become fired only to a depth of 1 *sun* – 1 *sun* 5 *bu*[196] from the interior of the kiln. Therefore, when sun-dried bricks were used, the amount clay shrinkage would change at a depth of around 1 *sun* 5 *bu*[197]. These were not very good bricks because there was a transitional area between the fired portion and unfired portion of the bricks. However, people used these bricks because [commercial] bricks were expensive and difficult to obtain. Using homemade sun-dried bricks was the most affordable means of building a kiln.

Even if the old kiln broke down, people saved fragments from the ceiling where the surface was coated with melted materials. They would use these old pieces when building new kilns because, I assume, the result was better than when only new materials were used.

Building noborigama kilns in this way was invented by old craftspeople whose experiences and ingenuity led them to discover these methods – this practice is completely different from modern disposable culture.

However, if craftspeople become too obsessed with a method believed to be the best, they are reluctant to think about new ideas or methods, and are resistant to adopting new techniques. I think that this is both positive and negative.

In my case, I never learned any particular technique or method from craftspeople. It was like painting a picture on a white canvas without knowledge of painting. It did not matter what method I choose, I just had to make a choice and proceed as I saw fit.

Sometimes, craftspeople may think that a particular kiln structure will not fire pottery [well]. However, I often think that there is a possibility that a particular kiln design will be successful. The only way to see who is right, is to build the kiln, fire it, take note of the problems which arise, and examine the results.

CAPTION: Large Bricks Made in a Wooden Mold

196 1.2 – 2.6 in. (3 – 6.5 cm).
197 1.8 in (4.5 cm).

The methods I discovered on my own were often exactly like the methods already developed by many other craftspeople in the past. I suffered a lot in slowly reinventing solutions (through repeated trial-and-error) to problems old craftspeople had already solved. Thinking back on this period of suffering and trial-and-error learning, I have realized that it was the period I enjoyed most of all.

D. Laying Bricks

i. Laying the First Row

After laying sand, place the large bricks in a row, wiggling them into the sand and aligning the inside edges of the bricks to the inside contour line of the kiln precisely.

When laying the bricks, leave a space between each brick about the width of one finger for filling with sand.

ii. Filling With Sand

After laying the bricks, fill the finger width gaps left between the bricks with sand. In this case, do not fill the spaces with clay mortar but instead use the same sand that was used under the bricks. Spread the sand over the entire foundation filling in the gaps. After that, lightly step on the bricks and wiggle them a little. Then spread more sand so that all gaps and all parts of the trench are filled. Make certain the bricks are stabilized and will not move at all.

CAPTION: Laying the First Row

Sweep any remaining sand off the top surface of the bricks with a broom to help fill the gaps with sand completely and stabilize the bricks. If the foundation bricks are not completely stabilized with sand, there is a possibility that the kiln will be weak.

Once the foundation bricks are in place, step back and look at the kiln from a little distance. Ensure that the foundation is well balanced and make adjustments to its lines if the inside edges of the bricks are not perfectly aligned with the inside contours of the kiln.

Once the first layer of bricks is completed, the first stage of building the kiln is completed.

iii. Preparing Kiln-clay

When the first step (laying the foundation bricks) is finished and the [foundation] bricks are stabilized, clean them thoroughly and beautifully. The next step is to apply the kiln-clay which serves as mortar, and to then lay a course of bricks.

If a lot of dust and sand is on the surface of the bricks, the kiln-clay will not stick to the bricks well. Clean the bricks thoroughly by sprinkling water from a watering can on them.

In order to lay the each course of bricks, make some soft wedged kiln-clay balls with a 10 cm[198] diameter prior to starting.

On the top surface of the the existing layer of bricks, slam two lines of kiln-clay[199] down both sides. I suppose that I am supposed to spread mortar evenly and properly over each brick with a trowel like bricklayers do. I omit this process by substituting kiln-clay for [commercial] mortar and I simply slam the kiln-clay balls against the bricks. In other words, the kiln-clay takes the place of the more commonly used [commercial] mortar. Consequently, the hardness of the kiln-clay balls is very important. If the kiln-clay is too hard, it does not adhere to the bricks well. If the kiln-clay is too soft, it splatters in all directions and the advantage of using kiln-clay is lost[200].

CAPTION: Foundation Is Filled with Sand

198 3.9 in.

199 This process is explained in greater detail at page 63 and 64.

200 Plainly, the author is describing something that can only be known by “feel”. The author's guidelines for developing a feel for the correct kiln-clay consistency will require experimentation to find a consistency between “too firm”, which will not stick to the bricks well, and “too soft”, which will splatter uncontrollably.

I suppose as a benchmark, the firmness of the kiln-clay balls should be similar in feel to an earlobe. Slamming the kiln-clay balls is different than troweling mortar. The power of the slam makes the kiln-clay fill the gaps between the bricks completely and makes the bricks adhere to one another well.

iv. Laying the Second Row

After completing the process of slamming kiln-clay over the foundation bricks, lay more *shoji* bricks over the foundation. These should lay precisely along the contour line of the kiln.

Once the kiln-clay has been placed, it is important to lay the next layer of bricks immediately. If too much time passes, the bricks will absorb water from the kiln-clay. The kiln-clay can become too hard in a short time and as a consequence, the next layer of bricks will not fully bond – it is important to lay the next layer of bricks immediately.

Also, using one's feet, stomp the bricks down and then hammer them into place with a wooden mallet. Be careful to avoid breaking the bricks when hammering them. Hammering them into place improves the bonds between the bricks.

v. Shape of the Kiln-clay Space

It is appropriate to lay bricks so that there is a 1 cm[201] space between them[202]. Lay bricks so that they overlap the [vertical] mortar lines of the previous row in a zig-zag[203] pattern. If the kiln is built with unbroken vertical mortar lines, when the kiln is fired and the bricks expand, the straight mortar lines will be compressed and large cracks may appear. Consider how the mortar joints affect the kiln's strength during construction – plan on laying bricks in a zig-zag pattern.

CAPTION: Slamming Clay Mortar

201 0.4 in.

202 This is a 1 cm (0.4 in) gap to the sides of bricks laid side by side. It is apparent from the photographs that the space between each course of bricks is larger than 1 cm.

203 Author literally used "zig zag". Note that by "zig-zag", the author is explaining that the bricks must overlap in pattern you would expect to see in a brick wall.

In order to make the zig-zag pattern in the mortar lines, make sure that when loading bricks, the upper bricks overlap half of the lower bricks.

vi. How to Lay Bricks

In order to make the foundation stronger, lay large bricks (*shoji*) before the arch begins. They should be oriented so that the narrowest faces [of the bricks] point toward the inside and outside of the kiln. Using the longer sides in this fashion makes the wall thicker and stronger. From the point where the arch starts, use JIS bricks. Again, lay them so that the narrowest faces point toward the inside and outside of the kiln. Note that the length of the JIS bricks is shorter than the length of the *shoji* bricks. This will help the arch become a little thinner than the foundation. The wide foundation lends strength and stability.

Do not, *under any circumstances*, work on only one side at a time. Do not build up the right side first and then the left side. This is dangerous. The work should proceed purposefully from both sides at once.

vii. Laying the Third Row

Lay one layer of bricks on one side and then do same thing on the other side. After the second layer is finished, start the third.

Use kiln-clay balls on the third layer just as was done in the second. Slam kiln-clay onto the surface of the second layer of bricks. This time, in order to allow the kiln-clay balls to fill all of the mortar space as tightly as possible, aim the kiln-clay at the mortar spaces between the bricks to solidly fill in those areas. Keep laying bricks, working both sides of the kiln together and following your written plans[204]. In this way, the kiln will become symmetrical down the long axis.

Remember that this kiln structure has a low ceiling. It is important to make certain that the side-wall bricks do not form plumb vertical walls. If the bricks are laid such that vertical walls are formed, the arch becomes higher and the kiln itself will have a high ceiling. When side-wall bricks are laid, consider the entire design of the arch and tilt them toward the inside of the kiln a little.

CAPTION: Ideal Pattern of Mortar Lines

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204 As the reader will come to understand, the author expects that a person building a kiln will draw up plans describing the dimensions and physical characteristics of the kiln prior to construction.

viii. How to Lay Bricks In Order to Make The Arch

When the side-wall bricks are laid, the upper courses should tilt toward the inside of the kiln. Otherwise, the arch will not form. When making the lower part of the arch, use small kiln-clay balls for the line of mortar toward the inside of the kiln, and large balls for the line toward the outside. This method makes the bricks tilt toward the inside of the kiln when they are stacked.

Furthermore, when a more extreme arch is needed, place tile pieces or similar materials in the mortar toward the outside of the kiln and then add more kiln-clay. This will make the arch more extreme.

CAPTIONS:
Top: Lay Bricks Symmetrically
Middle: Line Up Tile [Fragments][205]
Bottom: Diagram of Arch and Wedges

205 Note the small rectangular pieces of tile on the outside line of kiln-clay – these tiles will help tilt the bricks inward to form the arch.

As I explained above, two lines of kiln-clay is used as mortar on the inside and outside surfaces of the bricks. However, the empty space between [the kiln-clay lines] is unavoidable. It is not necessary to fill this void. Think of it this way: having little empty spaces in the center of the mortar lines improves the insulating properties of the kiln and allows it to hold heat better.

These are my tips for laying bricks. Also, make certain to visually confirm that the inside line of the kiln is curving appropriately while laying the bricks. Consider the width of the kiln to be the diameter of the arch. Although the ideal arch has the same shape as a semicircle, if the curve is more flat than this ideal, it is not something to worry about – it will not affect the structure of the kiln.

If the kiln is designed with a low ceiling, the arch starts right at ground level. On the other hand, if the kiln is designed with a high ceiling, the lower portion of the arch must be built up higher [before beginning the arch].

Next, decide the height of the entrance area and then mark it. If one focuses on a particular task too much, the kiln may not become symmetrical or the entrance may be forgotten – this is a disaster. Therefore, when one task is completed, visually inspect everything to ensure that the plans are being followed. Make certain that the entrance is marked off in chalk or with something else that is noticeable but not in the way.

E. Arch Frame

A framework for the ceiling will be made after the foundation is completed. The framework is built out of split-bamboo, square timbers, and other materials. Use thick long bamboo and split it into strips with a 1 *sun* – 1 *sun* 5 *bu*[206] width. Lay two of these together with the root and tip ends[207] of the strips alternating to take advantage bamboo's spring-like resilience when building the arch frame.

CAPTION: Arch Varies with Ceiling Height

a) High ceiling. Arch Is Above the Side-Walls
b) Low ceiling. The Foundation Blends Directly to the Arch

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206 1.2 – 2.6 in. (3 – 6.5 cm).

207 Think of it this way: bamboo grow from their roots to their tips. The bamboo stalks are thicker at the root end and thinner at the tip end. Laying two strips over each other “root to tip” equalizes the strength difference between the thinner and thicker ends.

Initially, let's review an outline of the arch frame construction procedures. First, a length of bamboo is firmly attached to the inside portion the foundation at the level where the arch will begin. This foundation level bamboo [attachment strip[208]] should follow the inside contour line of the kiln diagram – there will be a small gap between the strip itself and the foundation walls. This gap forms the receptacle for the ends of the bamboo strips that will be used to make the arch frame.

[To secure the bamboo attachment strip:] First, make marks on the inside and outside of the foundation across from each other. Next, hammer stakes with an appropriate girth and length [into the ground] at these points. Tie the the stakes together with vinyl rope in order to hold the split-bamboo [attachment strip] in place inside the kiln. Make sure the bamboo [attachment strip] is firmly held against the foundation. This is the first step[209].

Then, in order to decide the height of the ceiling, take two lengths of split-bamboo and lay them together tip-end to root-end. Attach the combined bamboo strips to the right and left sides of the kiln to make a bow. This is how the arch is made. Then decide the height of the ceiling using the front and back of the kiln as benchmarks. This is the second step.

After the height of the arch is decided, hang a 3 *sun*[210] (or larger) square beam from the peak of the bamboo bow. This beam will act like the ridgepole of a house.

Next, stand posts under the ridgepole. There should be two posts to support the ridgepole – one in the firemouth and one near the back. Try not to alter the height of the ridgepole when installing the posts – instead make adjustments to the post's lengths when installing them. Add crossbraces between the front and back posts for stability. This completes the third step.

CAPTIONS:
Top: Hammer Down Stakes on the Inside and Outside [of the Foundation]
Bottom: Bond Split Bamboo with Vinyl Rope

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208 This is perhaps confusing at this point. Please remember that the detailed instructions come at a later point. What the author is describing is construction of a bamboo horseshoe on the inside upper edge of the foundation wall. This "attachment strip" will form a slot between itself and the foundation wall. The ends of the bamboo strips which will be used to form the arch frame, will be inserted into the gap between the attachment strip and the foundation wall. The attachment strip allows the bamboo arch frames to be held in place.

209 This is a difficult paragraph to conceptualize because its structure does not fit a standard English pattern. Essentially, what Furutani is doing here is pressing the bamboo attachment strip against the inside rim of the foundation with these stakes. Detailed instructions start on the following page.

210 3.5 in. (9 cm).

Install split-bamboo arches parallel to each other down the length of the kiln spaced approximately 1 *shaku*[211] apart. Then hang 3 *sun*[212] square beams, one to each side of the ridgepole oriented so that they run parallel with the ridgepole. These act like girders in a house. Support the ends of these girders with posts as was done for the ridgepole. The girder posts should be arranged alongside the ridgepole posts. Install crossbraces to stabilize the girder posts. This is the fourth step.

Sometimes there will be a space between the bamboo arches (which are 1 *shaku*[213] apart) and the girders. Fill this space with pieces of wood to maintain the curve of the arches. After sandwiching the wood blocks into the gap, bind them in place so that they will not fall out. This is the fifth step.

Next, using the vinyl tape[214], attach 3 *bu*[215] thick stringers or split-bamboo [to the arches] every 3 cm[216]. These stringers travel the length of the kiln parallel with the ridge pole. The frame will take on a basket shape – this prevents the bricks from falling through when laid. This is the sixth and final step in building the arch framework.

Next, I am going to explain in detail the actual process of building the framework and give some pointers for the tasks involved.

i. Attaching Split Bamboo Along the Inside of the Foundation

After loading the foundation bricks in a symmetrical pattern according to your written plans, begin making the arch.

Attach the split-bamboo attachment strip to the foundation firebricks along the inside line of the kiln. This strip will create an attachment point for the bamboo that will be used to form the arch frames. The flexible nature of bamboo will allow it to follow the inside curve of the entire kiln. When viewed from above, the split-bamboo will be in a horseshoe shape along the inside of the foundation.

Some construction is required in order to keep the bamboo in the horseshoe shape along the kiln foundation. To do this, prepare 20 stakes approximately 50-60 cm[217] in length and 5 cm[218] in circumference.

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211 11.8 in. (30 cm).
212 3.5 in. (9 cm).
213 11.8 in. (30 cm).
214 Note – this is not sticky tape but rather, flat banding material commonly used to secure packaging for mailing.
215 0.1 in. (3 mm). Translator's note: this does seem thin particularly when the stringers are described as 1 cm (0.4 in) thick at page 171.
216 1.2 in.
217 19.7 – 23.6 in.
218 2 in.

If the long axis of the kiln is 3 m[219] or so, these stakes should be hammered down at five or six points – in this case, the space between these stakes is approximately 50-60 cm[220].

The stakes are pounded down along the inside and outside edges of the foundation. Do not pound them in plumb because they can be pulled out too easily – that would not be good. Hammer the outside stakes down to a depth equal to the bottom of the foundation – make sure the outside stakes slant away from the kiln. With the stakes on the inside part of the foundation, make sure they slant toward the inside of the kiln. The stakes planted on the inside and outside of the kiln should be directly opposite each other. The outside stakes are hammered down about half their length and the inside stakes are hammered down about 80 – 90% of their length. These stakes allow the split-bamboo which runs along the foundation to be used as an attachment strip for the bamboo ceiling arches – the attachment strip holds the ends of those arches in place.

Next, prepare split-bamboo strips. In this case, it is appropriate to use bamboo strips that are thick and meaty. Cut several lengths and lay them together so that the thin parts of one strip lay over the thick part of the other strip. Bunch two of these strips together and use them for the attachment strip. It is important to note however, that if the bamboo is too strong, it will not bend well and then cannot form itself to the foundation curve.

Put the two split-bamboo strips together and bow them into a horseshoe shape. Place them so that they run along the upper [inside] edge of the foundation.

CAPTIONS:
Top: Space Between the Stakes
Bottom: Angle of the Stakes

219 9.8 ft.
220 19.7 – 23.6 in.

The split-bamboo must be bound to the inside edge of the foundation. To do this, tie thick vinyl rope to the bamboo attachment strip. [Pass the rope over the foundation] and wrap it around the outside stake at the point the stake meets the ground. [Pass the free end back over the foundation] and tie it to the inside stake at the point it meets the ground. After the rope is tied to the horseshoe shaped split-bamboo [attachment strip], deeply pounding down the inside and outside stakes, causes the attachment strip to be tightly bound to the foundation.

When the outside stake is hammered down, the split-bamboo becomes well attached to the inside edge of the foundation and is firmly pressed against it.

Note, if the inside stakes are pounded in too much, the rope becomes too tight and the split-bamboo will separate from the inside wall of the foundation[221]. On the other hand, if the outside stake is hammered in too much, the rope will pull the bamboo against the foundation walls too tightly and will not leave a gap between the bamboo and the foundation.

ii. Building Arches Using Bamboo

As I described earlier, a horseshoe shaped split-bamboo attachment strip is wholly affixed to the foundation with stakes hammered in at various points. Next, prepare the split-bamboo for making the ceiling arch. I suggest that *mousou* bamboo is appropriate because it is thick. It should be cut into strips about 3 cm[222] wide. Again, always use two strips as a single piece by laying the thicker end of one over the thinner end of the other.

CAPTIONS:
Top: Bonding With Rope
Bottom: Tighten Rope by Hammering in Stakes

221 Conceptually, what would happen is that pounding the inside stake in too deeply would pull the outside stake toward the foundation. This would make the connection between the attachment strip and the outside stake looser thereby weakening the bond between the attachment strip and the foundation wall.

222 1.2 in.

The reason I use split-bamboo strips aligned with the thicker and thinner parts overlapped, is because when the arch is bent into shape, there will not be an uneven curve. The highest point of the arch formed by the two pieces of bamboo will be centered[223].

Stick both ends of the doubled split-bamboo (which will be used for the arch) into the space between the foundation and the horseshoe-shaped attachment point affixed to the foundation. Work both the left and right sides together by sticking one end of the doubled bamboo into the gap between the foundation and the attachment strip. Then bow the bamboo into an arch shape and stick the other end into the attachment strip gap on the other side of the kiln. Install arches starting from the front and working toward the back. Follow your written plans to precisely form the arches.

If the length of the split-bamboo arch is too long, use a saw to cut one end. Then insert the end back into the space between the foundation and the bamboo attachment strip running along the kiln's inside edge. Step back a little and look at the entire balance of the kiln and then decide the arch height.

The springiness of the bamboo arch frames attached to the foundation is sometimes so strong that they will fall over. In order to correct this problem, some bricks can be set to the sides of the split-bamboo arch frame to temporarily hold it in place.

Following this method will ensure that when the ceiling is finished, there will be a smooth curve between the top of the foundation and the arch walls.

CAPTIONS:
Top: *Mousou* Bamboo Forest
Bottom: Tools to Cut Bamboo

223 The thicker portion of a single strip will curve less than the weaker thinner portions. If this is not balanced through the use of two strips with the thin and thick parts alternately laid over each other, the curve will have an off-center peak.

If the the horseshoe shaped split-bamboo attachment-strip running along the foundation does not stay attached to the foundation, when the tons of bricks are laid on top of the arches, the bamboo arches may bow inwardly or outwardly and a beautifully curved arch will be impossible to build.

As I have said, this process is extremely important and it is important to check the structure often while working.

iii. Installing the Ridgepole

Check once again to see whether the tallest arch near the very front of the kiln (near the firemouth) and the shortest arch near the rear of the kiln (area toward the chimney) match your written plans. Once the arch is correct, tie the ridgepole beam to the front and back split-bamboo arches and then support it with posts.

As I said before, tie the ridgepole to the bottom side of the highest point (the peak) of the front (firemouth) arch and the rear (area toward chimney) arch with flat vinyl tape.

Even with a kiln of this size, when the bricks are over the ceiling frame, they weigh between 2 and 3 tonnes[224]. Strong 3 *sun*[225] timber should be used at minimum in order to withstand this weight. If the ridgepole is weak, it will bend under the weight of the bricks and the kiln itself will take on a bent shape.

Sometimes, after the ridgepole is bound to the underside of the split-bamboo arches, the arches might tip over. In that case, lightly attach an appropriate board to temporarily hold the structure in place. Later, add reinforcement posts.

Like I said, the ridgepole should first be hung from the arch before placing the supporting posts.

CAPTION: Arches Are Firmly Wedged Between the Split Bamboo and the Bricks

224 Not expressly stated as metric tonnes in the original but the translators presume that to be the case. The U.S. equivalent is 4409 – 6614 lbs.

225 3.5 in. (9 cm).

iv. Standing the Posts

Install the ridgepole supporting posts after the ridgepole is bound to the split-bamboo arches. Thick timber should be used for the posts. There must be two posts, one for the front and one for the back, and they should be placed a short distance in from the ends of the ridgepole, i.e., 1 *shaku* to 1 *shaku* 5 *sun*[226].

Place bricks or kiln shelves under the ridgepole support posts at the point they meet the floor – this lends stability to the posts and prevents collapse of the ridgepole. Without these, the heavy weight pressing on the posts would cause them to sink into the floor.

Once these posts are sandwiched between the ridgepole and the floor, they cannot tip over. These posts determine the height of the ceiling so do the work carefully.

When the above process is complete, the approximate curve of the kiln's arch, as well as the height of the ceiling, are set.

Stringers about 1 cm[227] thick will be attached over the split-bamboo arches which pass over the ridgepole. In this way, the inside wall of the ceiling is actually about 1 cm higher than the surface of the bamboo arches.

Be careful when standing the posts because if they force the ceiling up, the height of the ceiling will become higher than designed.

v. Stabilizing the Posts and Ridgepole with Crossbraces

In order to prevent the ridgepole from swinging front to back after the steps described above are finished, stabilize it by attaching a cross brace spanning the distance from the front of the kiln to the rear of the kiln. Place one end of the crossbrace at the point in the front of the kiln where the foundation bricks are buried. Angle the crossbrace so that it meets the ridgepole at a point towards the back of the kiln and then nail it in place. The crossbrace will pass by the lower end of the front post – nail the crossbrace to the front post at this point as well. When installed, the crossbrace will stabilize the ridgepole because it will be attached to three points: the foundation bricks, the lower end of the front post, and the ridgepole itself. Note that the longer the crossbrace, the more effective it is.

CAPTION: Standing the Posts

226 11.8 – 17.7 in. (30 – 45 cm).
227 0.4 in.

Attaching the crossbrace in this manner will prevent collapse by carrying the load which pushes against the ridgepole from the back of the kiln (inner part) toward the front (firemouth).

Next, using the same methods of joining split-bamboo as described before, create the arch shape for the kiln body. Again, use doubled bamboo strips. Attach these to the foundation by inserting the ends between the horseshoe shaped bamboo attachment strip attached to the foundation bricks. Space these strips every 1 *shaku* to 1 *shaku* 5 *sun*[228] and adjust the shape and height of the arch at this point. Then tightly bind all of these strips to the ridgepole using vinyl tape so that they are completely stabilized.

vi. Attaching Girders Parallel to the Ridgepole

At this point, something akin to house girders will be made. To the left and right and a little lower than the ridgepole, running parallel to the ridgepole, attach girders and support these with posts at the front and back. In other words, stabilize the front and back arches using approximately 3 *sun*[229] posts. Bind these girders to the front and back arch strips with the vinyl tape. If there is an empty space between the girders and the other bamboo arches, fill that void with wood so that the girder meets each of the arch strips. When the girders are adjusted properly, stand posts in the front and back as was done for the ridgepole. Just as with the ridgepole posts, place bricks or some other material under the posts so that they will not sink into the floor while bearing the heavy weight.

CAPTIONS:
Top: Attaching the Crossbrace to the Ridgepole
Bottom: Arrange Arches

228 11.8 – 17.7 in. (30 – 45 cm).
229 3.5 in. (9 cm).

Ensure that [each set of] three posts – ridgepole post, and the right and left girder posts – stand in a line side-by-side. Attach crossbraces angled across the three posts. One tip of each crossbrace should be wedged to the bottom of the brick foundation and rise up, passing across the first girder post, then the ridgepole post, and attach to the girder post on the other side. Nail the crossbrace into place at each post.

Attach crossbraces to both sides of the three posts by angling the second crossbrace across the backsides of the posts. Starting at other side of kiln foundation, nail a second crossbrace into place so that the crossbraces nailed to the front and backsides of the posts will form an "X" shape.

Repeat this process for the posts at the back of the kiln. When the crossbraces are perfectly attached to the ridgepole and girder posts, weight from any direction – the front, back, left, or right – will not move the framework. This is how the kiln framework is stabilized.

vii. Adjusting the Shape of Arch

In some places, the bamboo arches expand more and a gap appears between the girders and the bamboo arch. In order to make a beautiful arch, this gap must be filled while adjusting the arch. In larger gaps, insert pillows[230] made of firewood or wood blocks – in smaller spaces, use thin strips of wood as filler and then tie it all together with vinyl tape.

CAPTIONS:
Top: Attaching Girders and Placing Posts
Bottom: Attaching a Crossbrace

230 Old style Japanese pillows were made of wood.

During this process, the final shape of the kiln arch is almost set. Measure carefully and frequently. Check the results against the written plan while construction proceeds. This is how to adjust the whole shape of the kiln arch.

At this point, confirm that the bamboo, the ridgepole, and the girders will barely move when they are pushed. It is a bad sign if the entire framework moves as a single piece if it is pushed. If bricks are laid on the framework when it is in this condition, the shape of the kiln itself will distort or twist. In that case, the kiln would be beyond repair. If the framework as a whole swings, make reinforcements until it is completely and fully stable.

viii. Attaching Ceiling Stringers

When the basic framework is finished, the bricks still cannot yet be laid because the framework contains many large open spaces. In order to keep the bricks from falling through, the open spaces must be covered to some degree. This is done by attaching stringers of thin wood or split-bamboo.

This kiln does not have a strong curve to the ceiling so thin boards can be used as stringers to fill the spaces. However, if the kiln arch had a pronounced curve, bamboo, would be used because it is more elastic[231].

Stringers approximately 9 cm[232] wide and 1 cm[233] thick are bound to the top sides of the bamboo arches. These stringers will run in the same direction as the ridgepole and be bound tightly to the bamboo arches. The kiln ceiling will be like a basket in the form of a boat hull. Later, when the bricks are being laid, one must stand on this structure and carry bricks and kiln-clay up it many times. The stringers must be meticulously stabilized with the vinyl tape because if the bonds are weak, the stringers will become loose and slip out of place.

CAPTION: Adjusting the Arch Shape

231 The context suggests that the sideview of the arch is not very extreme, in other words, the arch curve from the front to the back is gentle enough that comparatively inelastic wood boards can be bent to its shape.
232 3.5 in.
233 0.4 in.

When binding the stringers with vinyl tape, unroll a length of tape about 30-40 cm[234] long but do not cut it from the roll. Then tie the stringers to the arched bamboo as follows: start below the point where a bamboo arch and a stringer cross. Wrap the tape tightly and strongly, starting from the lower right hand quadrant, twice around the portion of the bamboo arch below the stringer. Make sure that the end emerges from the space below the stringer and to the left of the arch. Then cross over the outside of the stringer drawing the tape tightly over the the flat surface of the stringer [and inserting it into the upper right quadrant]. This end is then wrapped around the arch starting from the right side, passing behind the arch and coming out to the left of the arch. Bring the end back down crossing over the stringer to the lower tape end and tie the ends together with a strong tight square knot.

If the vinyl tape is wrapped to the bamboo, even if the stringer wants to slip, it is held in place by the tape and cannot. If one forgets to wrap the tape to prevent slipping, even if many strands of tape are used to tie the stringer, when bricks are stacked and people walk up and down on the stringer, it will not withstand the stress and there is a possibility it will fall out of place. Therefore, at the points where stringers cross an arch, the idea is to bond them together tightly, strongly, and completely. If this is done, the entire shape of the kiln will look good.

Where the curve is gentle, stringers of about 1 cm can be bent into shape over the kiln and successfully attached to the underlying framework. If thicker stringers are used, they will not bend – the stringers must have some degree of flexibility. However, if they are too thin, they will bend too much when the weight of the bricks or the weight of a person is on them. The danger here is that the inside contour of the kiln will be warped – [it is important to] choose stringers which are of the appropriate thickness. Generally, I think stringers sold at lumber yards are appropriate.

Also, as the number of bamboo arches increases and the space between them decreases, the arch will be stronger.

CAPTIONS:
Top: Binding the Stringers to Arch
Bottom: How to Make the Knot
top: Bamboo
middle: Stringer
bottom: Vinyl Tape

234 11.8 – 15.7 in.

ix. Using Bound Bamboo for the [Arch] Basket

Besides using thin boards, bamboo can also be used for the ceiling stringers which fill in the spaces between the arches. As I explained earlier, if the ceiling has too steep of a curve [from front to back], the wooden stringers will not bend to it. In this case, the elasticity of large split-bamboo strips is needed and bamboo should be used like ribs.

The space between the stringers laid on top of the arches must be 3 cm[235] or less so that bricks will not fall through. Lay the bamboo stringers lengthwise down the kiln and bind [the arches and stringers] together with vinyl tape.

Why use vinyl tape? The vinyl tape makes the framework easy to dismantle because it burns off easily. Using a rag wired to the end of an iron pole, light the rag and burn off the vinyl tape. The framework is then easy to break down. Although hemp rope does not slip and is easy to tie, cutting all of the hemp rope bonds when dismantling the kiln is very hard work. The vinyl tape is convenient in this sense.

Bamboo stringers laid over bamboo arches slip very easily and it requires great skill to bind these together. It is difficult to keep the strips bound at a 3 cm[236] spacing. Further, while working on one part of the arch, the stringers attached to another part might slip down little by little. It is possible that all the ceiling stringers could slip down the sides and there would be no stringers left in the ceiling.

As I said, lay the stringers along the long axis of the kiln leaving a gap of about about 3 cm[237] between stingers. When the entire structure is covered with split-bamboo, the arch framework looks like a basket. In fact, anagama frameworks are sometimes called "baskets".

Long ago, anagama baskets were made out of brush wood. Soft fresh poles were bent into the basket shape. However, even if the quality of the poles was good, it was nonetheless, only brush wood. It was unavoidable that the basket would have a bumpy appearance and it was not appropriate for laying bricks. Although bamboo is slippery and hard to work with, compared to brush wood, I can say it is a far better material.

CAPTION: Making a Basket with Split Bamboo

235 1.2 in.
236 1.2 in.
237 1.2 in.

When I was building one of my early anagama kilns, after laying the foundation bricks, I suffered from not knowing how to go about building the ceiling. From my immature thinking, I finally devised the methods [I describe in this book].

When many "pillows" [i.e., wood blocks] are used to build up the shape of the kiln, a very rounded kiln shape results – this shape is a little complicated. For Kilns which develop a swollen shape, bamboo stringers should be used instead of wooden stringers. This is because [wooden] stringers are not as elastic as bamboo – it is technically almost impossible to build [a highly rounded] kiln [with wooden stringers]. [On the other hand], if the kiln is a simple half tube shape, bamboo stringers are not needed. Instead, boards with a width of 2 *sun* 5 *bu* to 3 *sun*[238] can be used to easily build the kiln frame.

Whether bamboo or boards are used, it is not necessary to fill in the spaces between the stringers. It is better to have just enough space to keep the bricks from falling through because after the kiln is built, the spaces will allow the kiln to dry more easily.

x. Construction the Entrance/Exit Arch

When the entire kiln basket is completed, it is time to work on the arch that serves as both the entrance for loading the kiln as well as the firemouth.

The ceiling shape of the kiln's entrance is fairly complicated. Therefore, use many layers of split-bamboo, inserting the ends into the horseshoe attachment strip built along the kiln foundation. Make a beautifully curved basket and adjust the shape of the arch to follow the written plans as much as possible.

In order to make the entrance arch, a plywood form is made. Draw half circles to the diameter of the entrance width on 5 *bu*[239] thick plywood, and then cut them out with a jig saw.

CAPTION: Form for the Entrance Arch

238 3.5 in. (9 cm).
239 0.6 in. (1.5 cm).

Using the method described above, make both ends of the form. Stand these directly opposite each a distance equal to the length of a brick. In other words, the space [between them] should be between 7 to 8 *sun*[240]. Connect these ends together with boards which are approximately 2 *sun* wide and 5 *bu*[241] thick. Thoroughly moisten a 1 *bu*[242] thick piece of plywood and bend this over the two arch form ends. Nail it at a number of points along the curve line of the arch and when finished, it will have the shape of a half tube. In order to set the height of the arch form, attach wooden legs to the bottom side. Adjust the height of the arch by adjusting the length of the legs. When the height is decided, fasten and stabilize the arch form to the kiln basket.

Essentially, using this form shaped like a half tube to build the arch is a European method of construction.

The entire kiln shape is approximately completed. At this point, check the structure against the written plans to see if it differs or bows out. If it does, correctly mend any errors.

F. Raising the Arch Ceiling

When the arch framework for the ceiling is completed, the next step is to put up the ceiling.

CAPTIONS:
Top: Completed Form for Entrance Arch
Bottom: Placement of the Form at the Entrance

240 8.3 – 9.4 in. (21 – 24 cm).
241 3 in. (7.5 cm).
242 0.12 in. (0.3 cm).

A long time ago, when the ceiling of a large kiln was put up, people would have a ceremony similar to the ridgepole completion ceremonies[243] that happen when houses are built. When the ceiling of a large kiln was put up, relatives and neighbors came to help and it was like a festival or ritual event[244].

i. Clean the Foundation Bricks

First, thoroughly clean all dust and foreign objects from the surface of the foundation bricks that the arch will rest upon. Then, sprinkle water on the foundation bricks to make them wet in order to allow the kiln-clay to adhere to the foundation. Finally, purify the kiln with rinsed rice, salt, and sake. Pray that the kiln will be a good one and that construction will proceed without any trouble. Then start laying up the ceiling.

ii. Laying Courses of Bricks

The idea in laying bricks for the arch wall is almost the same as was used when laying the foundation bricks. However, laying the bricks for the ceiling is different because the whole arch is curved.

When building a kiln using formal techniques, bricks which have an angle built into them are normally used[245]. Here I am doing things my own way and, just as in the foundation, I employ JIS approved used bricks "as is", i.e., there is no angle cut into the bricks[246].

The foundation will have dried in the days after construction and during this time, a lot of dust will have collected on top of the bricks. Unless the top surface of the side-wall bricks is cleaned and lightly sprinkled with water, the clay mortar will not stick.

Soft wedged kiln-clay is used as mortar. Form balls about 10 cm[247] in diameter and energetically slam them onto the top surface of the foundation bricks in side-by-side lines. Over that, lay bricks making sure that the smallest face of the bricks precisely fits against the side of the basket.

CAPTIONS
Left: Laying Bricks
Right: Clean Up

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243 For a detailed description of a ridgepole ceremony for a temple, with photographs, see S. Azby Brown, The Genius of Japanese Carpentry 149 (1st Paperback ed. 1999).

244 The ceremony occurs after completion of the framework and before brick work commences.

245 Commercial arch bricks are angled in this manner.

246 In other words, only straights are used.

247 3.9 in.

In this case, I previously explained a little about how to use smaller kiln-clay balls for the inner line and larger kiln-clay balls for the outer line. This will make the slope of the arch.

As the work proceeds, lay one row of bricks on the right and then, lay one row on the left. Continue in this manner row by row. Little by little, carefully adjust the rows to fit the inside arch curve using kiln-clay and bricks until the ceiling is completed. Do not forget to leave spaces for the firemouths, peep holes, or other open spaces as the work progresses. Work on the firemouths should be completed in the early stages of construction.

iii. Laying the Entrance Arch Bricks

[Next], completely finish building the entrance arch (which will also be used as the firemouth) when the walls begin sloping in. In this case, the idea is the same as when laying up the ceiling. Bricks are always stacked with the long edge perpendicular to the curve of the ceiling.

Working from both sides of the arch, carefully stack bricks along the shape of the plywood entrance arch mold. About six bricks are needed for the point where the arch curve becomes most pronounced, i.e., the peak of the arch. Almost no clay mortar is needed between the bricks [at the point where the bricks meet the arch form]. [However,] the upper ends of the bricks will have a space between them. Use kiln-clay to fill those spaces[248].

CAPTION: Laying Entrance Arch Bricks

248 Remember that the bricks are straights, not commercial arch bricks. There will be a wedged shaped gap between the bricks, with the narrowest point of the gap pointing down into the archway.

Pay close attention to the point where the bricks meet the plywood arch form.

Lay bricks from both sides saving the peak for last. There will come a point where there is space left for two bricks. These bricks must be altered so that they meet the plywood form without leaving a gap. It is ideal if these two bricks will perfectly fit into place without being modified. If the the two bricks are too wide for the space, they will not butt up against the plywood form when wedged into the space and a gap will remain under the ends of the bricks. Cut these bricks into a wedge shape using a cold chisel until they butt against the plywood mold.

In other words, there will be a wedge shaped opening between the bricks at the arch's peak. Slam kiln-clay strongly into this space. Then, take the bricks which were shaped with the cold chisel, the key bricks, and hammer them down into the clay mortar with a wooden mallet. When the key bricks are pounded into place, the entrance arch becomes firmly stabilized.

After that, starting at the top of the entrance archway and working towards the bottom, hammer in fragments of tiles or other materials in the spaces between the bricks. By doing this, the entrance arch becomes firm and strong.

iv. Laying the Ceiling of the Main Body of the Kiln

Now that the entrance arch of the kiln is finished, the ceiling of the main kiln body still remains. Building the ceiling arch of the kiln's main body also follows the same idea of alternately slamming kiln-clay on the bricks, and then laying another course. Pay close attention to fit along the underlying arch framework.

When the lumps of kiln-clay are slammed on, they are very thick. Because the mortar is thick, [it is necessary to] stomp the bricks into place to ensure that the end face of each brick meets the inside of the kiln wall. Also, be creative when blending bricks into the entrance arch of the kiln without breaking the line of the ceiling arch.

CAPTION: Hammering Down the Key Brick

Also, when laying the bricks for the rear of the kiln (*sutema* area), lay them as securely as possible. If the arch framework is firmly made, even if the bricks are forced in place a bit strongly, there is no need to worry that the framework will fail.

Lay bricks from both sides as indicated in the photographs. Change the way the kiln-clay is applied when the bricks rise to the critical portion of the ceiling.

[At this critical part of the ceiling], do not use kiln-clay on the inside ends[249] of the bricks. Slam on a larger amount of slightly softer clay mortar at the top end of the bricks. In this way, the bricks join together but watch with special care the angle at which the bottom parts of the bricks touch the framework arch. Think about the angle at which the bricks are laid.

CAPTIONS:
Top: Blending Bricks
Middle: Laying Bricks from Both Sides
Bottom: Placing Clay Mortar on the Upper Ends of the Bricks

249 In other words, don't place two lines of kiln-clay on the wide faces of the bricks. Use only one line at the top end of the wide faces of the bricks. Remember that at this point in the arch, the bricks are approaching vertical, the small faces which directly face the inside and outside of the kiln *do not* receive kiln-clay. The kiln-clay is placed at the upper end of the widest face of the bricks.

COLOR PLATE: Iga Triangular *Hanaire*

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The reason kiln-clay is not placed at the lower end of the bricks (bricks are oriented with the smallest face toward the basket) is because the arch curve is large here[250]. If the mortar seams were thicker, they would expand more. It would be impossible to prevent kiln-clay from falling through those spaces during firing. Kiln-clay and other bits would fall from the seams and there is a danger that it would become dust, and rain down on the pottery.

Furthermore, the reason slightly softer kiln-clay is used at this stage, is that it is no longer possible to stomp the bricks in place by stepping on them. However, if they were pounded into place with a metal headed hammer, there is a danger that the bricks would crack. Instead, use the handle of the metal hammer to pound them firmly into place. In either case, lots of power cannot be used so softer mortar is employed.

Lay the ceiling in this manner. If the surface structure touching the bricks is not well finished, when the underlying framework is removed, the brick walls will be irregular. This is a bitter sight. Also, the kiln loses strength. Recognize that how the framework is constructed is important.

CAPTIONS:
Top: Diagram of Laying Ceiling Arch Bricks
Top Arrow: Key Brick
Lower Arrow: No Space
Bottom: Pay Attention to the Point the Bricks Contact the Framework

250 Again, in this paragraph, the "lower end of the bricks" refers to the portion of the widest brick face which, at this point, has a vertical orientation. As explained on the next page, it is undesirable for mortar to be sandwiched between the bricks and the basket.

v. Shaping Bricks

As indicated in the lower right photograph, adjust the width of the remaining bricks where they meet at the [peak] of the ceiling. The bricks must touch the underlying framework in the same manner as those used in the entrance arch. [Make the bricks fit] by cutting the bricks with a cold chisel or some other equipment to ensure that when installed, they fit nicely and tightly.

By the way, if the kiln-clay spills onto the arch framework surface or if crumbs of bricks are left there during these processes, when the kiln is completed and the arch framework is removed, the shape of the kiln will not be beautifully constructed. Use extra care to make certain throughout the work that the surface where the bricks touch the underlying framework is clean.

Continue the work neatly laying brick after brick until there is no more space to insert bricks.

vi. Stabilizing Bricks with Kiln-clay

For the most part, the ceiling is completed at this point. In this method of building the ceiling, the smallest face of each brick points toward the inside of the kiln. All of the small faces of the bricks on the inside of the kiln must fit together, side by side perfectly snugly. By the same token, the curve line is formed on the outside of the ceiling (outside of the kiln) and there are spaces between the ends of the bricks [which face the kiln's outside]. As the curve increases so does this space. Strongly slam kiln-clay into any gaps left between the outside brick ends.

After that, insert carborundum[251] kiln shelf fragments, fragments of tiles, or other similar things into the slammed-in kiln-clay. Work from the peak [downward] to the sides, carefully pounding these in as wedges.

CAPTIONS:
Left: Hammering in the Key Brick
Right: Cutting Bricks

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251 Silicon carbide.

During this process, the balance will be destroyed if one only pounds wedges into one area while leaving a surrounding area in which no wedges have been inserted. In other words, all the trouble that went into laying bricks on the underlying arch framework will be wasted if wedges are strongly pounded in at only one place. This is because the wedges cause the bricks to spread apart and the kiln's arched ceiling will become loose. Therefore, always look at the balance of the whole kiln, inserting wedges at all the necessary places. Gradually place the wedges from the peak and down both sides following a top-to-bottom pattern and fitting them tightly. The key in this process, is to avoid clustering wedges at one point.

The pictures show the results of filling the empty spaces with tile, roof tile fragments, or other fragments. In the event a fragment cannot be completely embedded, break off the portion of the fragment [that sticks out]. The mortar becomes more effective and is strengthened through this process.

CAPTIONS
Top: Strongly Slamming Kiln-clay
Middle: Pounding in Wedges
Bottom: Ceiling is Almost Completed

vii. Plastering the Finishing Coat

Depending on the season, at this stage it will take about a week before the mortar will be very dry and the kiln itself will have settled.

In order to give the kiln a beautiful appearance when viewed from the outside, plaster the outside with mortar to give it a smooth surface. Again, kiln-clay is used. Take 60 kg[252] of kiln-clay similar to that used when the kiln was built, and mix into this kiln-clay, three times its weight of sand. This sand, as I said before, is a byproduct of dried refined clay and consists of feldspar and silica sand.

Mix that sand into the kiln-clay and blend [the mixture] by stepping on the clay. It should not be very sticky but should have a rough texture the same consistency as cement. Put this mixture into a bucket and pour it over the kiln starting at the top. Use a trowel to carefully fill in all the mortar seams. By doing this, all bumpiness on the outside of the kiln is smoothed and it finishes into a beautiful kiln.

Generally speaking, it is good enough for the kiln's ceiling to be about one brick [length] thick. Consequently, the ordinary thickness of the cosmetic plaster need only be about 5 *bu* to 1 *sun*[253]. The purpose of plastering this cosmetic coat is to smooth the bumpiness and make a more handsome kiln.

With that, the kiln is almost completed. Let it dry for a number of days and when dry, remove the underlying arch framework.

viii. How Long to Take in Building the Ceiling

Raising the ceiling is done in one day. Many days can pass between construction of the foundation/side-walls, and it does not matter if a lot of time is used to build the underlying arch framework. However, when raising the ceiling, complete the work quickly from start to finish.

CAPTION: Plastering the Cosmetic Coat on the Outside [of the Kiln]

252 132.3 lbs.
253 0.6 – 1.2 in. (1.5 – 3 cm).

If the work of raising the kiln ceiling is stopped before completion, there will be a division in the ceiling because it is impossible to prevent the bricks from absorbing the moisture in kiln-clay. The kiln-clay (mortar) becomes too solid after one day and it is likely that wedges could not be pounded into [the seams]. As a result, work as quickly as possible.

G. The *Sutema*

The *sutema* is built behind the kiln and in front of the chimney in the same manner that the main body of the kiln is built.

Build the *sutema* foundation while constructing the foundation for the main body of the kiln. The ceiling arch basket is built in the same way the basket for the main kiln body is built. However, [there are two ways to make the *sutema*]. One is to make a *sutema* just like the main kiln body, but in miniature, so that the lengthwise axis of the kiln extends in one straight line all the way to the end. The other type of *sutema* is built across the main body of the kiln. In this case, the underlying *sutema* arches and the ridgepole will be perpendicular to the framework of the main kiln body.

In the former instance, that is, where the ridgepole of the main kiln body and the *sutema* make one straight line, do not think of these sections separately but instead, raise the ceiling of both at the same time. By making a partition inside the main kiln body, the *sutema* just appears.

On the other hand, when the *sutema* is built separately from the main kiln body, for example in my case, I attach a strangely shaped *sutema*. It looks like a large oil drum on its side. I make each section separately including a separate main body, foundation, and ceiling basket, up to the border between the *sutema* and the main body of the kiln. When the ceiling of these sections is put up, the work should be done in one day – the same day the main body of the kiln is built.

CAPTIONS:
Top: *Sutema* Types Diagram Depending on Framework
a: Direction of Ridgepole
Inside diagram, top to bottom: Girder, Ridgepole, Girder
Left Arrow: Split Bamboo
Right Arrow: Place to Build the Partition Wall After the Kiln is Finished

b: Direction of Girders
Inside diagram, top to bottom: Girder, Ridgepole, Girder
Left Arrow: Girder
Middle Arrow: Ridgepole
Right Arrow: Girder

Bottom: How the Bricks Are Laid at the Junction (Partition Wall Area)
arrow: *Sama Ana*

Lay bricks to form an overhang where the main body of the kiln connects to the *sutema*[254]. The sideview of the transition point where the last bricks of the main body are laid and the *sutema* is begins shows this overhang. Along the top of this junction, use bricks 1½ times normal size and then connect them with normal length bricks. The bricks in this area should be laid well.

The ceiling of the *sutema* is, of course, also in the shape of an arch. If a tiny *sutema* is desired, do not give it in an arch shape. Use kiln shelves or other similar refractory materials to make the ceiling. Using large shelves as lids, make a flat ceiling over the side-walls and then plaster it with kiln-clay. I think that is enough. However, after many firings with the flat ceiling, it is unavoidable that the ceiling will suddenly break. Even if high quality refractory materials are used, there is way to prevent cracking and breaking. Please remember that. If it is possible, the ceiling should be made in an arch shape because it will be stronger.

Other than that, I can think of other ideas for *sutema* design. For example, the size of the *sutema* may be different [from the rest of the kiln]. Specifically, the ceiling height of the *sutema* may be different [from that of the kiln] even if the ridgepole of the main kiln body and the *sutema* run in the same direction. Although the structure [of the *sutema* may differ from that of the kiln], the construction principles remain the same.

H. Chimney

Make the *endou* by narrowing both side-walls between the *sutema* to the chimney. There should be vertical exhaust vents at the point where the *sutema* [starts to] narrow.

Just as the main kiln body [requires] a strong foundation, construct a strong foundation from the exhaust vents to the area under the chimney where the narrowing ends. The foundation must be strong enough to support the tall chimney that will be placed on it. If possible, build a pad under the place the bricks will be laid. If the foundation is not well made, there is a chance that the chimney will fall over in a strong wind.

254 Please refer to the lower diagram on page 87.

In the concrete pad, plant three or four thick rebar rods which have a height close to that of the chimney. Later, lay foundation bricks in a tube shape – the width of this tube must be wider than the chimney will be.

The area immediately at the foot of the chimney is [a potentially] unstable [area], so the chimney foundation bricks should be a minimum of 50 cm[255] in height. [When connecting the *sutema* to the chimney through the *endou*,] stack bricks in such a manner that they surround the mouths [of the *sama ana*] and lay them so that they taper [to the chimney].

In my case, as I will explain later, I place oil drums atop the chimney base. Make sure that the outside width of the base is a little wider than the diameter of an oil drum.

[The lower portion of the chimney is made with] bricks stacked to a 50 cm[256] height. Then place 2-3 *toukan*[257] on this chimney base. This is the height of the chimney.

If the *toukan* were stood "as is", they would crack or break during firing. So, in several places, use heavy gauge wire wrapped tightly around the *toukan* as reinforcement.

Then, slip oil drums over the outside of the standing *toukan* to form a sheath. Cut the bottom of the drums and the lids so that the oil drums form a tube. Use these for the *toukan* chimney sheath.

CAPTIONS:
Top: Chimney Foundation
Top Arrow: Concrete Foundation Pad
Left Word: *Endou*
Right Word: Chimney
Bottom Left: Oil Drums Around Chimney
Bottom Right: From *Sutema* to *Endou*

255 19.7 in.
256 19.7 in.
257 Fired ceramic pipe sections. As one might imagine, these come in many lengths and widths and we had no luck determining the size by contacting various manufacturers. From the diagram at page 90, it appears that the author used *toukan* which were slightly longer than the height of an oil drum – probably in the neighborhood of 4 ft. (1.2 m). Also note, in recent times *toukan* have fallen out of favor as a chimney material. Even Furutani had switched to brick chimneys toward the end of his career.

Have the oil drums cut at a metal shop leaving a rim of about 1 *sun*[258] at the lid and the bottom of the drums. If the rim is too small, the oil drums stack poorly.

Put an oil drum in place, and then fill the space between the *toukan* and the oil drum with fine sand of the type used as building material. Pour the sand from a bucket and use a pole to poke the sand until it fills the space around *toukan* chimney completely. After the first *toukan* and oil drum are filled, place another *toukan* and oil drum and then fill it with sand also.

Why build an oil drum sheath for the *toukan* chimney? *Toukan* do not handle thermal shock well and if they are suddenly heated, they crack easily. When protected with an outer sheath, even if they crack they will not collapse. This is the same principle behind the ceiling arch.

The chimney looks more like a tower of oil drums. This sheath alone eliminates the risk that the chimney will tip over. To make it perfect, bind the rebar rods to the chimney with wire [for added stability]. This is the most reasonable chimney and can easily be built in a day.

I. Finishing the Kiln Interior

After the kiln is completed, the chimney built, and everything is finished, let the kiln dry to a certain extent. The arch framework which was built earlier should be taken out now.

First, take out the framework crossbraces. Crawl into the kiln to a certain degree and pull out the nails of the crossbraces carefully. When pulling the nails with a crow bar, if too much force is applied with a crowbar there is a risk that bricks will become loose where the crossbraces concentrate power on one particular point of the kiln. Remove the crossbraces as gently as possible and it is desirable to do so skillfully.

CAPTIONS:
Left: How to Cut Oil Drums
Top Arrow: Leave a Rim Approximately 1 *sun*[259] Wide

Right: Chimney Oil Drums
Top Arrow: Fill with Sand
2nd Arrow from Top: Wire
Middle Arrow: *Toukan*
2nd Arrow from Bottom: Oil Drum
Bottom Arrow: Foundation

258 1.2 in (3 cm).
259 1.2 in (3 cm).

If the split-bamboo or boards of the kiln framework were knotted together with flat vinyl tape, the vinyl tape bonds can be burned off. Attach a rag to the end of an iron rod or similar tool, soak it in oil, and then light it.

As is shown in the photograph, insert this torch into the kiln and use the flame to melt the vinyl tape. There is no need to cut the bonds one by one – the bonds can be removed instantly [by burning them off].

When doing this, note that if the flame from the oil soaked rag is too large, soot may accumulate on the inside walls of the kiln. Pay close attention because if too much black soot accumulates on the walls it may cause a problem later in the finishing stage.

After all the bonding tape is melted in this way, dismantle the framework lumber and remove it from the kiln. Be careful not to exert too much force during this process.

The walls of the inside of the kiln will be roughly formed and between the bricks, kiln-clay will be hanging in pieces from the mortar seams. Clean up the mortar seams using a gardener's hand shovel or a little chisel to scrape off the excess kiln-clay. This makes a beautiful finish.

CAPTIONS:
Top: Taking Out the Framework
Bottom: Burning Out the Vinyl Tape

Then, using a broom with a short handle so it can be brought into the kiln, clean the walls and remove any loose kiln-clay as thoroughly as possible. The broom will pick up dust better if its tip is moistened.

After the inside of the kiln is completely cleaned, the entire inside of the kiln should be coated with a surface coat of slip in order to prevent bits of mortar from falling [on the pottery]. It is not appropriate to use highly fire resistant clay as slip. Make the slip out of clay which is normally used for pottery and then mix in a small amount of *gairome* clay or other highly fire resistant clay. Mix it with water until it has a soft consistency like mud. Put this mixture into a bucket and soak the tip of the broom long enough so that it absorbs the slip. Then paint the slip on the ceiling and side-walls of the kiln with a gentle and light touch. This will finish the inside of the ceiling and side-walls beautifully.

At this point, if there is too much soot on the walls, the surface coat of slip will not stick well. Consequently, preventing large deposits of soot will be important when burning the oiled cloth.

When finishing the kiln, consider issues regarding the bottom side of the kiln, i.e., the floor. There are many loading methods: One is to set the height of the shelves just like a *hina dan*[260], that is, in a stair configuration. Another method is to make the floor out of silica sand but instead of building steps on the floor, use the slope "as is". Another method is to use *uma no tsume*[261] and etc. When a *tsubo* is fired on a sloped floor in this method, the *tsubo* cannot be placed on the floor "as is" because of the slope. Thus, an *uma no tsume* supports the bottom of the *tsubo*.

The point here is that the problem of defining the interior structure, whether the kiln floor is made for easier pottery loading or for keeping the pottery horizontal, should be considered when the inside of the kiln is finished. I will explain this in Chapter 5: loading.

CAPTION: *Hina Dan* Kiln Floor Type
Inside: *Sutema*

260 Stepped pedestal for placing dolls on Girl's Day (a festival for girls which occurs on March 3rd of each year).

261 Literally, a "horse's hoof". In this case, it is a wedge placed on the lower end of the slope beneath an individual pot to make the pot stand straight. See page 100 and the top diagram at page 101 of this text. Further discussion can be found at LOUISE A. CORT, SHIGARAKI, POTTER'S VALLEY 84 (1st Weatherhill ed. 2000).

J. Trends in Pottery and Kilns

In my case, to a certain degree, kiln structure and pottery have merged into a unified idea. My thinking has been continuously evolving from what it was in the past, and it will continue to evolve into the future. My primary goal is to achieve the results for which I am aiming. When I am intending to make *hi iro* pottery, I fire in a kiln specifically designed for that purpose. For the firing, I start with the fundamental concepts and incorporate new ideas as I strive for the *hi iro* I envision achieving.

In this case of course, if my new ideas related only to redesigning the kiln structure, it would not be possible for me to achieve my vision. If the [desired] *hi iro* fails to appear, aside from kiln structure, I think about new ways to stack the pottery or about the firing process itself. All the while, I experiment with many kinds of clay.

Sometimes, the fired pieces will be very similar to what I envisioned and sometimes, I will get an unexpected result in the pottery from one part of the kiln. When this happens, a desire may begin growing in me [for that type of pottery]. In approaching this goal, I try to build kilns which will develop an atmosphere capable of producing that type of pottery. When I successfully incorporate new ideas into a kiln, yet more ideas appear and my pottery continues its evolution.

In summary, I have explained how to actually build a kiln. This manner of construction is not purely a Shigaraki method. If I really had to label it, my own method would be called “Shigaraki Style”. Many pottery centers are carrying on the age old traditional techniques.

In the end, I would like to emphasize the things that really must be kept in mind.

First: material. With bricks, used ones are better but always know the precise origin of the materials. Although at a glance, bricks look alike, if they are acquired from an untrustworthy source, it may be the cause of an accident.

CAPTION: Large Shigaraki *Tsubo* Resulting from a Change in loading Methods

Another example: regarding the kiln-clay ingredients, if the kiln-clay is used without confirming [it is sufficiently refractory], in the worst case scenario, its heat resistance will be too low and the mortar will melt and drip. I would be beyond tears.

Even *mousou* bamboo [should be selected with care] to ensure that each stalk is the same thickness. If there is too great a difference between the bamboo, even if the shape of the basket is correct, when heavy weight is applied, the shape will become contorted and cause the kiln structure to be weak.

Examine old and new bricks as well as kiln-clay and bamboo carefully for flaws.

Besides paying attention to materials, one must devote attention to the actual work. Building an anagama does not seem like intricate work along the lines of making electronics. People are apt to think that the work can be haphazard. [This is untrue], the work does require close attention to detail.

During the work for example, the bricks should be laid evenly working both left and right sides alternately. If several layers are built on one side only, the whole body of the kiln will tilt. This is a very dangerous situation.

Both the work of laying bricks and the method of "slamming" kiln-clay should also be precise to a certain degree. As the work proceeds, accidental errors will multiply such that during the building process, fixing [those errors] will become impossible.

When building the kiln, a skimpy work attitude of "this looks good enough", cannot be tolerated. Follow the processes and each succeeding step of the work absolutely precisely. Building an anagama is delicate work.

Recently however, especially with the introduction of special refractories, one can think that simpler building methods are possible. From now on, this is an assignment I have given myself to consider.

Chapter 5: Loading the Kiln

I have been writing a lot about [the structure of] anagama kilns. In addition to kiln structure however, knowledge about clay properties, firing methods, and other processes is necessary in order to express my purposes directly in the pottery. The loading process is the most important of all. Loading includes examples such as partition loading[262], as well as shelved and shelfless loading techniques. Anagama kilns can be made to fire pottery like that of noborigama kilns by incorporating new ideas into the loading plan. It is possible to make an anagama kiln perform like various other types of kilns, providing that different anagama kilns are built and the appropriate type of pottery is freely fired. In this context, I think that loading is the center of firing.

A. Flame Movement Inside the Kiln

The floor of an anagama is shaped like the outline of a candle flame. How does the flame run inside the kiln when firewood is burned in an anagama? What is the relationship between flame movement and temperature distribution?

The flames running through the inside of anagama kilns which have an orthodox candle flame shape, will pass through the kiln uniformly creating a stable firing.

Although firing methods affect the temperature distribution, anagama kilns with an an [orthodox] shape do not develop extremely uneven temperatures. The fire holds the temperature inside [the kiln] steady and the flames streaming from the firemouth to the chimney can be monitored. Consequently, it can be said that the temperature distribution in each part of the kiln is almost even, although the temperature does fall off a little toward the chimney.

CAPTION: Prior to loading

262 Recall the way in which snake kilns use tightly packed pottery to act as a partition wall. See page 3.

B. Temperature Distribution

Now, I just said that the temperature distribution of anagama kilns is nearly even. However, what I mean by "evenness" in the temperature distribution has a totally different meaning from that of "evenness" in an electric kiln. In other words, "evenness" has a different feeling to it than the way this term is used by people who fire electric or gas kilns. Among the various kinds of wood fired anagama kilns, the most evenly-temperatured shape is that with a floor shaped like a candle flame.

Generally speaking, a "small temperature difference" means that if the temperature is measured in any part of the kiln, the temperature is almost the same [in that area]. With anagama kilns, even if there is a temperature difference of 100 °C[263] or more between the front firebox area (near the firemouth) and the back of the kiln, when the word "even" is used, it is understood that the temperature distribution "feels" even[264].

If firing *youhen* pottery is the goal, a half tube[265] shaped [kiln] is used. In this case, if a *mizusashi*[266] is stacked very near to the firemouth, there is an extreme temperature difference between the front and back sides. In anagama kilns which have a flame-shaped floor, this extreme temperature difference does not exist. Although I can say that the temperature distribution is "even" in this sense[267], there is more than 100 °C[268] difference between the firemouth and the area near the *sutema*. I do not use a pyrometer very much so I cannot be accurate about the numbers. Regardless, rear area of the kiln near the *sutema* is much lower in temperature than the firemouth.

The width of the firebox depends on the width of the kiln. If the widest part of the kiln is around 6 *shaku*[269], the width of the firebox ranges between 4 *shaku* – 4 *shaku* 5 *sun*[270]. The important issue here is not the width of the firebox, but it's depth.

CAPTION: Flame Inside the Kiln

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263 Note – Whether this is Celsius or Fahrenheit is not indicated. Celsius is presumed here because Fahrenheit is not used in Japan. There are 180 °F per 100 °C (do not confuse this scale with a measurement of the the actual temperature: a measured temperature at 100 °C is 212 °F – in terms of temperature *difference* however, remember that the first 32° of the Fahrenheit scale are in the negative range of the Celsius scale. As a result, a difference of 100 °C = 180 °F).

264 Perhaps what the author is driving at, is that the temperature change is evenly gradual.

265 Untapered. Author used the word *kamaboku*. *Kamaboku* is a fish cake that is shaped like a half cylinder, i.e., a cylinder split down the long axis.

266 One of the tea utensils. This lidded vessel holds the water supply which is used in the heating kettle and also holds water for rinsing the *chawan* – note however that the *chawan* are not rinsed in the vessel, it simply holds the water that will be used in rinsing.

267 In other words, any single piece does not have an extreme temperature difference between the front and back side of *that* piece.

268 There are 180 °F per 100 °C. See footnote 263.

269 5.9 ft. (1.8 m).

270 3.9 – 4.4 ft. (1.2 – 1.35 m).

On average, the length of the firebox extends a bit more than roughly 2 *shaku* (60 cm)[271] from the firemouth. This 2+ *shaku*[272] area is the place where the fuel burns.

However, when one gets used to anagama kilns, one begins to think that it would be nice to stack as many pieces as possible. In this case, one might be tempted to stack pieces close to the firebox. If this is done, the length of the firebox becomes even shorter.

The highest temperature is the area about 3 – 4 *shaku*[273] behind the firemouth toward the back of the kiln. From that point, the temperature drops little by little toward the rear [of the kiln]. As I said before, at a point a little in front of the *sutema*, the temperature difference is more than 100 °C[274]. Carefully consider this temperature difference when placing shelves and loading.

C. Interior Shelving

Inside the kiln, build shelves or other similar devices [to be used] in the loading space. Depending on the goals one has for the pottery, for example, in the case of *hi iro* pottery, it is better and most rational to place shelves so that the fire will flow all around pieces.

In terms of preparing for loading, the placement of kiln shelves is extremely important work. Even if the kiln is well designed, poor loading will prevent the temperature from rising and increase the possibility of failure.

CAPTIONS:
Left: Firebox of My Kiln
Right: Gas Fired Kiln (Shigaraki Ceramic Cultural Park)

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271 23.6 in.
272 23.6+ in. (60+ cm).
273 35.4 – 47.2 in (90 – 120 cm).
274 There are 180 °F per 100 °C. See footnote 263.

i. Kiln Shelves

In order to place the kiln shelves, first determine the appropriate sizes for the kiln and obtain the necessary number of refractory carborundum[275] kiln shelves. Although these can be special-ordered in custom sizes, this is expensive. It is better to find shelves ready-made to a size suitable for the kiln.

Kiln shelves with a thickness of 1-1.5 cm[276] and about 45 cm[277] long are often used.

When placing shelves, begin at the back of the kiln near the *sutema*. First, decide what length of kiln shelf will fit in the very back.

The lower region of the kiln is wider than the area near the ceiling where the kiln narrows. Consequently, several larger kiln shelves may fit on the lower levels while fewer may be laid at the higher levels. This process does not apply if custom-made shelves were ordered. When custom shelves are not available, just deduct a shelf on the second level.

If one already possess shelves, it is important to build the kiln width so that when it is completed, the shelves fit the kiln.

ii. Kiln Shelves and Posts

Posts which can be used in electric and gas kilns can be used for the posts which support the kiln shelves. These store-bought posts have a diameter of about 1 *sun* to 1 *sun* 5 *bu*[278]. Use posts according to the height of the pottery. Small posts starting at the height of 5 *bu*[279] and increasing in 1 *sun*[280] increments are available. Needless to say, longer and thinner posts are not very stable and create a risk that everything will fall.

CAPTIONS:
Top: Kiln Shelves (Made from Carborundum)
Bottom: Constructing Shelves in the Back-most Area

275 Silicon carbide.
276 0.4 – 0.6 in.
277 17.7 in.
278 1.2 – 1.8 in. (3 – 4.5 cm).
279 0.6 in (1.5 cm).
280 1.2 in (3 cm).

With anagama kilns, the temperature is higher toward the front of the kiln. Although store-bought posts can be used for the back most shelves, if possible, use firebricks or other similar thick materials in other places because they make more stable posts.

iii. Constructing the Floor

Imagine looking at the lengthwise cross-section of an anagama – the high point of the kiln is in the back near the *sutema*. Stairs descend from that point to the firemouth in stepwise fashion.

If the floor is made of steps, it may be built just before loading begins.

When the floor is made in steps, calculate how many shelves will fit from left to right and also make the width of the steps fit the width of the shelves. The steps must be precisely level.

The steps will need to support not only the shelves and posts, but the weight of the pottery as well. When fired, the temperature reaches a thousand and several hundred degrees [Celsius][281]. When the temperature rises, if the floor bricks and the shelves they support move or become loose, it is a disaster. Without question, it is extremely important to build a stable floor.

CAPTIONS:
Top: Kiln Shelf Posts
Bottom: Stepped Floor

281 1000 °C = 1832 °F; 1200 °C = 2192 °F; 1300 °C = 2372 °F.

In order to make [a stable floor], do not simply lay a single layer of bricks for the floor. The foundation for the floor should be dug down at least 10 – 20 cm[282] and bricks should be buried there. Attentive preparation [here] is also needed.

iv. Stabilizing Kiln Shelves

It cannot be helped that when the kiln temperature rises, the shelves in the front near the firebox will be pulled toward the front by the fire. There is a risk that they will tilt or settle to either side. Particularly during the first firing of a kiln, the floor sometimes sinks when the temperature rises and the amount it sinks cannot be predicted at all.

So, stabilize the shelf posts in the front near the firebox by inserting wedge-shaped fragments into the spaces between the kiln walls and the shelves. It is best to be prudent when placing the shelves.

v. *Hitotsu Narabe*[283]

Depending upon the kind of pieces [being fired] – large *tsubo* for example – they may be placed directly on the floor without any shelving. In other words, the *hitotsu narabe* loading method may also be used.

Large *tsubo* are placed on the sloping floor. An *uma no tsume* wedge is inserted under each *tsubo* to keep it level. *Uma no tsume* are made with high-fire clay and are shaped like round balls. Long ago, these were often used in old kilns.

CAPTIONS:
Top: Stabilize the Shelves with Wedges
Bottom: *Hitotsu Narabe* Floor

282 3.9 – 7.9 in.

283 Method of loading pottery directly on the kiln floor without shelving. Literally means "standing in one line".

D. Actual Loading

[In preparing to load the kiln], stand shelf posts on the step near the *sutema*, construct the kiln shelves, and then start loading pottery. Start in the very back [of the kiln] and when finished there, construct the next set of shelves and then load more pottery. Loading starts at the rear of the kiln and moves forward to the firemouth in this order. I will explain the details below.

i. Principles of Loading

On average, the space extending 2 *shaku*[284] from the firemouth will be used as the firebox. The point about 1 *shaku*[285] further in is where the kiln shelves will be constructed and the pottery stacked.

The area which is closest to the *sutema*, irrespective of the size of the pieces, is for pottery intended to have *hi iro* effects. The *hi iro* will be different depending on the type of clay used, and some clay will not show any *hi iro* at all. I cannot say that all pottery placed near the *sutema* will take on a *hi iro* appearance.

Sloping down toward the firebox at the front, the *shizenyu* area [of the kiln] gradually begins. *Shizenyu* will cover [pottery] well from about the halfway point [to the front of the kiln].

The place closest to the firemouth on the very front row of the shelves is the area where very good *shizenyu* pieces can be made. In the first and second row, fire *koge*[286] and *haikaburi* pieces. *Youhen* pieces might also result as well.

The front rows are for *koge* and *haikaburi* pottery. The middle is for *shizenyu*. Further back, only *hi iro* pottery will result. This is the principle progression and it must be kept in mind when loading the kiln.

CAPTIONS:
Top: Diagram of *Uma no Tsume*
Arrow: *Uma no Tsume*
Bottom: Predicting Firing Results

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|     Shizenyu     |
|<--  Youhen -->|<--  hi iro -->|
|    Haikaburi     |
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284 23.6 in. (60 cm).

285 11.8 in. (30 cm).

286 Pots near the firebox may be covered with embers during the firing. Burying pots in embers causes cooler firing temperatures for those pots (or the buried portions of those pots). When natural-ash glaze is <u>not</u> allowed to develop on the pieces buried in embers, burial in embers causes the clay to develop dark charcoal-colored or pastel-hued qualities. On the other hand, if *haikaburi* or *shizenyu* is allowed to develop <u>prior</u> to burying the piece in embers, and the firing temperature is sufficiently high, the buried portions of natural-ash glaze will develop a coal encrusted surface. Note that a piece which is partially buried may exhibit *koge* on the buried portion and *haikaburi* or *shizenyu* on the exposed portion.

ii. Arrangement of Pottery

Which is more difficult – firing a kiln with too few pieces or too many? One important characteristic of anagama kilns is that when they are loaded with too few pieces, they are harder to fire. If the fire in an anagama does not pass through many pieces of pottery, the chimney's draft weakens and it becomes harder to fire. Interestingly, it is more difficult to fire the kiln than when there are too few pieces in an anagama, than when there are too many. The heat from an anagama kiln's wood fire is held inside the kiln by the pottery – this allows the temperature to rise. However, if too little pottery is loaded into the kiln and room remains for more, the fire passes through [the kiln] quickly without allowing heat to build up. In this case, the kiln is very inefficient at at storing heat. For example, if no pottery is placed in a kiln and it is fired empty, the temperature will not rise to more than 1100 °C[287]. As a result, it is necessary to stack enough pieces to fill approximately 60% or more of the kiln's capacity. One might think that this is too much to load in the kiln, but it is at this level that the kiln is easier to fire. Any less, and there is too much space inside the kiln – the fire will pass through without raising the temperature very much.

Moreover, because the flame runs along the ceiling, take care not to leave too much space between the ceiling and the pottery. It is important to stack pieces so that they almost touch the ceiling. With the upper area of the kiln filled in this way, the flame will run underneath. In this way, the pieces stacked near the ceiling divert the flames and better pieces will usually result. Similarly, to ensure that there is enough draft in the lower areas of the kiln, do not stack too much pottery there.

Note that when loading unbisqued unglazed pieces, the pottery will shrink. When Shigaraki clay is used, the shrinkage is usually 15%. As a result, there is no risk in loading pieces very close to the ceiling.

When loading, the [height of the] space between the ceiling and the [top] shelf is sometimes greater at the back [of the shelf] and lower in the front[288]. In this situation, set the back of the kiln shelf at a height which accommodates the height of the pottery that will be stacked there. [Then], allow the front of the kiln shelf to tilt downward so that it is parallel with the slope of the ceiling.

CAPTION: Pottery Buried in Coals

287 2012 °F.

288 Remember the ceiling is sloping downward and the shelves are level. As a consequence, there is more clearance between the ceiling and the top shelves at the back part of the shelves than at the front part of the shelves.

For example, if a 10 cm[289] post at the front will support the kiln shelf so that it is level, use a post about 5 cm[290] tall to temporarily keep the shelf from collapsing while it is tilted. Keep the shelf in this position while the pottery is placed [on the shelf]. At the back of the shelf, place pottery that will fit the space between the shelf and the ceiling. In front of these pieces, place shorter and shorter pieces up to the front of the shelf. Finally, raise the front of the shelf with the pottery on it so that the 5 cm post can be replaced with a 10 cm[291] post to make the shelf level. In this way, taller pottery is placed at the back of the shelf.

CAPTIONS
Top: Top Shelf Tilted Forward
Arrow: Tall Post
Middle: When loading is Complete, Switch Posts
Arrow: Short Post
Bottom: Stack From the Upper Shelves to the Lower Shelves

<u>NOTE – it appears that the top and the middle main captions were misprinted. Corrected, it would be like this:</u>

Top: When loading is Complete, Switch Posts
Arrow: Tall Post

Middle: Top Shelf Tilted Forward
Arrow: Short Post

Bottom: Stack From the Upper Shelves to the Lower Shelves

289 3.9 in.
290 2 in.
291 3.9 in.

iii. Sequence of Loading

As described above, the very top kiln shelf is temporarily tilted and, according to plan, pottery is stacked on that shelf from back to front. In this way, the space at the ceiling is made extremely small. Under that shelf, the pottery is simply inserted from the front because there are no problems similar to those of the top shelf.

When the pottery is stacked, always start at the top shelf, then move to the middle shelves, and finally do the bottom shelf. This is the order of loading. If the opposite sequence is used, that is, starting at the bottom and working up, there is a risk that pottery or a post will be dropped by mistake and destroy the pottery beneath it. Furthermore, sometimes dust or bits of brick fall during the loading process.

When the very back row of shelves is completely stacked, place the next row of shelves and stack pottery following these same ideas. The height and number of shelves will depend upon the size of the pottery being stacked.

E. Loading Strategies

When I am loading the kiln, my back is toward the firemouth and I keep my face looking toward the rear of the kiln. Work from the back [of the kiln] forward, all the while picturing how the fire will run from one's back toward the chimney. At the same time, one must be calculating how the flame will exist in any particular place: it may run in one place or be deflected and change direction in another. Question how it will affect nearby areas and what kind of result will appear if it touches a piece. Of course, it is needless to say that with tea utensils and other things, consider which side of the piece will be the front after firing.

CAPTIONS:
Top: Shelves Constructed Two Rows from the Front
Bottom: loading is Finished. Looking at the Inside of the Kiln from the Firemouth

All these things must be kept in mind – careful loading is of the utmost importance. Loading is so important that if the loading is a success, the firing itself has almost succeeded.

i. *Hi Iro* Shadows

Here I will give a little more detail about how to stack pottery.

The fire resistance is lower in weak clays[292] especially in the red clay group. Even in the back of anagama kilns where the temperature is lower, there is a possibility that such pottery will stick together. However, clay that is not so weak can be spaced more closely together to a certain extent. This changes the way the flame runs through the kiln. [Further,] there will be an absence of *hi iro* in places where the spacing is narrow – [this contrast] creates unique landscapes. Planning while loading is important because it allows one to gauge this effect and obtain different landscapes and patterns.

Note, near the front firebox area where *shizenyu* covers [the pottery], [it is important to leave enough space between pots] because the *shizenyu* will make the pots [which are too close to each other] stick together – this leaves a scar.

CAPTIONS:
Top: Pottery Fired with the Front Side Kept in Mind
Bottom: *Hi Iro* with Shadows

292 In general, when the author refers to "weak clays" he is referring to clays that are more-highly-fluxed, and less refractory that other clays being used and considered. It is tempting to use "low-fire" here, but that implies a clay far "weaker" than the author references. Any "low-fire" clay available in the U.S. would likely melt even at cooler anagama temperatures. To avoid misconception, we retained the more literal usage.

These procedures are a result of many layers of experience. Just as I know my own body, I am thoroughly aware of my kiln and I can use this wonderful knowledge as I wish.

ii. *Koge*

The front area near the firebox is where *koge* pottery is fired. Because of the coals which meld to the pottery, *koge* can be beautifully vivid or terribly ugly.

If a wide-mouthed bowl is placed in the front area near the fire, much ash collects on the inside of the pottery. There is high probability that this ash will not melt, leaving behind a piece of pottery that has a dirty appearance.

If *chawan* or other similar pottery are placed near the firebox, there is a slight probability that the ash which collects on the inside will melt into beautiful *bi-doro*. However, even if such results might be expected, they are not likely to occur. In the end, the collected ash does not melt and it leaves such a dirty finish, the piece will not be usable as a *chawan* anymore.

With wide-mouthed bowls or *chawan* on which a beautiful interior finish is desired, avoid loading them near the front where the fire burns. Instead, I think it is better to place them in the second or third rows where they can still get a *shizenyu* finish.

The same is true with *mizusashi* – stack these carefully because if they are stacked in the front area with the lid on, there is a large possibility that when fired, the lid will slip off. Load *hanaire*[293] or *tsubo* in the very front nearest the firebox.

I am able to fire interesting pottery by using the various methods I devised.

iii. Upside-Down Firing

If a bowl-shaped piece of pottery is fired upside down, a unique effect results. In Bizen and Shiga, some pottery has a flame shadow in a round *botamochi*[294] shape. In Bizen, [this effect] is called *botamochi.*

CAPTION: *Koge* Pottery

293 These are vessels for flower arrangement. Materials include metal, porcelain, pottery, bamboo, and wood.

294 Round rice cake shape area with a contrasting color that results when wadding placed over the clay prior to firing, is removed after the pottery is fired.

By making a stand similar to a *gotoku*[295] used in hibachi, I devised a slightly different way to achieve the *botamochi* result of Bizen style pottery. The *gotoku* is built with refractory clay. Bowls or similarly shaped pottery are placed upside down over the *gotoku*. When a piece is [arranged on a *gotoku* and] fired on the very top shelf, [the result] is different than if it had been fired right side up – remember that the flames pass underneath. Deflecting the fire in this manner, sometimes produces a moving landscape on the bowls.

When *chawan* are fired, insert posts or *gotoku* which will fit inside the *chawan*. Alternatively, place the *chawan* upside down on top of small saggars or other things. There is a possibility that unique pottery will be born.

By doing things a little differently than common sense may dictate during loading, a unique surface might result from the firing. I encourage everyone to experiment with different ideas during loading.

CAPTIONS:
Top: Bowl Which Was Fired Upside Down
Middle: Example of Upside Down loading
Bottom: Image of the Cosmos at the Aurora Exhibition

295 Three or four pronged stand placed in a *hibachi* to support a kettle above the layer of coals. See diagram on page 108.

iv. Shell Marks

Loading requires a plan. One idea is to place a piece of pottery on a high stand made of refractory clay. Place wadding between the stand and the pottery and a landscape will result there. In places like Hagi or Tokoname which are near the ocean, certain kinds of shells, for example, red clam shells, are used. These will leave shell marks on the landscape as well.

I combine these various methods with Shigaraki clay. Sometimes, they turn out well and produce interesting landscapes.

v. Other Loading Plans

Loading requires attention to detail. For example, suppose a shelf is placed on a post which is almost 1 *shaku*[296] tall and then a *hanaire* whose height is a little shorter but very close to that measurement is placed on the shelf. If more *hanaire* similar to the first are lined up together, when the firing is complete, the pieces placed near each other will not show many differences – all of the *hanaire* will have almost the same tone.

It becomes interesting if a cup with a height of 2 *sun* 5 *bu* or 3 *sun*[297] is placed near the foot of the *hanaire*. When the firing is complete, a landscape will have appeared there.

Further, consider the changes to this *hanaire* if a 3 *sun* to 4 *sun*[298] post is placed nearby and topped with a cup which barely touches the shoulder of the *hanaire*. Keep loading like this, perhaps placing a different *hanaire* or *tsubo* next to these other pieces. Note the height differences between these items and the first *hanaire*. Continue loading, keeping in mind that changes in the flame path itself, become decoration on the surface of the pottery. The placement-decoration[299], color, and shape are things I consider by reading how the flame will move inside the kiln during firing. This is how I go about loading the kiln.

CAPTIONS
Top: Several loading Ideas
 Top Arrow: Upside-down Plate
 Middle Arrow: Upside-down Bowl
 Bottom Right Arrow: *Gotoku*
 Bottom Left Arrow: Post
Left: Fired Kiln Prior to Unloading
Right: Loading Completed

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296 11.8 in. (30 cm).
297 3 – 3.5 in. (7.5 -9 cm).
298 3.5 – 4.7 in. (9 – 12 cm).
299 Remember that the pattern of loading will itself create a unique decoration on the pottery. The author uses this term to make it clear that placement, in and of itself, is a form of decoration.

The way the ashes cover the pieces and the manner in which the *hi iro* appears, all change depending on how the pottery is stacked. Do not arrange the pieces with a constant height. Instead, mix lows and highs, place some pottery upside down, and lay other pieces on their sides. Continuously experiment with various loading plans and seek methods which lead to good results.

F. Loading an Iga Kiln

Different kiln structures require changes in the loading methods. In this chapter, I have explained how to load anagama kilns. Finally, for your reference, I would like to explain my methods for loading my Iga kiln.

My Iga kiln is in a half-cylinder shape similar in appearance to split bamboo. Loading this kiln is a little different from what common sense would suggest – it is quite interesting.

This kiln measures about 10 *shaku*[300] to the *sutema* and the slope is close to 3 *sun* 5 *bu*[301]. The ceiling is especially low, more or less 2 *shaku*[302], the width is 4 *shaku*[303], and the floor shape is rectangular. Just as with anagama kilns, the firebox extends about 2 *shaku*[304] from the firemouth.

This kiln is designed for pottery intended to have an Iga *shizenyu* surface. The fire runs only through the center of the kiln where a pathway for the flame is made. In this type of kiln, the extreme left and right sidewalls receive almost no flame because of the fire-pathway running down the center of the kiln.

CAPTION: My Iga Kiln

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300 9.8 ft. (3 m).
301 4.1 in. (10.5 cm).
302 23.6 in. (60 cm).
303 3.9 ft. (1.2 m).
304 23.6 in. (60 cm).

The loading of this kiln is designed to prevent the fire from flowing straight through to the chimney. The very back part of the kiln near the *sutema* is constructed just like a common anagama. In order to stop the fire to some extent at this point, stack pottery as densely as possible on the shelves located near the *sutema*.

Leave a fire-pathway approximately 8 *sun*[305] wide down the center [of the kiln] starting from the 2 *shaku*[306] length firebox at the front [and extending] to the back of the kiln. This will be used as a space for burning firewood. During the firing, wood is thrown into this approximately 8 *shaku*[307] long pathway.

Place pieces in a *hitotsu narabe* pattern on both sides of the fire-pathway. *Hanaire*, *mizusashi*, and other pieces can be placed in two or three rows. Do not stack above the pieces.

With this type of kiln, the pottery is covered by *shizenyu* and the pieces close to one another may stick together. [To prevent this,] leave a wider than usual space between the pieces. Moreover, it is likely that firewood will hit pottery when firewood is thrown into the kiln. When this happens, one pot is pushed against the next and that pot may hit a third resulting in a domino effect. There is [also] a possibility that the pots may fall and crack. This is another reason to leave wide gaps.

Further, generous quantities of highly fire-resistant wadding should be placed under the pottery in order to stabilize the base as much as possible.

Also, it takes skill to fire a kiln to temperature with pottery stacked *hitotsu narabe* style. People who have some degree of experience firing standard anagama kilns can fire this kiln, but otherwise, firing is impossible. When a person is not experienced with the rhythms of adding fuel, raising the temperature itself is difficult.

CAPTIONS:

Left: Iga Anagama Loading Diagram

Left Arrow: Firebox

Middle Left Arrow: Fire-pathway

Middle Right Arrow: Shelves

Right Arrow: *Sutema*

Right: Fire-pathway Made Inside the Kiln

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305 9.4 in. (24 cm).

306 23.6 in. (60 cm).

307 7.9 ft. (2.4 m).

The reason it is hard to raise the temperature [in an iga kiln], is because it is not possible to prevent the flames from running through the kiln too quickly. One has little control over this problem. In order to control the flame, the thickness of the wood, the amount thrown, and the stoking rhythm are the main issues.

With iga pottery, a blue *bi-doro* is desired. Without a reduction atmosphere, the color of the *bi-doro* is bad. Reduction will not occur unless a new load of wood is thrown into the kiln in the moments before the last load of firewood in the kiln burns out. If the firewood is thrown in after the previous fuel has burned completely, an oxidizing atmosphere will result.

Moreover, this kiln has a steep slope which causes the firewood to burn quickly. If a mere moment too much passes after the firewood burns up and new wood is thrown in, cold air will be drawn into the kiln making it difficult to raise the temperature. A tiny slip in the timing allows the temperature to drop drastically – the correct rhythm of throwing firewood is extremely difficult. With good timing, the will kiln achieve a reduction atmosphere and the *shizenyu* will be a beautiful blue *bi-doro*. Additionally, there is a possibility that *youhen* will be born.

Once one learns how to fire this type of kiln in this style, one can expect interesting and unique pieces impossible in other kilns.

That is all. In this chapter, I presented an outline of the loading process.

There is an old saying: "draw a picture with the kiln" on the pottery. This saying demonstrates how the kiln's atmosphere coupled with the effects of the fire itself, alter the landscapes on the pieces. If this is true, I can also say that one can "draw a picture by loading". As I explained in this chapter, the expression one gives to the pottery is decided by the loading.

CAPTION: Iga *Bi-doro* Pottery

Loading is an ongoing process of trying new patterns. Over time, a person's individuality will appear in the pieces by playing this important game. Do not forget that carefully considering [the arrangement of the pieces], as well as the safety of the pieces when loading, will have an immense effect on the fired results.

Now the loading is finished and finally, firing can begin. In the next chapter I would like to explain the actual firing process.

Chapter 6: Firing the Kiln

A. Regarding Fuel

There are three reasons why long ago, Shigaraki became one of the *rokkouyou*. First, there was an abundance of good quality clay. Secondly, there was a river nearby to supply water. Finally, there was plenty of pine to use as fuel. All of the *rokkouyou* sites met these fundamental environmental criteria.

Pine firewood comprises 80% of the fuel I use. All of the wood, mostly red pine, comes from mountains near Shigaraki.

Some time ago, there were several merchants in Shigaraki who specialized in selling firewood. Today, only one or two remain and they are just selling wood as a sideline to their usual businesses.

In my case, I have been getting firewood from a local farmer for quite some time. He cuts pine firewood during the off season and can cut enough to supply all I need by himself.

Other than pine, I use 20% miscellaneous abandoned wood. When I say “miscellaneous abandoned wood”, I mean that I use two kinds of oak, cherry, and other hardwoods. Hardwood is particularly useful when it is necessary to build up embers. Hardwood burns for a long time and produces a lot of embers.

I rarely use cypress, cedar, or other trees which can be used architecturally. I avoid using these woods as fuel because cedar and cypress do not have much heat value. During the oil crisis in the 70's, I used mill-ends which lumber mills discarded as fuel. However, the results were not very good if there was some imported timber – the salt content of imported timber lingers in the kiln for a long time and it has a negative effect on *hi iro* pottery[308].

CAPTION: Pine on a Mountain in Shigaraki

308 This salt content is perhaps due to the fact that raw logs are often rafted and towed to shipping yards by tugboat.

Additionally, Shigaraki has recently had a problem with worms which bore into pine trees and breed there. It has been a difficult problem but even the pine trees infested with worms are an important fuel.

If not stored well, worm-infested pine becomes full of holes in a very short period of time. To use this wood for firewood, cut it into pieces and store it in a shed or similar structure to keep rain from falling on the wood. The wood should be kept dry and stored well. If this wood is simply piled in a field, it absorbs humidity, will not dry easily, and will rot. The worm-eaten pine wood does not have a very high heat value, but it burns easily and does not leave many embers. If there are too many embers in the kiln, burning this wood is a convenient way to reduce the amount of coals.

Because I fire anagama kilns, many people think that the only fuel I use is wood. In my case however, I burn crude-oil for the first night of the firing. I will write about this matter later.

i. Characteristics of Pine Firewood

The reason why red pine is very suitable for anagama and noborigama kilns, is suggested by the following anecdote. During the war period, there was a shortage of airplane fuel. There is a rumor that airplane fuel was made from red pine. This shows that the heat content of red pine is much higher than other types of wood. The heat content of cypress and cedar is smaller than red pine and [these woods] barely leave any embers. Without a buildup of embers, it is difficult for the kiln to store heat. Keep in mind that pine and hardwoods produce embers but cypress and cedar do not.

CAPTION: Worm-infested Pine Firewood

Besides these considerations, the length of the flame produced by pine firewood is several times longer than that of hardwoods. The length of the flame represents its strength and heating power. [Although] the long length of pine flames is [usually] an advantage of pine firewood, it can sometimes be problematic.

If only pine was used for fuel, it would not be possible to efficiently fire the kiln. I will explain this a little.

With kilns like Shigaraki's large noborigama kilns, there are ten or more chambers. Pine is preferred because of its long flame length. By burning pine in noborigama kilns, not only is the front chamber heated, the excess heat warms the next chamber and the next chamber and so on. In this way, the long pine flame preheats many chambers. This is a very important characteristic of the fuel for noborigama kilns and it explains why pine firewood (with its long flame length) is used. However, when the firing is almost complete, at the front where the temperature will not rise easily, miscellaneous hardwood is used to finish the firing. Compared with pine, hardwood flames are short and as a result, the flame will not extend deeply [into the kiln][309].

As I explained, pine has a long flame length – it burns well because it contains a lot of resin. In my kiln, the length of the slope from the firemouth to the chimney is about 10 m[310], or 5 *ken*[311]. When the temperature of the kiln rises to a certain level, if enough pine wood is burned, it produces sufficient heat to create a flame which stretches from the firemouth, passes through the back of the kiln, and exits the chimney in a 6 *shaku*[312] plume of fire. When considering the distance from the firebox to the *sutema*, it is not necessary for the flame to stretch this long.

CAPTIONS:
Left: Fire Plume of Iga Kiln
Right: Pine Firewood

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309 In other words, the heat of the hardwood fire will stay near the front of the kiln where it is needed.
310 32.8 ft.
311 29.5 ft.
312 5.9 ft. (1.8 m).

Thinking in reverse, the floor shape of the loading space in my anagama kilns is close to the same shape as the core of a candle flame.

In a candle, wax vaporizes and burns. The combustion [of this wax vapor] in the outer part of the flame is complete and it is there that the temperature is highest. There is also combustion occurring in the first third of the flame.

If the length of the flame is divided by three, the center area, i.e, the part inside the flame, is deprived of oxygen as compared to the outer part of the flame. As a consequence, the combustion is not as complete as in the outer part of the flame.

Further, the part of the flame close its core (the flame heart), makes up one third of the flame height. This portion is comprised of incompletely burning vaporized wax. It is the coolest part of the flame.

With anagama kilns, if the flame length of the fuel is too long, as with the heart of a candle flame, the flame heart will extend to and fill the back of the kiln where pottery is stacked. This pottery in the flame heart will not receive 100% of the flame's heat.

As a consequence, using firewood that has too long of a flame means that the heat produced is not used efficiently. Instead, a large amount of heat is wasted through the chimney. Consequently, it is easier to raise the temperature by burning hardwood as opposed to pine.

I have read in books written about pottery fuel, that pine is the best and that without pine, a kiln cannot be fired. With my anagama kilns, if the focus is only on raising the temperature, I can say that hardwood will work.

CAPTION: Candle Flame

The front area [of the kiln] is easy to fire – anyone can fire [this area] to some degree because the temperature rises by itself. However, in the back near the *sutema*, raising the temperature is extremely difficult. In order to raise the temperature in the back of the kiln, use wood with a little longer flame length.

From the perspective of firing the back of the kiln, pine is a better fuel. Using pine, the pottery loaded in the back can be fired.

The varying characteristics of different woods must be used to one's advantage. Choose pine or hardwood as appropriate to achieve an ideal kiln firing.

ii. Reasons to Use Pine Firewood

As I explained, miscellaneous hardwoods work well enough to raise the temperature. They also produce a large volume of embers. However, this does not mean that hardwood is the most appropriate fuel.

Miscellaneous hardwoods include not only oak, but cherry and other kinds of hardwoods. When a kiln designed for *shizenyu* pottery is fired, the fuel greatly affects the tone of the glaze. Consequently, I burn mostly pine in my kiln.

Even with pine firewood, some pine will have a higher iron content and other pine will have less. The ashes of pine trees which grow in mountains comprised of red clay contain a lot of iron. Where the iron content of the soil is lower, it seems that pines growing there also contain less iron. Although the makeup of pine varies to a slight degree, for the most part, it does not vary much. With oak, chestnut, camellia, or other miscellaneous woods of unknown type, there is a possibility that they will contain small amounts of metal oxides other than iron oxide. If these metals are contained in the wood, just as with prepared chemical glazes, it effects the tint of both the *shizenyu* and *hi iro*. One reason I mainly use pine is because it's makeup is stable. With hardwoods, there is some uncertainty about their properties.

CAPTION: Hardwood Bundles

iii. Firing Conditions and Fuel

When firing the kiln, one must be prepared for any conditions which arise. The kiln is fired continuously for four and a half days. During that period, rain or snow may fall one one day, or the wind may blow on another. It never happens that the weather is the same for the entire period. Moreover, different pottery is fired each time and there will be differences in the loading. Even with the same kiln, because of the changes in the conditions, sometimes it will fire well and sometimes it will be terribly difficult to fire.

If, as I mentioned before, it is firing extremely badly and the kiln is filling up with embers, burning worm-eaten firewood is an effective solution. When well dried worm-eaten pine is thrown into the kiln, it instantly bursts into flame. This wood is as light as a sponge and burns up rapidly.

Worm-eaten pine is a very convenient and handy fuel. It produces almost no coals as it burns and as a result, the quantity of embers will be reduced without lowering the kiln temperature. In my case, if worm-eaten pine is not available, I may sometimes get into trouble and cannot fire the kiln well.

B. Necessary Quantity of Fuel and Its Preparation

When I fire the kiln, I preheat it with crude-oil. I use firewood as fuel for the rest of the firing. I would like to discuss the preparation of these fuels in this section.

CAPTION: Worm-eaten Pine Wood

i. Standardizing Firewood

Find a person who supplies firewood either as a specialty or as a sideline business.

In Shigaraki, firewood is generally cut to a length of 1 *shaku* 3 *sun*[313] and bound with wire such that the circumference of the wire ring is about 4 *shaku*[314]. This is the typical Shigaraki size.

It seems that in Tanba and Bizen, the wood length has been adjusted to the local kiln types and the size of the firewood is different – it is longer than in Shigaraki and the bundles are a little smaller in circumference. In this way, the standard size of firewood depends on where it comes from.

People get used to using a particular size of firewood. I usually use 1 *shaku* 3 *sun*[315] length firewood. When it has not been available, I have obtained firewood from other places and tried using it. In that situation, because I was not familiar [with the cut], it was harder to handle. Even though the wood was only slightly longer, it often upset my stoking rhythm.

ii. Drying Firewood

There is an appropriate season for cutting pine into firewood. The best time to cut wood is from fall to early spring when the trees are not full of sap. Cut the wood in those seasons and allow it to dry naturally before use.

When seasoning wood, pile it near the kiln where it will get plenty of sunshine. The wood is not set near the kiln so that the kiln's heat will dry it – rather this is to prevent doing needless work. Doing pottery requires one to continuously carry things and when a kiln is fired, a large amount of firewood, 200 bundles, is burned. Moving this firewood from place to place requires a lot of labor. Good planning from the start prevents unnecessary labor.

CAPTIONS:
Left: Making a Band for Firewood
Right: Equipment for Making Standardized Firewood Bundles

313 15.4 in (39 cm).
314 3.9 ft. (1.2 m).
315 15.4 in (39 cm).

When the firewood is stacked on the ground to season, first lay two poles or similar objects on the ground parallel to each other like train tracks. Then lay firewood over the poles. Particularly during the long rainy season, cover seasoned wood with a tarp or corrugated metal to prevent keep it from getting rain soaked. If the wood is not yet seasoned and the weather is rainy, place a tarp or corrugated metal over the wood to protect it during drying. However, covering green wood slows it's drying.

Carefully stack the wood in side-by-side rows. Leave a little space between the rows so the wind can blow through and encourage drying. It is difficult for the wood to dry if it is stacked too tightly.

Note, firewood shrinks when it dries. If the wood is not stacked carefully in the beginning, the wood may collapse as it dries and one will be faced with two or three times as much work. It takes about six months to one year before the wood is seasoned.

If the wood is seasoned to some degree, it is best to put it in a shed for storage. However, the large amount of wood takes up a lot of space, and besides, it is heavy. Realistically, pile the wood near the kiln and at necessary times, lay tarps or corrugated metal sheets over the wood to ward off rain and prevent the need to re-dry.

CAPTION: Snow on Stored Firewood

After the wood is seasoned, it is not good for the wood if it gets wet and is then re-dried repeatedly. Once the wood is dry, it is necessary to prevent it from getting wet.

Also, if the wood is kept for one to two years outside, it will inevitably absorb ground moisture during this long period in the stacks. There is a possibility that the wood in the lower areas [of the rows] will rot. The general idea of this comment is that if one keeps the wood from getting wet and requiring re-drying, even if a long period of time passes after the wood is stacked, there is not much effect on the wood.

Firewood is different from other materials. It is not just a phone call away and even if it is available, it cannot be used if it is not seasoned. In firing the kiln, it is very important to plan ahead for one's firewood supply.

iii. Amount of Firewood to Prepare

Always prepare and have on hand, more than twice the usual quantity of wood [needed] for a kiln firing.

However, the amount of wood it takes for a single kiln firing varies drastically even between kilns of almost the same capacity. This is because of differences in the kiln structures, kiln personalities, and the methods used to fire them.

My experience has shown that for anagama kilns of the size I have described so far, 150 to 250 bundles of wood are required to fire one kiln-load[316].

CAPTIONS:
Top: Seasoned Firewood Stored in a Shed
Bottom: Use Two Poles to Prevent Wood from Absorbing Ground Moisture

316 Bundles have a circumference of 120 cm and length of 39 cm, therefore, a bundle's volume is about 0.045 m^3. A cord of wood measures 8' x 4' x 4' = 128 ft^3 = 3.62 m^3. As a result, there are about 80.4 of Furutani's bundles per cord. In other words, it takes 2-3+ cords of wood per firing. It would be advisable however to presume you will need more wood than this calculation would suggest – from the photographs, it appears that the bundled wood is packed more densely than cord wood is when it is stacked (cord wood being less densely stacked, there is less wood for a similar volume, and so a larger volume is required to obtain the same amount of wood).

However, in actually firing a kiln, it is not always true that preparing 250 bundles is enough. The reality is that during firing, the way the kiln is fired, or the weather, or the temperature, or some other conditions sometimes changes the situation. If the kiln has not finished in the number of days planned for the firing, the firing may have to be extended a day or two.

Considering these possibilities, it is important to have twice the quantity necessary to fire a kiln on hand. If the kiln typically uses 200 bundles, have nearly 400 available.

If the firewood runs out in the middle of firing a kiln, those days and sleepless nights of firing are a waste, a failure.

I heard this story from Narumi Sensei who is Kato Hajime Sensei's apprentice. Once, when Kato Hajime Sensei was firing a kiln, the fuel ran out when the firing was almost finished. They burned the storm shutters for the house[317] and the *tobukuro*[318] that contained the shutters. The kiln was still not hot enough. They had to cut the precious and carefully-raised garden bamboo and burn that to finish the firing.

One's foremost goal under all circumstances, should be to fire the kiln until the pottery is done.

Nothing is more discouraging than running out of firewood. When firing the kiln, if one worries about whether there is a sufficient supply of firewood, it is impossible to fire good pottery. A reserve supply of wood is essential.

In my case, I fire kilns quite often. I always store enough wood to fire five or six kiln-loads. This equates to about 1000 to 1500 bundles.

CAPTION: View of the Firewood Storage Area

317 These are wooden shutters that are put up during typhoons. Typhoons are the Pacific equivalent of Atlantic hurricanes.

318 The shutters are slid into these receptacles when not in use. They are attached to the side of the house.

My technique has advanced by firing kilns many times. I have already formed my personal stoking rhythm style, the amount of wood I throw in on each stoke, and other processes. However, I am in a completely unknown world when I am firing a kiln for the first time.

Note, besides fuel, it is absolutely necessary to have the physical stamina and energy to fire the kiln. Taking on the challenge of firing a kiln requires one to maintain his or her physical strength and energy.

iv. Other Fuels

Later, in "How to Fire the Kiln"[319], I will explain in more detail how I use crude-oil in preheating my anagama kilns. I use a small crude-oil rotary burner overnight and try not to raise the temperature of the kiln any more than necessary by keeping the burner set on low. Approximately 1/3 of a drum, or about 60 *l*[320] of fuel, is consumed in one night of firing.

As I will explain later in the section on preheating, when I say that I fire with a crude-oil burner, it is important to not misunderstand my purposes. Using a crude-oil burner to raise the kiln temperature higher than bisque is not the goal and would have a negative influence on the pottery.

When one or two people stay with the kiln preheating it with wood for an entire night, sometimes the temperature will rise more than expected. I use crude-oil in order to prevent this problem.

In this case, the first priority is to use as small a burner as possible. A foolproof method is to use a burner which cannot raise the temperature to more than 500 – 600 °C[321]. When morning comes, the changeover from oil to firewood is made and the firing proceeds to the stage at which the kiln temperature rises little by little.

CAPTIONS:
Top: Crude Oil Drum Used as an Oil Tank
Bottom: Small Rotary Burner

319 See page 124.
320 15.9 U.S. gal.
321 932 – 1112 °F.

C. Ceremony for the Start of the Firing

It is said that the elements of the *kanji*[322] for "kiln" mean that in front of a hole, precious lamb meat was sacrificed and the smoke of the burnt offering dedicated to the kiln god. I suppose this means that when the hole was filled with earthenware vessels and other pottery, that if the god was honored appropriately, the pottery fired well and without failure.

It was thought in ancient times that the work of pottery making involved powers beyond human abilities and that gods ruled these areas. When the fire is started in a kiln, potters usually perform a ceremony or something similar.

Currently for me, rather than praying to the kiln god before the fire is started in the kiln, my ceremony feels more like a ceremony of reflection on my past work.

For example, it never happens that when unsatisfactory pottery is loaded in the kiln, or the kiln itself is unsatisfactory, that the fire god will cause the work to be free of defects and acceptable. Working seriously during the several days of firing until the kiln is finished, I have a feeling of solemnity. It is out of this feeling that I offer salt sprinkled on the kiln for purification and rinsed rice and *sake* to the kiln god. Lately however, there are more and more people firing anagama kilns. The kiln gods must be very busy and surely, often cannot spare their powers.

D. How to Fire the Kiln

With anagama kilns, the fundamental stages of firing do not change: preheat, aggressively raise the kiln temperature, soak, then cool. However, the details of the firing process are a little different when compared to other kilns.

CAPTION: Making an Offering to the Kiln God Before the Start of the Firing

322 *Kanji* are the Chinese characters used by Japanese.

Prepare many kinds of firewood for firing the kiln. Use wood according to the conditions which arise. [This may require] splitting the firewood or using different kinds or amounts of firewood. The firing conditions, the stoking rhythm, and everything else, must be fully understood. It is outrageous to ask others to fire a kiln for you.

Cut firewood is usually used. Wood thickness can have an effect on the firing conditions. If thick wood is thrown directly into the kiln, or skinny pieces 3 cm[323] in diameter are burned, these differences will not only affect how the temperature rises, but will also affect whether there is an oxidation or reduction atmosphere in the kiln.

Further, the extent of the firewood's dryness affects not only how the temperature rises, but the quantity of embers produced. The amount of wood thrown into the kiln and the interval between throwing in successive charges also affects the firing conditions.

When throwing firewood into the kiln, rather than lay the wood in a parallel pattern, each piece should alternately cross the others (make “X” patterns). Doing this will allow secondary air to pass freely through the wood and increase the strength of the combustion. It is necessary to master this stoking technique.

It is extremely important to control the quantity of embers which build up in the firebox. Burning embers are extremely important for *haikaburi* of *koge* to appear on the pottery. Additionally, embers enhance the heat holding power of the kiln, help in raising its temperature, and stabilize the firing by preventing drops in temperature to some degree. These are the most important characteristic of embers.

Note, there are various kinds of embers. Mix the embers with a stainless steel pole so that they are evenly distributed from top to bottom. When properly mixed, the embers at the bottom [of the pile] and the embers at the top should have almost the same color – it should look like there are little jewels sparkling in the ember pile. When embers are large and retain the shape of the wood, they have a very dark color. The color of the kiln changes depending on the kinds of embers.

CAPTION: Splitting Firewood into Small Pieces

323 1.2 cm.

Note, mixing embers with a stainless steel pole relates to a rise in kiln temperature and also causes ashes to cover the pieces. As a result, *shizenyu* and *haikaburi* pottery can be obtained. Choose a method of mixing when aiming for this type of pottery, but note, if stirring is not done quickly enough, it will have the opposite effect[324].

A kiln should be fired while thinking of the overall process. Make a plan for the most appropriate way to fire the kiln by combining various factors, including considerations regarding oxidation and reduction atmospheres. If only one variable is maintained, the temperature will drop and the firing will be troublesome. When the kiln is fired for the first time, do what is necessary to achieve the first priority: raising the temperature. One must fire by continuously looking at the state of the embers and rapidly judging what must be done.

i. Preheating

As I alluded to before, loading determines 80% of the success of a firing. Even if the loading goes well and the firing is 80% successful, failure can still happen in the firing stages – particularly in preheating. There are four stages of firing: preheating, aggressively raising temperature, soaking and cooling. Which stage is the most important? I can say that preheating is the most important stage.

(a) Where to Build the Preheating Fire

First, let me explain the place to start the preheating fire in anagama kilns. After loading, decide the height of the firemouth and use bricks to block the kiln's entrance. As I explained before, changing the height of the firemouth has the same effect as changing the slope of the kiln. First, carefully determine the height of the firemouth. Then, build the large opening under the firemouth. The preheating fire is burned in this [lower] opening.

CAPTION: Stainless Steel Pole with a Crook for Mixing Embers

324 Taking too long to mix the embers will cause the temperature in the kiln to decrease because it also lets in air.

In my case, the true firemouth[325] is square [with sides] between 15 – 20 cm[326] long. The firemouth under this has dimensions of a square about 30 cm[327] high and wide. Brick up the entrance leaving these openings. The lower firemouth is primarily used for preheating and is where I place my preheating oil burner.[328]

(b) Reasons to Preheat

Preheating proceeds slowly and should not exceed a temperature of 300 °C[329]. The essential aim of preheating is to dry the stacked pottery and completely drive any moisture from it.

During preheating, the kiln is not brought to a high temperatures in a short time. If one does not preheat slowly, it has a negative effect on the firing. Additionally, pottery might explode, cracks may form on the bottoms of pieces, warpage may occur, and various other defects may appear.

One more thing, the sense of preheating an anagama is fairly different from that of preheating electric or gas kilns. Why is there such an outrageously long period of time for preheating anagama kilns? It is a very long distance from the firemouth to the *sutema* and when firing from a single point, it takes time to raise the temperature over that distance. Unlike gas kilns, which have many burners firing at once, there is no way to prevent a temperature difference from appearing between the front and back of an anagama. Making this temperature difference as small as possible depends on the preheating technique.

CAPTION: Coating the Outside of the Firemouth with Wall Clay

325 This is the upper firemouth.
326 5.9 – 7.9 in.
327 11.8 in.
328 Note: in later portions of the text, the author describes how the the lower firemouth may also be used as a secondary air inlet.
329 572 °F.

In some sense, preheating is an easy task which anyone can do. If it is not done carefully however, later when the temperature is being raised aggressively – and also during the soaking stage – an extreme temperature difference will appear inside the kiln. In that type of situation, there is absolutely no way to mend the problem.

First, think about what happens when the fire is initially started. As soon as the fuel begins burning, the temperature in the front rises rapidly. However, it takes some time for the heat to reach the other areas of the kiln. Even when the smoke reaches the other areas of the kiln, although those points warm up quickly, it is not true that the [entire] kiln itself warms up. Because the kiln is made of clay and bricks, it takes many hours before it is warm to the touch.

When a small fire is burning, some places in the kiln reach nearly 700 – 900 °C[330]. However, only a little warmth can be felt a short distance [from that point]. After firing for 30 minutes, the bricks of the kiln itself located near the firemouth are too hot to touch. To get an even warmth from the front of the kiln to the back, takes more than 10 hours.

When the fire[331] is started in the kiln, if there is a temperature difference of some hundreds of degrees [Celsius] between the front and the back of the kiln, it is difficult to reduce that difference to 100 °C[332] or less over the course of the firing. Here is a simpler explanation: when the firing starts after preheating, make sure the temperature difference is as small as possible. Between the start of the firing and the time when the firing is completed, that temperature difference must be reduced.

CAPTION: Preheating with a Small Fire

330 1292 – 1652 °F.

331 Plainly, this is the fire used to bring the kiln to temperature, not the preheating fire.

332 There are 180 °F per 100 °C (do not confuse this with the actual temperature: a temperature of 100 °C is of course 212 °F – remember that the first 32 °F are in the negative Celsius range).

As an extreme example: if a large fire is started and the front temperature rises to about 1000 °C[333], if the back of the kiln is at 300 °C[334] at that time, the temperature difference from front to back is 700 °C[335]. In attempting to shrink that 700 °C[336] difference, even after many hours of firing, in the end there will still be more than a 300 °C[337] temperature difference. [During the course of the firing,] it is impossible to shrink a 700 °C[338] temperature difference existing at the beginning of the firing. So, creating a temperature difference within 100 °C[339] is very difficult.

Therefore, to make the front and the back of the kiln have as little temperature difference as possible, it is very important to preheat with a weak fire and take many long hours in the process.

24 hours or more can be spent in preheating. If the preheating time is short, problems occur – the longer the preheating time the better. If more than 24 hours are spent, it will not create problems.

Generally, many of you may have the sense that if the front is fired properly, the temperature in the back will follow. This is definitely not true.

(c) Actual Process of Preheating

Now, let me explain the actual process of preheating anagama kilns.

There are usually no ash pits in anagama kilns and as a consequence, attempting to start the fire can be problematic at first. This is easily resolved by using well-dried kindling or brush wood.

CAPTIONS:
Top: Smoke and Water Vapor Escaping Through the Chimney
Bottom: Preheating Firemouth and True Firemouth
Left Arrow: True Firemouth
Right Arrow: Preheating Firemouth

333 1832 °F.
334 572 °F.
335 This would be a 1260 °F difference. There are 180 °F per 100 °C (do not confuse this with the actual temperature: a temperature measurement of 100 °C is of course 212 °F – remember however that the first 32 °F are in the negative Celsius range).
336 This would be a 1260 °F difference.
337 This would be a 540 °F difference.
338 This would be a 1260 °F difference.
339 This would be a 180 °F difference.

As I explained before, the preheating fire is built in the square opening with the 30 cm[340] sides, [i.e., the lower firemouth]. When this is done, simply block the upper firemouth with bricks.

Because we are talking about “kiln firing”, some of you may think that means placing a lot of wood and newspaper or fire starters inside the kiln, and then setting all of that ablaze. If the fire is started that way, the pottery stacked near the fire will drastically heat up and there is a possibility that the kiln temperature will also rise rapidly [causing damage to the pottery].

When starting the preheating fire, it is not started inside the kiln but instead, about 10-20 cm[341] in front of the lower firemouth. It feels like burning leaves[342]. Burn the fire for one to two hours and then gradually move the fire through the lower firemouth to the inside of the kiln. When doing this, do not move the fire from outside to inside the kiln quickly – move it about a brick's width at a time. Gradually burn the fire and in this way, the inside kiln temperature will not rise too fast. At first, the pulling power of the chimney is weak – this is normal. Smoke and flame will be drawn into the kiln to some degree as the fire continues to burn, and this will remove moisture from the entire kiln.

The firewood used when starting the fire must be thin or it will not catch fire. However, even this kindling does build up embers to some extent. Somewhat thicker firewood can be placed on the ember pile little by little and because of the heat from the coals, it will start burning. In this case however, in the very beginning there are almost no large flames rising [from the wood] and instead, it smolders. Smoldering is good because the temperature inside the kiln will not rise drastically.

CAPTION: Starting the Fire

340 11.8 in.

341 3.9 – 7.9 in.

342 It is a Japanese tradition to cook potatoes in piles of burning leaves during the fall.

COLOR PLATE: Flat Shigaraki *Tsubo*

It will take a few tens of minutes for the thick firewood to burn up. It is not necessary to continuously stand by the kiln pushing wood into the fire. Take a break. Wood with many knots in it cannot be chopped into kindling, so save that wood and use it for this part of the preheating process.

Note, for preheating it is not necessary to always use pine wood or other good firewood. Off-size firewood chunks, or scrap wood from demolished houses can be used. These scraps are fine but old nails or other bits of metal may have an effect – be careful to avoid these. Excluding imported timber, any firewood can be used.

In my case, about ten hours after the fire was first built, I switch to an oil burner to stabilize the kiln at a low temperature. When burning crude-oil, I of course pay close attention so that the temperature does not rise too high. Basically, a wood fire can be used for the entire preheating stage and people who are confident that they can continue preheating all night long with firewood should do it.

The remaining temperature gain in preheating reaches a maximum of about 500 – 600 °C[343]. In my case, I don't bisque fire so I preheat as long as I do in order to drive out all the moisture. When the surface of the pottery rises to around 400 °C[344], the chemically bonded water will vaporize. If the temperature rises drastically at this point, the pottery makes a pinging noise and may explode destructively.

When I fire, I always start the fire around 10:00 o'clock or later in the morning. By dusk, the kiln temperature is such that the pottery will no longer crack. [In other words], I start the fire around 10:00 a.m. and after about 10 hours have passed – at 7 or 8:00 in the evening – I change to the crude-oil burner.

CAPTION: Using Thick Wood, Gradually Fire

343 932 – 1112 °F.
344 752 °F.

[In preparation for using the oil burner], cut a hole in a kiln shelf for the oil burner mouth – the kiln shelf [itself must be] the same size as the preheating firemouth. Quickly set this burner tile over the open [lower] firemouth and insert the mouth of the oil burner into the port cut in the burner tile. Be careful that when using the oil burner, the temperature does not rise rapidly and exceed 500 °C[345]. If it does, turn the burner down.

It sounds like a difficult task but if one becomes familiar with it, using the crude-oil burner is easier.

When the burner is used, adjust the strength of the flame one turn at a time to keep the temperature from rising too quickly. This makes it easier to slowly and continuously raise the kiln temperature. From this point, conserve energy in preparation for the coming several days of firing – taking a little nap while the temperature stabilizes, also stabilizes one's physical strength and is efficient.

ii. Aggressively Raising the Kiln Temperature

Run the oil burner from 7 or 8:00 at night until 10:00 the next morning when the changeover to firewood is made. When the crude-oil burner is started, the kiln temperature is about 400 – 500 °C[346]. The kiln temperature is around a maximum of 600 °C[347] the next morning when the firing reverts to using wood.

When the temperature is around 600 °C[348] and while the oil burner is running, drop kindling wood into the kiln through the upper firemouth. The fire from the oil burner will set this wood on fire. Wait until the kindling completely burns out and then insert more kindling. Repeat this process several times and when there is a little pile of coals, remove the oil burner[349].

CATPIONS:
Top: Using a Rotary Burner to Preheat
Bottom: Switching from the Crude-oil Burner to Firewood

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345 932 °F.
346 752 – 932 °F.
347 1112 °F.
348 1112 °F.
349 Do not remove the tile. This becomes clear in a later section. See page 144.

Continue preheating in this way, placing firewood in the kiln until about 7:00 in the evening when the temperature should be around 800 °C[350]. At that point, it is time to really fire the kiln, in other words, time to aggressively raise the temperature.

(a) Temperature During the Aggressive Firing Stage

By ten in the morning on the third day of the firing, the kiln temperature will be about 1150 °C[351] – aim to have the temperature at about 1200 °C[352] by evening.

At that point, even if the kiln is fired all night long, the temperature of the kiln will fluctuate up and down around the 1200 °C[353] point by some tens of degrees. Hold the kiln close to this final temperature until the morning of the fourth day.

During this period of soaking, adjust for variables that have an effect on one's goals. These include variables such as the kiln's atmosphere, temperature, or amount of embers. Pay attention to the pottery in the kiln in order to ascertain when the firing is complete.

That is about all there is for an outline of an average firing of one of my kilns. When anagama kilns are fired, it is not always true that raising the temperature high enough is sufficient to fire pottery with a good result. Even when the temperature is low, one can see the condition of the pottery by looking at the *shizenyu* streams that start to form on the pottery. When the pottery is fired and removed from the kiln, even if the kiln went to temperature, if it does not live up to one's expectations it means nothing.

CAPTIONS:
Top: Changeover from Preheating to Aggressive Firing
Y Axis: Temperature
X Axis: Time (Number of Days)
First Arrow: Firewood
Second Arrow: Burner
Third Arrow: Firewood

Bottom: Pyrometer

350 1472 °F.
351 2102 °F.
352 2192 °F.
353 2192 °F.

If someone asked me to state at what temperature the firing will be complete, I would be at a loss to answer because I usually do not use a pyrometer in my kilns.

When I started writing this book, I thought it would be necessary to record actual temperatures so I experimented with a pyrometer. It is better to think of the temperatures I recorded in this chapter simply as rough guidelines.

(b) Atmosphere During Aggressive Firing

Temperature problems which arise during the aggressive firing stage can be related to the kiln's atmosphere – it will be either in oxidation or reduction.

If the goal is to fire the kiln in a reduction atmosphere, burn wood constantly so that the flames never die down inside the kiln. However, it is very difficult to raise the temperature with a reduction atmosphere. If much firewood is loaded into the kiln, it will burn longer and the temperature will drop. When only a small quantity of firewood is thrown into the kiln, it burns up rapidly. Throw in the next load just before the previous charge burns out. As the interval between repeating these activities becomes shorter, the kiln has an increasingly strong reduction atmosphere and it will be more difficult to raise the temperature – it may even stop rising. It is extremely difficult to master the timing for stoking firewood as well as the amount of firewood to stoke.

On the other hand, if the next load of firewood is thrown in when the previous one has completely burned, even though there is no flame running through the kiln, embers remain and the kiln temperature will rise. If this slow tempo of firing is used, the kiln will have an oxidation atmosphere.

CAPTION: Thermocouple

Generally, the result of wood burning up quickly, coupled with a fast rhythm of stoking, is that the kiln will be close to a reduction atmosphere. [On the other hand,] if the wood is allowed to burn out, and there is enough residual heat to hold the kiln temperature for a while, you may conclude that the kiln is near an oxidation atmosphere.

(c) Aggressively Firing and Fuel

Aside from the atmosphere present during the aggressive firing stage, one must consider the types of fuel which properly correspond to the kiln's conditions.

Once the temperature breaks through the 1150 °C[354] level, there is some comparative leeway allowed in the kiln firing tasks. However, it is needless to say that the quantity of embers and kiln temperature must still be considered.

The reason too many coals build up is because of the fuel used and the method of firing. If this happens, it is very difficult to reduce the amount of embers. In this situation, as mentioned earlier, use worm-eaten firewood. It burns up in an instant.

A long time ago, I used a fuel called “pine-leaves” which is naturally made by bundling pine tree branches while still green. Just as I did back then, think about the finished result and choose an appropriate fuel to reduce the amount of embers while preventing the temperature from falling.

(d) Actual Process of Aggressive Firing

Finally, I would like to explain how I actually do the aggressive firing in my anagama kilns.

During the aggressive firing stage, first fill the firemouth with a lot of firewood[355]. This is called the “wood lid”. When these pieces have burned to some degree, push the wood inside the kiln and then throw in more wood[356]. I often use this method.

Not all Shigaraki anagama kilns are fired this way. I fire the kiln for four days and nights but it is impossible for me to do it all by myself. My wife helps and if the situation permits, even my father helps continue the firing like this. This method is technically easy and it is the most stable technique for firing.

CAPTION: Wood Lid

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354 2102 °F.

355 The firewood is actually wedged into the firemouth with the one end of each piece sticking into the kiln and the other ends sticking outside the kiln. This is similar to the “wood pig” method described in: Isamu Mizoguchi, *Nanban,* WOOD FIRING: JOURNEYS AND TECHNIQUES (The American Ceramic Society 2001) (*collected articles*).

356 Further detail regarding this process was obtained from the author's son, Furutani Kazuya. When a reduction atmosphere is desired, after the wood-lid is pushed into the firebox, additional firewood is fed through the firemouth before replacing the wood-lid. In contrast, if an oxidation atmosphere is desired, the wood-lid is simply replaced without throwing additional wood into the firebox.

Other methods for closing the firemouth include hanging an iron plate, kiln shelf, or other fire resistant material from a wire. However, when these other methods are used, if the timing of opening the cover is off, the kiln temperature will fall. Further, the kiln temperature may also fall if there is a slight delay in throwing in new wood.

When the wood lid is used, after it is dropped inside, it continues burning inside the kiln and the kiln temperature will not fall dangerously low.

In Shigaraki, various methods of firing are employed. Even I do not exclusively use the wood lid method. According to the time or situation, I sometimes use bricks or kiln shelves as a cover. The most appropriate method of firing must be chosen on the basis of the kiln conditions.

With either a kiln shelf cover or one made of firewood, the inside of the kiln can be seen from the firemouth area. Peek inside the kiln and watch the flames gradually become shorter until they are almost gone. In other words, when the firewood turns into embers and the flame length becomes about 10-15 cm[357], it is appropriate to add more wood. Another method is to watch the smoke coming from the chimney and when there is almost none, add wood. These are rough guidelines for when to throw on more wood. I had to fire kilns several times to learn this myself. Timing is something one must learn.

CAPTION Top: Hanging Cover
CAPTION Bottom: Brick Cover

357 3.9 – 5.9 in.

iii. Soaking

If the goal of the firing is to achieve *shizenyu* pottery, the soaking stage begins on the night of the third day and continues to the morning of the fourth day.

Pay close attention to the condition and quantity of embers, the state of their distribution, and the state of the ash on the pottery. Hold the same temperature for a long time all the while confirming the condition and amount of *shizenyu*.

If too much ash covers the pottery, the firing must be stopped. If the temperature is not high enough at this point, and the ash buildup is not too great, the firing can extend to the fifth day. These conditions, [ash buildup and temperature], determine when it is time to stop firing.

If *shizenyu* pottery is the goal, is it better to use a kiln which can easily and quickly attain 1300 °C[358] and at that point, stop firing? Or, is it better when the temperature reaches about 1250 °C[359] and then more time is expended in raising the temperature [further]? I can say it is better to take time raising the temperature from 1250 °C up to 1300 °C[360] because the ashes cover better than when the kiln is quickly taken to 1300 °C[361] and then stopped. Further, the embers can be adjusted without haste – this is more appropriate.

On the other hand, if the goal is to make *hi iro* pottery, needless to say, allowing *shizenyu* to coat the pottery must be strictly avoided. Also, the appearance of *hi iro* is extremely temperature sensitive. The *hi iro* often disappears if the pottery is over-fired. An awareness of clay characteristics is necessary in order to prevent the *hi iro* from burning out. Depending on the type of clay, the appropriate final temperature for *hi iro* varies.

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358 2372 °F.
359 2282 °F.
360 2282 – 2372 °F.
361 2372 °F.

iv. Cooling

The kiln's interior can be seen even through the small spaces between the bricks stacked in the firemouth. Peeking through those spaces [allows one] to see how weak the fire is.

When I visually confirm that the condition of the kiln interior is OK[362], I brick up the firemouth openings and seal them with the clay mortar used for the walls.

For example, when *hi iro* pottery is sought, if there is too much fire remaining, I worry that the *hi iro* pieces will become black. I wait to shut down the kiln until the last of the firewood thrown into the kiln is completely burned. Then I completely block the firemouth and coat it with kiln-clay.

Another example: if *youhen* is sought, block the firemouth when the last of the wood has not completely burned – this increases the possibility of something interesting happening. The *bi-doro* color of *youhen* depends upon the remaining fire in the kiln.

On the other hand, if beautiful bright blue *bi-doro* is sought, when the the last of the firewood is thrown into the kiln open the firemouth all the way. Sometimes it is left open one to one and a half hours in order to cool the kiln rapidly. Again close up the firemouth after a certain amount of rapid cooling.

With the rapid cooling process the *bi-doro* changes markedly and it may become bright.

Like I said, timing the moment to shut the kiln depends on many variables. Each firing varies and I have built up much experience. I have found that in using these personalized techniques, I have received pieces with individual and original fire effects.

CAPTIONS:
Left: *Youhen* Piece
Right: Using Mortar-Clay

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362 Note for the curious, author literally used "OK" here.

Note, from the time the firing stops until the kiln is unloaded, the basic idea is to cool for the same amount of time as the firing took. If the kiln was fired for four days and nights, it should cool for four days and nights.

v. Unloading

As I explained above, the period of time spent from when cooling begins until the kiln is unloaded, is basically the same number of days as were spent firing. However, unloading is sometimes done after one day if the kiln is cooled quickly.

When the unloading occurs after a longer period [of cooling], there is not much effect on the pieces. In contrast, effects can appear on the pottery with early unloading.

Particularly when aiming for *hi iro* pottery, the pottery may lose its color if unloading is done extremely early. If *shizenyu* is sought, the opposite seems to happen and [quick cooling] brightens the *shizenyu*.

At any rate, while unloading, observe the pieces inside the kiln taking note of which pieces are good and which are bad. Studying the results is important for preparing for the next firing. If detailed data is taken on each unloading, one can instantly see whether the clay is appropriate, whether the loading methods are appropriate, whether the kiln slope needs adjustment, and [any of the] other various concepts. I can say that the best chance to improve results from this point on, is to study the kiln when unloading.

CAPTIONS:
Left: Taking Out Bricks Stacked in the Entrance
Right: Unloading

<u>NOTE: It appears that the captions may be reversed in the original. Corrected, they should read like this:</u>

Left: Unloading
Right: Taking Out Bricks Stacked in the Entrance

E. How to Fire the *Sutema*

I would like to explain how to fire the kiln when pieces are stacked in the *sutema*.

When the main body of an anagama reaches its final temperature, the *sutema* will be at about 1000 °C[363] or more.

Essentially, it is better to complete firing the main body of the anagama and then move on to the *sutema*. [Finishing the main body firing] is desirable because at that point, there is no risk that firing the *sutema* will negatively impact the firing of the main body of the kiln. However, for the inexperienced, it is likely that firing the *sutema* in this manner will fail and the temperature will not rise. In such a case, the *sutema* firing would have to be abandoned. So, until one gets used to firing the *sutema*, I think one should begin firing the *sutema* about 30 minutes before finishing the main body of the kiln. Firing the main body of the kiln together with the *sutema*, is a foolproof method.

[When firing the main body and *sutema* together], the firewood burning in the main body of the kiln will have consumed most of the oxygen. In other words, smoke and an oxygen poor atmosphere flows into the *sutema* through the *sama ana.* As a consequence, the firewood thrown into the *sutema* burns very badly. However, if a pile of embers is built up in the *sutema*, when the firing moves to the *sutema* after finishing the main body, the *sutema* is much easier to fire.

Fire the main body of the kiln and the *sutema* at the same time for 30 minutes. Note that the main purpose is to fire the main body of the anagama. Be careful not to devote too much attention to the *sutema* – it may cause a failure of the main purpose.

CAPTION Top: View of Unloading
CAPTION Bottom: Firing the *Sutema*

363 1832 °F.

After the main body is finished firing, completely seal the secondary air hole with clay mortar or other clay at the point shown by arrow ➁. Further, partially seal the upper firemouth with bricks but leave some space at arrow ➀ in the diagram. Next, looking at the condition of the fire burning in the *sutema*, see arrow ➂, adjust the space between the bricks marked by arrow ➀ to make the smallest air inlet possible. Use this opening as the *sutema's* secondary air inlet.

The temperature of the *sutema* should be brought up rapidly. Fire for 1-2 hours and when the fire in the *sutema* has a reservoir of power and energy, shut the small inlet for secondary air marked by arrow ➀. Seal it with clay mortar to shut down the anagama and begin cooling.

In this case, if the secondary air inlet hole [for the *sutema*] is made in the area of arrow ➁, it will cause the amount of embers in the anagama body to decrease. Be especially careful about this.

Note, if the air inlet marked by arrow ➀ is not made large enough, the fire in the area marked by arrow ➂ may not burn. In this situation, if the hole at arrow ➀ is opened, it radically reduces the embers in the main body which causes problems. If there are no embers, the main body of the anagama loses temperature rapidly and it is impossible to gradually cool the kiln. If quick cooling of the kiln is desired, reducing the amount of embers is acceptable. However, it becomes a significant matter if the goal [for firing the main body], is to make *hi iro* pottery.

If this happens[364], one of the emergency solutions is to take out all of the bricks marked by arrow ➀ in the diagram and then spread dry straw over all the embers. The straw ashes prevent further decrease in the amount of embers. When doing this, after the dry straw is spread, quickly close the firemouth with bricks rebuilding it as it was before – leave the air inlet hole but please do not forget to cover it.

CAPTION: How to Fire the S*utema*
GL: “Ground Level”
Labeled Arrow: *Sutema* Firemouth

364 In other words, if the embers begin to burn up and disappear.

To some degree, the fire placed at the location marked by arrow ③ in the illustration adds firing power to the *sutema*. Even if the inlet at arrow ① is closed, the *sutema* temperature will rise. The fire can do the work by itself until the inside of the kiln reaches the desired temperature.

When the goal in firing the anagama kiln's main body is to achieve *hi iro* pottery, it is safer to avoid loading pottery in the *sutema.* When experimenting with *sutema* firing, it is better to stack pieces in the *sutema* when the main body is being fired for *shizenyu* or *youhen* pottery[365].

F. Strategies for Conditions Which Effect Kiln Firing

Next, let's discuss the various effects several specific conditions have on firing anagama kilns.

i. Effects of Wind

When firing anagama kilns, the effects of wind is the first consideration.

Previously, I noted the importance of building the kiln so that wind would not cause a downdraft through the chimney to the kiln's interior. Even if the kiln is well situated, unexpected typhoons or drastic weather changes may cause a downdraft through the chimney into the kiln. The kiln is especially effected if a sudden downdraft occurs during the aggressive firing stage.

The downdraft causes the temperature of the kiln to drop. During this type of problem, do not try to quickly force the temperature up as an emergency solution. Wait for the fuel to burn out naturally inside the kiln just as one does when finishing the firing, and then throw in the next load of wood. Do not fight the situation. Instead, it is best to let the natural power of the kiln work with the wind – let the wind blow and just wait it out. If one becomes impatient and attempts to raise the temperature by stirring the embers with a pole from the firemouth, it may cause a failure.

CAPTION: Firing the Kiln During a Strong Wind

365 Recall that *shizenyu* especially can benefit from rapid cooling. See page 139.

There may be some damage [to the pottery] even if you approach the situation in the manner I described above. On the other hand, considering the fact that interesting *youhen* pottery might be formed in this situation, [downdrafts] can also be beneficial.

ii. Effects of Rain

Rain does not have much effect on firing the kiln. However, it is harder to fire during the rainy season[366] and it is said that failure is most likely to occur during this season. This is not because the pottery loaded in the kiln contains a lot of moisture – it is because the kiln itself contains a lot of moisture. During the rainy season, it is especially necessary to spend a lot of time preheating unglazed pottery.

If this is forgotten, the humidity will cause cracks in the bottom of the pottery, crooked shapes to form, or other possible problems. These problems can be solved by preheating a little longer than normal.

iii. Effects of the Seasons

It is much harder to fire anagama kilns in the summer. The relationship between convection and the chimney's pulling power causes the chimney's draft to weaken when the [ambient] temperature is high. In this situation, it is more difficult than usual to raise the kiln temperature.

The reverse is true in the winter time. The chimney's pulling power increases and the kiln temperature rises more easily.

CAPTION: View of a Shigaraki Landscape in Late Fall

366 In Japan, the rainy season lasts from early June to the middle of July.

Also, more fuel is required in the summer to raise the kiln temperature – but less is required in winter.

Pottery fired during the cold winter season often attains a beautiful *hi iro* finish. If *hi iro* pottery is the goal, fire in winter. Aiming for *youhen* pottery is reasonable during the difficult conditions of summer. Use the various seasons' opposite characteristics as a kiln firing technique.

iv. Effects of the Firemouth's Height

After loading, decide the height of the firemouth when blocking the entrance. One must understand the kiln's characteristics in order to decide the height of the firemouth. However, it is impossible to know the kiln's characteristics on a it's first firing – choose a standard height and build the firemouth appropriately. Record the firemouth height and then fire the kiln once.

After the first firing, evaluate whether the results of the firemouth height were good or bad. Adjust the height of the firemouth up or down according to the results.

Recall my explanation of the relationship between the firemouth and season of the year. The chimney does not draw well in the summer – a weak draft has the same effect as a slope which is not steep enough. In summer, make the firemouth a little bigger and set its placement a little lower. This has the same effect as making the slope steeper and, to some extent, it solves the problem of a weak draft.

I will next describe other approaches[367] related to kiln structure which can be used to solve problems regarding the height of the firemouth to some extent.

For example, I previously outlined details about starting the fire at the large lower fire mouth and also explained how to use an oil burner during preheating of the kiln. When the burner is removed, a hole remains in the burner tile. This hole can be used as a secondary air inlet to improve the draft.

CAPTION: Secondary Air Firemouth

367 The author uses the word "*kufu*" often. Sadly, we have never really settled on a satisfactory replacement, and "approach", although not a terrible English replacement, doesn't convey a sense of action. For example, in our raw translations, the phrase "make *kufu* and fire" came up frequently. The usage here is very active – certainly more so than the word "plan". A word like "scheme" feels more active than "plan", but there is an aspect of "scheme" which suggests deviousness, and that flavor is inappropriate. Try to hear "approach" as having a feeling action in this passage.

As a further precaution, do not fix all of the bricks under the burner tile in place. Simply lay one or two under the tile. These bricks can be removed very quickly by just pulling them out during the middle of the firing thus altering the structure[368]. This emergency remedy will solve a problem with weak draft to a certain extent.

Note, the opposite is true in the winter time. The chimney pulls well and the temperature easily rises. If the firemouth is constructed the same as one would in the summer, too much cold air will be forcefully drawn into the kiln. This will have a negative impact on the kiln by causing its temperature to fall. Therefore, make a small firemouth and place it a little higher in an effort to solve these problems.

v. Effects of Loading

Sometimes, the flame will not stream well through the entire width of the kiln during firing. The flame may flow only to the left, the right, or the center of the kiln depending on [several variables]: how the pottery is stacked, the direction of the wind, quirks in the kiln itself, or other various causes. The following technique can be used to adjust flame flow.

For example, if the anagama kiln's floor is in the shape of a scoop[369], both the firebox area behind the firemouth and the firemouth itself are a little wider. In this case, it often happens that the flame will stream only to one side of the kiln. In the moment when the firemouth is opened to decide how much wood to throw in and where to throw it, the direction of flame movement inside the kiln can be assessed quickly.

Usually, if the flame inside the kiln is being pulled to the left, in order to make it run on the right side as well, most people would throw firewood to the right-hand side. Unfortunately, once the flame's path has been set, it tends to resist change no matter where fuel is burned in the kiln.

CAPTION: Cold Air and Flame Movement
Top Arrow: Close Small Firemouth
Upper Middle Arrow: Exit / Entrance
Lower Middle Arrow: True Firemouth
Bottom Arrow: Inward Flow of Outside Air

368 That is, by removing the bricks, the tile can be lowered and the air inlet cut into the tile will also be lowered.

369 This refers to a flame shaped kiln.

During the construction of kilns which are a little wider, build in a small firemouth about the size of a brick on both the left and right sides of the firemouth for additional firing control. If the flame is being pulled to the left, in order to make it flow to the right, remove the brick blocking the right small firemouth. This will inlet additional air.

If this is done, the chimney draws cold air through the right-side small firemouth into the high temperature of the kiln. This creates a powerful draft on the right-hand side and shifts the easiest path for the flames to travel to the right – this of course pulls the flames to the right.

Just like when a road is built through a stream of muddy water – little by little, the stream will shift and follow the road. This stream of air will pull a flame that is flowing to the left, back to the right. Of course, the entire kiln temperature drops a little when this is done. When the leftward pulling flame has naturally shifted course and the flame path across the width of the kiln regains balance, replace the small firemouth brick. From this point on, proceed with the firing in the normal manner.

Note that when performing this operation, there is a possibility that the result will occur quickly. Usually however, it takes at least 30-40 minutes for the results to appear.

When the width of the firebox is 6 *shaku*[370] or more, the large kiln's width makes unevenness in the fire stream especially easy to see. As I explained, building small firemouths is convenient. However, with small kilns about 4 – 5 *shaku*[371] wide, when the firewood is burned, the flame is larger than the width of the kiln and consequently, it runs through the entire kiln. In that case, there is no need to install small firemouths. Be aware of these points when the kiln is actually built.

CAPTION: Small Firemouths on Both Sides of Firemouth

370 5.9 ft. (1.8 m).
371 3.9 – 4.9 ft. (1.2 – 1.5 m).

vi. Effects of Dampers

I don't build dampers into my anagama kilns. I respond to firing conditions by adjusting the firemouth. When the chimney is pulling weakly, opening the firemouth wide will allow more air to be sucked into the kiln. This will increase the chimney's pulling power. If the chimney is pulling too strongly, make the firemouth as small as possible – even if the chimney wants to pull hard, it will not suck in more air than is needed.

In thinking about the flow of air into the kiln, dampers and firemouths operate on the same principles. The firemouth alone can perform the role of the damper well.

Generally, the terms oxidation and reduction are often discussed. However, whether the inside of the kiln is temporarily in oxidation or reduction does not have much effect on the results of unglazed pottery. The real problem when dampers are built into anagama kilns, is choosing how much to shut the damper. If the damper is closed too much, the strength of the fire dies – a small problem becomes a more significant one and the kiln will be extremely hard to fire.

Also, if the kiln is not working well while the damper is closed, one may presume that opening the damper [will help]. However, after opening the damper, the chimney's pulling power does not return immediately – closing the damper will have caused the flames to stop running as actively through the kiln. While the damper is closed, the flame stops flowing energetically and the chimney immediately starts cooling. Conditions inside the kiln will not recover immediately. These fluctuating conditions cause problems with the stoking rhythm, and this leads to pottery defects. [In any event,] whether the results are good or bad, it is absolutely impossible to relate the damper adjustments to the finished appearance of the pottery.

Considering these issues, is it better to control the kiln through the firemouth, or by using dampers? I definitely think it is better to use the firemouth.

In any kiln in which a damper has already been built in, it is a hard decision requiring much courage to take it out.

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vii. Clay and Firing Methods

Firing methods change greatly depending on the characteristics of the clay.

That is to say, with Bizen or Tanba pottery, the iron content of the clay is high and its degree of fire resistance is weak. It strongly vitrifies when fired. With clay like that used for Bizen ware, if the temperature is raised quickly and it is held at the maximum temperature for a long time, bloating (which looks like a toad's back) will occur. Additionally, the pieces may shatter. [To avoid these defects], the clay is fired at a temperature range which will not destroy the pottery or cause bloating – the firing takes a week to 10 days or more[372].

This method of firing requires raising the temperature to a little over 1100 °C[373] and requires advanced technique. By holding that temperature for an extended period of time, the pottery comes out like pottery that was fired to over 1200 °C[374].

Shigaraki and Iga clay are strongly refractory and contain almost no iron. Unless they are fired for a significant time period, they will not mature.

With Shigaraki clay, raise the temperature to a maximum of 1250 °C[375] or above in order to firmly vitrify the clay. Further, the ashes that cover the pottery will melt into *shizenyu* and start to stream.

If an inexperienced person fires Shigaraki clay very roughly, for example, heats it a little too quickly during the firing, or cools it too quickly, as long as the preheating was done well, cracking, warpage, and breakage are rare. Shigaraki clay is easy to handle.

Shigaraki pottery certainly includes large pieces which I categorize as the larger tea utensils – *hanaire*, *mizusashi*, or *tsubo*. Shigaraki clay is appropriate and works well for these purposes. However, for *chawan*, other small pieces, or small tea utensils, I may say it is not suitable.

CAPTION: Bloated Pottery

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372 For more discussion regarding the properties of Bizen clay, see: Frederick L. Olsen, The Kiln Book: Materials Specifications & Construction 83 (3rd ed. 2001); Richard L. Wilson, Inside Japanese Ceramics 155 (1st Paperback ed. 1999); Jack Troy, Wood-Fired Stoneware and Porcelain 3, 5 (1995).

373 2012 °F.

374 2192 °F. Also note, what is implied here is that Bizen clay will be completely vitrified even though not fired to as high a temperature as other clays if it is fired at a lower temperature for a longer time period.

375 2282 °F.

Kinose Clay from Shigaraki contains feldspar and silica in proper proportions – a little heavy on the feldspar. Lately, *gairome* clay is often mined in Iga and it contains an extremely high proportion of silica. If it is fired, it will not vitrify because it is such a highly refractory clay. Both of these clays posses an abundance of uniqueness representing the clays of Japan.

In summary, when firing the kiln, it is important to understand the characteristics of the various kinds of fuel as well as the appropriate place, time, and materials that must be used. In order to do this, prepare for the 1 in 10,000 chance of a situation requiring more fuel. Sufficient quantity is necessary.

The first step for a successful firing is to understand how to use various fuels, prepare plenty of fuel, and adjust one's physical condition in order to maintain the psychological frame of mind needed to fire the kiln.

On actually starting the fire, first be aware of the purposes for preheating. Without such understanding, it will not be possible to shrink the temperature difference between the front and the back of the kiln. Problems may arise during the firing itself. For example, problems with atmosphere and temperature may arise during the aggressive firing stage. Alternatively, the kiln might build up too large or too small of an ember pile. Pay attention to kiln conditions because the conditions correspond to how the fuel must be used. Think about the firing and study its rhythm until it is something you know in your bones.

Also, soaking is designed to finish the pottery. During the soaking stage, keep in mind the type of pottery sought and cautiously adjust the conditions inside the kiln without missing the correct time to close the firemouth.

During cooling, it is natural to feel a great desire to open the kiln and see what kind of pottery resulted. Do not be hasty – if one does not cool the kiln properly, all the work of firing will go to waste.

CAPTION: Shigaraki Large *Tsubo* (110 cm x 75 cm[376])

376 43.3 x 29.5 in.

I think about my techniques in analyzing the fuel and firing process. Anagama fired pottery is absolutely not accidental. I think it is possible to control the results to a fair extent.

In this way, whether the goal is *hi iro*, a particular *koge* landscape, a certain amount of *shizenyu* coverage, or any other desired effect, it can be realized to some degree. It is not absolutely impossible.

That is all. In this chapter, I outlined anagama firing techniques. In other words, I scratched the surface of the soft parts. In the next chapter, I would like to write about the harder parts, that is, how each type of pottery corresponds to a particular kiln structure. The hard and soft parts are just like the two parts of a car's wheel – only when they are joined together do the work effectively. The same can be said of the knowledge necessary to work with anagama kilns efficiently.

Chapter 7: Kilns for [Various] Types of Pottery

A. Kilns for *Hi Iro* Pottery

Once a long time ago, I loaded into one kiln, pottery near the firebox for *haikaburi*, behind that, *shizenyu* pottery, and further back near the *sutema, hi iro* pottery. I was thinking about getting these results when I loaded and fired the kiln. However, it is very difficult to use one kiln to achieve several effects.

If one firing results in a certain kind of pottery, it will not always happen that the same results occur the next time. The size and shape of the pottery is different each time and the kiln conditions constantly change.

The reason I built various kinds of kilns and have used them according to each type of pottery, is that if I can understand the characteristics of each kiln, it is possible to fire pieces which almost perfectly match my goals. For example, one type of kiln structure is suitable for oxidation firing. If the oxidation firing is easy, it makes the likelihood of getting *hi iro* pottery high.

If one is attempting to get *hi iro* pottery and at the same time is thinking about getting *haikaburi* pieces, the results are not very good. The reason for this is that in firing a *hi iro*-priority kiln, the *hi iro* will be [negatively] affected if ashes build up. The kilns used for *youhen*, *shizenyu*, or other types of *haikaburi* are different [from *hi iro* kilns]. If *haikaburi* firing is the priority, the *hi iro* becomes bad.

CAPTION: Kiln for *Hi Iro* Pottery

Kilns are like human beings. Some kilns have faces that look the same but each kiln has its own personality. Take advantage of these characteristics to fire various kinds of pottery. Some kilns easily produce *haikaburi* pottery and others are good for *youhen*. It is ideal to own several kilns.

i. Kiln Shape

When firing *hi iro* pottery, it is better if the kiln has an orthodox shape with a comparatively high ceiling. As I explained earlier, the floor should be in the shape of a candle flame.

Theoretically, when speaking of kilns limited to *hi iro* pottery, I think that there is a possibility that ash pits are related to good *hi iro* results depending on how they are used. I have never fired pottery in a kiln which had an ash pit so I will not talk about ash pits here.

Currently, for *hi iro* pottery, I am using an anagama with a slope of 2 *sun* 8 *bu*. Flame movement and path are controlled through the strategies used in loading the pottery. One must judge the flow of flame and stack pieces near each other in various combinations to obtain *hi iro* [patterns].

CAPTIONS:
Top: Loading *Hi Iro* Pieces
Bottom: Dark and Light *Hi Iro*

I already explained in the chapter about loading the kiln, that if pieces of the same size and shape are aligned evenly, one cannot expect many differences in the appearance of the *hi iro*. However, even with the exact same shelf setup, if the pottery is loaded in varying combinations, i.e., stack short, tall, round, and flat pieces in front and behind each other, and other techniques[377] which we have discussed are employed, the flame will move freely among the pieces. This flame movement will be revealed on the pottery as *hi iro* tinged with light and dark[378] tints.

If the pottery does not develop the correct *hi iro* even with the best loading placement and good firing conditions, adjust the composition of the clay.

ii. Kinds of Clay

The clay must match the type of pottery desired. One must adjust the clay composition to some degree and experiment through firing, in order to make different clays for *hi iro*, *shizenyu*, *haikaburi* with interesting *koge*, and *youhen* pottery.

In order to make *hi iro* pottery, the clay must be of a type which minimizes as much as possible, the extent to which ashes covering the pottery become *bi-doro*. If the ashes covering the pottery become *bi-doro*, *shizenyu* pottery results.

When firing bright *hi iro* pieces, the iron oxide or other metallic oxide content of the clay must be very small. Use clay which has a pure white finish. In this case, when I say "pure white", test the clay for color reaction in a gas or electric kiln. The color of the fired clay color is different from the color of the fresh clay itself.

CAPTIONS:
Top: Digging Kinose Clay
Bottom: Natural Drying Shed for Kinose Clay

377 Recall other techniques from the previous chapter such as the *botamochi* technique. See page 106.

378 Recall that where the fire does not touch the clay, the clay color will come through. In areas the fire touches, the clay color will be altered.

The *gairome* clay representative of Shigaraki, is the famous clay called *kinose*[379]. However, even with *kinose* clay mined from the same [location], there are slight differences between the clays of different strata. [Particular clays] may not be a good match for the firing atmosphere and because *hi iro* is very delicate, they may fail to produce *hi iro*. Of course, the firing temperature has strong effects. If the temperature is too high or [the pottery] fired too long, it may happen that the *hi iro* completely disappears and a pure white [clay body] remains.

Accordingly, experiment with a little higher fire resistant *gairome* clay than is used for *shizenyu* or *haikaburi*. Test the color reaction by carefully firing to ensure that the clay finishes to a pure white color. Then, depending on the results, blend with *kinose* clay in order to stabilize the *hi iro* effects. Note that in this case, several experimental firings should be done in the actual kiln to be used[380].

iii. Actual Firing

Hi iro is related to whether the kiln atmosphere is near oxidation or reduction. If bright *hi iro* pottery is sought, the kiln atmosphere should be in oxidation or close to that state. On the other hand, if the kiln temperature is raised with a reduction atmosphere, the *hi iro* becomes dark – nearly a dull chocolate color. Moreover, if the clay contains a small amount (1-1.5%) of iron oxide or other elements, the chocolate color becomes even darker than normal reduction fired pottery because of those metals. Old Shigaraki pottery shows this deep brown color.

CAPTION: Piece with Dark *Hi Iro*

379 "Kinose" is the name of a place and of course, the clay derived from that place.

380 Here, the author is plainly "speaking" to those who have access to the referenced clays. Even so, it is important that we not miss the main teaching of this section: that the quality of the clay body is very important to fired results in any particular kiln, and that continual experimentation is required to fully know the possibilities of the clays within a particular kiln.

Among *gairome* clays, there is a particular clay that if used as it is found, develops a beautiful *hi iro*. However, if the clay is levigated[381], it may lose its *hi iro* characteristics and become a clay with totally different characteristics.

The reason for this is that soluble salts contained in the clay body, such as soluble iron compounds (iron hydroxide, iron sulfate, iron chloride) and particularly, iron hydroxide, dissolve and are removed when levigated.

Also, I assume that the soluble iron compounds (iron hydroxide) are directly related to *hi iro* because right after a piece is made, these compounds leach to the surface of the clay as it is drying. For proof, take a look at a shard of *hi iro* pottery. When looking at the broken side, the clay is pure white. Only the surface of the pottery shows *hi iro*.

Also, a few days after pure white clay is dug from a pit, a little color appears on the surface of the fresh clay. I assume that this is soluble iron hydroxide which has become oxidized. I think that *hi iro* develops when this iron hydroxide reacts with the flame.

In other words, burning firewood emits streams of alkaline vapor containing potassium and soda. These substances volatilize around 1000 – 1200 °C[382] and react with the soluble iron which has spread over the surface of the pottery [through evaporative migration]. In so doing, [the combination] becomes *hi iro*.

Let me explain this from the standpoint of the relationship between *hi iro* tint and the firing temperature. Starting at about 1150 °C[383], the iron becomes reduced and and yields a red color. This lasts up to about 1200 °C[384], but after that, the reduced iron changes from red to black and eventually to a gray color. However, [once firing is complete,] during the slow cooling period the reduced iron reoxidizes at these temperatures and in returning to red, it becomes *hi iro*.

CAPTION: *Hi Iro* with Shadows

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381 This is wet processing the clay in order to refine it. For detailed description, see Richard L. Wilson, Inside Japanese Ceramics 49 (1st Paperback ed. 1999).

382 1832 – 2192 °F.

383 2102 °F.

384 2192 °F.

Note, at the temperature range of 1150-1250 °C[385], ashes cover [the pottery] to a large extent and the ashes may become *shizenyu* pottery. Also, if the kiln is soaked in a high temperature reduction atmosphere and a piece of pottery is pulled suddenly from the kiln, a beautiful green *bi-doro* can form on the pottery because of the especially strong reduction atmosphere. Removing a piece in this way is just like the *hiki dashi kuro*[386] method of Seto. However, with the pottery that is suddenly cooled, there is no *hi iro* in places where it should show up and instead, the pottery is very white. Therefore, I can say that the firing conditions for making *bi-doro* and those for making *hi iro* are completely opposite.

[For *hi iro* pottery], do not build up too many embers, rather, the amount should be just enough to allow the temperature to rise. Use a somewhat smaller amount of firewood and allow it to burn out [before adding more]. Avoid letting ash build up [on the pottery] and avoid stirring the embers with a stainless steel rod as much as possible.

Do not fire the kiln any longer than is necessary. Try to use less firewood and finish the firing as soon as possible. This is one of the most important principles for producing bright *hi iro*. Consequently, winter is an especially appropriate season for firing the kiln [to produce *hi iro* effects].

When finishing the firing, throw in the last of the wood. Allow it to almost burn out and then seal the firemouth. If the kiln is sealed while there are flames remaining inside the kiln, the *hi iro* may become dull or dark.

The cooling should always be slow. By cooling gradually, the look of the *hi iro* has a much more profound meaning. If the kiln is cooled quickly however, the *hi iro* disappears.

CAPTIONS:
Top: Pulling Out [a Pot]
Bottom: State of the Kiln When Gradually Cooling

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385 2102 – 2282 °F.

386 This method involves removing the pottery from the kiln during firing to make the pottery very black through sudden cooling. Yellow Seto/Black Seto: these wares combine the glazes used in the kilns of Seto. However, they are pulled from the kiln at key temperatures, like Raku. The telltale yellow glaze comes from the Seto ash glaze mixed with clay, and the black color comes from an iron rich glaze.

[For *hi iro* pottery,] there is a temperature range through which the kiln must be cooled slowly. This temperature range depends on the characteristics of the clay and it is known that the clay's fire resistance is inversely related to the temperature range through which cooling must proceed slowly. Generally, if the clay is not very refractory, the temperature range for slow-cooling is at higher temperatures. With highly fire resistant clay, the temperature range for slow-cooling is at lower temperatures. [Using the correct] temperature range has a very remarkable effect on the appearance of the *hi iro*.

Is the slow-cooling temperature range from 1200 to 1000 °C[387], 800 to 300 °C[388], or from 500 to 300 °C[389]? Without taking data, I cannot say precisely. However, from my I experience, I believe the range is from 900 to 300 °C[390]. If the pottery is quickly cooled through this temperature range, all the weak *hi iro* will disappear and there is a possibility that the pottery will be white.

It is necessary to pay close attention to cooling.

iv. Cautions

As I said before, when firing *hi iro* pottery, moisture contained in the kiln has a strong effect. Although very beautiful *hi iro* can be expected on the first firing of the kiln, it will not continue to fire the same quality of *hi iro* pottery.

When a kiln has been fired many times, it becomes a piece of pottery itself. In other words, the ceiling becomes coated with a beautiful *shizenyu*. The walls near the firebox reflect more heat into the kiln and thereby raise its temperature. If *hi iro* pottery is fired in an old kiln, as one may expect, the appearance of the color becomes bad.

An old kiln can be improved a little by making a *gairome* clay plaster. Using the methods I explained in the chapter on building kilns, paint a thin coat of plaster from the ceiling to the walls of the firebox using a short handled broom.

Thinking of the various conditions discussed, I think it is best to design the kiln structure to meet the needs of the pottery to be fired.

CAPTION: Piece Pulled [Hot from the Kiln] and Its *Bi-doro*

387 2192 – 1832 °F.
388 1472 – 572 °F.
389 932 – 572 °F.
390 1652 – 572 °F.

B. *Shizenyu* and *Koge* Pottery Kilns

i. *Shizenyu* Pottery

I would like to explain [some things] about kilns suitable for *shizenyu*, *koge*, or other *haikaburi* and their firing methods.

(a) Kiln Structure

The kiln structures for *shizenyu* and *haikaburi* are related. These types of pottery are inevitably limited to the front of the kiln near the firebox. The first consideration then, is to make a wide firebox, or in other words, a wide kiln.

It seems that the ceiling should not be too high. If the ceiling is high, the ashes fly out and do not cover the pieces well.

It is better if the chimney pulls strongly. A strong and powerful flame allows firing in a reduction atmosphere which leads to *shizenyu* with a beautiful finish. Therefore, a steep slope is desirable.

(b) Clay Composition

If the clay is too highly fire resistant, ash will be absorbed[391] too much and the ash [glaze] will not cover the surface easily. Therefore, it is necessary to choose a clay which has a little lower degree of fire resistance[392]. This is exactly opposite from *hi iro* pottery.

Be aware that when the degree of fire resistance is low, there is a possibility that too much *shizenyu* will result and the pieces may look too shiny and cheap[393]. If the clay is extremely low in fire resistance, blisters may form, the pieces may break, and other problems may occur.

Always reformulate the clay many times – it is necessary to make an original clay suitable for each kiln.

CAPTION: Iga Anagama Suitable for *Shizenyu*

391 The actual word here is "*suu*". It means breathe, inhale, absorb, soak and like terms. The key to understanding Furutani's usage here, is to understand that *suu* implies the disappearance of one substance into some other object. In English, a term like "resists" might be more commonly used to imply that the clay does not develop glaze.

392 In identical firing conditions, a clay that is highly fire resistant is more refractory (and has *less* interaction with the ash) than a clay which has a lower degree of fire resistance and is more highly fluxed (which would cause it to have *more* interaction with the ash).

393 *Yasuppoi*: suggests a cheap or inelegant appearance. It could also be translated as gaudy or chintzy.

(c) Loading

If the pieces are stacked extremely close together when loading, they may stick together when the ash [glaze] forms. Especially up front near the fire, it is necessary to leave wider gaps between the pieces.

Also, for the wadding, choose clay with as high a degree of fire resistance as possible – the higher the better. For *hanaire* or *mizusashi*, use [balls of] wadding which have a 2-3 cm[394] diameter on the bottom [of the pieces] to make them stand a bit high.

It is impossible to prevent the *shizenyu* from covering the wadding and sticking to the sand on the floor. When unloading the pieces, this may cause cracking and lead to failures. In order to prevent these defects, it is necessary to be cautious.

(d) Actual Firing

When the temperature exceeds about 1150 – 1200 °C[395], the ashes glassify and become *shizenyu* as they start melting in streams on the pieces. From about 1000 °C[396], fire the kiln in reduction as much as possible to produce brightly colored *shizenyu* – beautiful.

CAPTIONS:
Top: Clay Shed Organized by Clay Type (Shigaraki Industrial Association)
Bottom: Pieces Which Stuck to the Floor Sand

394 0.8 – 1.2 in.
395 2102 – 2192 °F.
396 1832 °F.

Start removing embers from the pottery after the temperature rises to a certain point. This allows the *shizenyu* which covers the top parts of the pots to begin streaming down. Just before the *shizenyu* reaches the bottom of the pottery, cover with embers again. This cools the *shizenyu* to some degree, carbonizing the glaze and making it stop in the middle of the piece. By repeating this process, not only can thickness be built up in the *shizenyu*, the way it flows can be controlled. So, every time firewood is thrown in, it is necessary to instantly take note of the amount of embers and their location.

As I explained, the embers are as small and bright as possible and remind me of jewels. Black coals still in the shape of the wood do not have any effect.

For *shizenyu* pottery, it is better to fire in a kiln which tends to build up embers a little too much. Even kilns which have imperfect combustion and a consequent difficulty rising in temperature, will build up embers if the firing process is carefully considered and the kiln fired well. When the embers have built up, try different firing strategies which do not allow the kiln to cool down. One way to get *shizenyu* is to stir the embers with a stainless steel pole to cover the pottery with ashes. These ashes then then melt and by repeating this process many times, the pieces will develop enough *shizenyu*.

When firing *haikaburi* pieces, remember that it is better to avoid using a lot of chestnut, camellia, or other woods which contain less iron as fuel. If the iron content is low, the *bi-doro* becomes very transparent and does not show beautiful coloring. In order to make a beautiful blue *bi-doro* appear, the ash must contain a small amount of iron oxide. With iron and other metal oxides, the glaze becomes a celadon green in oxidation firing.

CAPTION: Pottery Adjusted for *Shizenyu* Streams

Camellia, oak, and chestnut are used to make glaze but even if the ashes of these woods cover the pieces, it seems that the *bi-doro* has less depth of color.

(e) *Yobigusuri* Method for Iga Pottery

In Iga, potters use the *yobigusuri* method. In this method, they don't use formally mixed glazes. Instead, they take the wood ashes which remain in the kiln [after the completion of firing], mix these with water, and then pour this mixture on the parts [of the pottery] where thicker *shizenyu* is desired. For example, with Iga eared[397] *hanaire*, the shape or design determines which side is the front of the piece. While loading, the flame movement is considered in order to get a landscape on the front of the piece. If *yobigusuri* is applied, it is much easier to decide which side will be the front.

It also appears that *yobigusuri* was used very often on ancient Iga pottery. I think that *yobigusuri* is one method that can be used. The key to *yobigusuri* is to apply [ashes] so that they look natural.

In Shigaraki however, the basic firing method is to fire the pottery naturally without artificial [glazing]. The *yobigusuri* artificial [glazing] of Iga [pottery] is not usually done in Shigaraki.

(f) Kiln Drip

After being fired many times, *shizenyu* builds up on the inside of the kiln's ceiling and side-walls. The interior takes on a beautiful appearance like the surface of pottery. When the kiln reaches this state, the glossy surface of the kiln reflects heat during firing, saves fuel, and can make the kiln easier to fire.

When *shizenyu* pottery is fired, if the firing is repeated many times in the same kiln it becomes easier to get *shizenyu*. However, if the firing is repeated too many times, the ceiling *shizenyu* becomes a little too thick over time – it will drip and start falling onto the pieces. In the tea ceremony world, they call it "kiln drip" and sometimes respect it as a rare landscape. However, I would say that instead, it is a defect in the firing process. It is really up to the potter whether to take advantage of this or not.

CAPTION: *Bi-doro* of Iga [Pottery]

397 This refers to the lugs characteristic of Iga *hanaire*.

ii. *Koge* Pottery

Koge pottery has a finish in which the embers are carbonized and melded to the surface of the pottery. The places where *koge* can be obtained are limited. If the pieces are not stacked up front in the first or second row near the fire in the firebox, they will not develop *koge*. It is impossible to get all of the pieces in one kiln to become *koge* pottery – there is no kiln which can fire only *koge* pieces.

(a) Where *Koge* Pieces Can Be Fired

The places where *koge* will develop are definitely the same places that can also develop *shizenyu*. When the temperature is raised to the point at which the ash melts, the pottery will always form *shizenyu* and naturally, *koge* can be expected. However, the problem is whether the *koge* surface is thick and looks black and carbonized, or whether it visually assumes the strong appeal of a rock's rough surface. If the pieces are fired at low temperatures, they will only become black. If a rock-like appearance is desired in the *koge*, the temperature should be raised very high [up at the front of the kiln] near the fire.

CAPTIONS:
Left: Drip Kiln Ceiling
Right: Kiln Drip on the Inside of a *Chawan*

(b) Firing Techniques

The wood thrown in sometimes gets out of control and ends up in [only] one part of the firebox. The embers pile up like a little mountain in that place but there are no embers in other places. Use the stainless steel pole to move embers to the parts which need them and thereby control the embers.

In this case, if an iron pole is used, sparks containing iron will fly off and affect the pieces. Remember to always use a stainless steel pole.

When the embers are stirred, air comes up through the embers and even the jet black embers will burn very well. Note however, if the firemouth is kept open too long while stirring, cold air will enter the kiln and the temperature will fall. Stir quickly once every several stokes.

When looking inside the kiln at the area visible from the fire mouth, if some pieces have fallen or stuck together, use the stainless steel pole to right those pieces and separate the ones sticking together. If they are left like that, when the firing ends and the kiln is sealed and cooled down, all of the pieces which were stuck together will remain so and will be a failure.

I cannot say exactly how many days the kiln should be fired but it is more effective to fire longer than when firing *hi iro* pottery. As a result, more fuel is required. Note, if a clay which is too refractory is used for the pottery [placed near the firebox], it is hard to get *koge* pieces even if the temperature of the kiln is raised to high temperatures. The same is true for *shizenyu* pieces.

CAPTIONS:
Top: *Koge* Piece
Bottom: Detail of *Koge*

Regarding *shizenyu* and *koge* pottery, please be aware of the following points:

(c) The Relationship Between *Koge* and Ember Volume

In order to get *k*oge pottery, it is necessary to control the quantity of embers for at least 12 hours before the firing ends.

Judge the temperature of the kiln interior by looking at the extent to which the ashes are melting. When the temperature reaches the point at which the ashes start to melt, constantly pay attention to the amount of embers while firing to ensure that enough embers remain.

During the firing, burn miscellaneous hardwoods to build up more coals if the amount of embers is too small.

The amount of embers that accumulates depends upon the kiln's characteristics. It is necessary to know which kilns are likely to build embers, and the volume of embers they normally accumulate during each firing.

Think about the height to which *koge* is desired on the pieces. Cover the pieces with embers about 20-30% higher than the level at which the *k*oge is actually desired.

Even if the embers cover 80% of a piece's height, after the firing is finished and the firemouths sealed, oxygen will enter from somewhere and the embers will burn out. As a consequence, the *k*oge will only cover half the piece, more or less. In other words, less than half of 80% of the pieces' height, will develop *k*oge. If *k*oge is desired to 80% of a piece's height, the piece should be buried almost to the very top. If a jet black *koge* surface is desired on the entire piece, after the temperature has become quite high, i.e., 1150 °C[398] more or less, bury the pieces completely in the embers. Fire for many hours and replace the embers when they burn down. If half of the piece is buried, half of it will become jet black and half will be covered with *shizenyu*.

CAPTIONS:
Top: Mixing Embers with a Stainless Steel Pole
Bottom: Pieces Stuck Together

398 2102 °F.

In the beginning when the temperature of the kiln is still low, if the entirety of a piece is buried in embers, its temperature will not rise. As a result, the piece becomes carbonized and looks like nothing more than a piece of black pottery – like a roof tile. These concepts are the result of many layers of experience and if one understands them well enough, it will be possible to get ideal *koge* pottery through these techniques.

C. Kilns for *Youhen* Pottery

In regards to kiln shape, the floor width should be narrower and the slope steeper. The ceiling should be as low as is possible to build and the kiln structure should be designed so that a powerful fire can be built. This yields a large probability that the kiln will fire *youhen* pottery.

With respect to loading, as I explained before, the shelves in the in the very back [of the kiln] must be set up to block the fire. It is best to stack as many pieces on those shelves as possible. Then, leave a fire-pathway about 20 – 25 cm[399] wide down the center of the floor [starting] from the back where the [densely stacked] shelves are located [and extending down] to the firebox. Stack pieces [along this fire-pathway] using the *hitotsu narabe*[400] method. It is appropriate to leave the standard amount of room for the firebox in front of the stacked pottery[401]. I have used this method in my Iga style kiln many times. These experience gave me some good hints and I often use this loading method. It appears that in loading and firing with this method, the reducing flames tend to cluster in the center of the fire-pathway. Barely any flames run along the kiln walls however, and the pieces are fired by the [radiant] heat of the fire rather than by an oxidizing flame[402].

CAPTION: *Koge* Pottery with 80% Coverage

399 7.9 – 9.8 in.
400 See page 100.
401 Previously, the author stated that a 2 *shaku* (23.6 in.; 60 cm) length is typical.
402 It is probable that near the kiln walls there is an oxidizing *atmosphere*, even though there may be no oxidizing flames.

The front sides of the pieces which face the center fire-pathway give the sense of being fired in reduction while on the same piece, the back has the appearance of an oxidation firing. Note that in this method, the kiln temperature does not rise easily. Unless the person [firing the kiln] is skilled enough to throw wood dead center to the back of the kiln, and is confident in [his or her] ability to raise the temperature, it cannot be done well.

Even though firewood is thrown on the fire-pathway, why doesn't the temperature rise? When wood is thrown in through the firemouth, it burns like firewood usually does and in so doing, consumes all of the secondary oxygen. Less and less of the secondary air from the lower firemouth reaches the fire farther toward the back [of the kiln]. The firewood thrown in the back is deprived of oxygen and burns incompletely. This lowers the kiln temperature.

After embers are built up in the firebox as well as in the fire-pathway, just before sealing the kiln, boldly throw in as much firewood as possible from the back of the fire-pathway to the point near the firemouth. Without waiting for the wood to finish burning completely – the fire will be flickering – seal the kiln.

Plainly, firing the kiln with the *youhen* technique requires a slightly unique method. Therefore, in order to keep failures to a minimum, I think it is better to try this after one is able to use the ordinary kilns.

Lastly, regarding the season, when firing in the heat of summer, it cannot be helped that the chimney will pull badly. This will result in a highly uneven firing which makes it much more difficult to get *youhen* results. On the other hand, one method to use in summer time firings is to use a normal kiln and [aim for] an atmosphere which will fire both *youhen* and *shizenyu*.

CAPTION: Half Oxidized, Half Reduced Iga *Hanaire*

Left Arrow: Reduction

Right Arrow: Oxidation

Chapter 8: Miscellaneous Notes on Firing Pottery

Up through the present, I have fired 30 or more different anagama kilns and I have fired these in all seasons. During this period, I have fired unexpectedly good pottery at times. I have also encountered unexpected situations. In finishing this book, I would like to describe some of these experiences.

A. Building a Chimney While Firing the Kiln

One day, I suddenly came up with an idea for the structure of a kiln which I thought would be most appropriate for firing *youhen*. That very day, I immediately started building the kiln. I decided to build the kiln to the west of two kilns which were already built.

I was already experienced at building kilns so the work went smoothly and without any difficulties. After several days, I had finished the rough shape of the kiln.

I always keep a supply of kiln bricks on hand and I had those available. As luck would have it however, when it came to the chimney, my *toukan* supplier was out of stock at that moment. They said it would take several days for delivery [and this delay] would have abruptly stopped my work.

I was very confident in my new kiln's abilities. I felt I couldn't wait for the *toukan* to arrive, nor could I wait for the kiln to dry naturally. I wanted to fire right away and see the results so [I built] an *endou* to the adjacent kiln's chimney. I thought I could make do with one chimney for both the new and the old kilns. I built the *endou* to the base of the eastern kiln's chimney and attached it there. When the new west kiln was fired, I completely blocked off the *endou* from the east kiln's interior to prevent the chimney from drawing cold air from the east kiln.

When the east kiln was to be fired, I planned on blocking off the west kiln, and when the west kiln was to be fired, I would block off the east kiln – [the setup was] similar to a junction switch for train tracks. In this way, I could save the labor involved in building another chimney.

Next, I built a fire in the new kiln to force it to dry enough so that some days later, the kiln was dry enough to fire. I loaded it and started firing.

In the first stage of preheating, as I expected, there was absolutely no problem with the chimney's draft. Two and half days later however, at the most important stage of aggressive firing, no matter what firing techniques I tried, it seemed that the temperature would not rise at all. I do not use pyrometers so I don't know the exact temperature. However, I think that the temperature was around 1150 °C[403] at that point.

I split well-dried firewood as thinly as possible and burned that – I tried many other strategies as well. The kiln would backfire when I threw in a slightly large volume of wood.

I thought the chimney was being overworked and that air was entering the chimney at the point where it connected to the *endou*. I assumed that because of the leaks, the chimney pulled badly and I thought that sealing the juncture with clay mortar or other clay would seal out the air. I made several layers over the junction but even then, although the temperature could be sustained, I could not get the temperature to rise any higher.

Peeking from the firemouth at the pieces inside the kiln, ash had thickly covered the pottery but it was in a dust-like state. It was not at the melting stage and if the firing stopped at that point, the [pottery] would have been completely raw. It would have been a failure.

CAPTION: Firing Two Kilns with One Chimney[404]

Top Arrow: Temporary *Endou*

Middle Arrow: Newly Made Chimney Base

Bottom Note: New Kiln

403 2102 °F.

404 Rounded kiln is the east kiln – straight kiln is the new west kiln.

Just in the nick of time, I received notice that the *toukan* sections I had ordered arrived at the supply yard and I sent someone down to get them.

Because the *toukan* sections arrived, my wife took over firing to maintain the temperature of the kiln while I started working on building a chimney.

Firing a kiln while building a chimney is an outrageously uncommon story. It was my first experience at it but I took up the challenge because I felt strongly about avoiding failure.

It took almost one day to finish building the new chimney. The newly built *endou* attached to the new kiln on the east side in a “>”[405] shape. Using an iron pole to remove the glowing bricks blocking the fire's path, the fire was channeled into the newly built *endou* and at last, [the kiln and the new chimney] were directly connected.

At the very instant the 1100+ °C[406] high temperature flames suddenly started running through the newly built cold chimney, the *toukan* sections made a cracking noise and many small cracks formed.

The chimney had been wrapped with wire in many places and the *toukan* sections entirely wrapped with a spiral of rope. Over this, a 5 cm[407] thick mixture of clay mortar and cement was applied with gloves. Usually, when this type of work is done, the clay mortar bonds to the rough rope and the cement hardens. Even when it is rained on, it will not dissolve and it thoroughly protects the outside of the *toukan*.

In this case however, because the coating of wall clay and cement was applied only several minutes earlier over the newly-built chimney, it was still like mud and not dry. When the 1100+ °C[408] high temperature flames directly attacked the chimney, the *toukan* sections made outrageous cracking noises.

CAPTION: Chimney *Toukan*

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405 Literally, “opposite *ku* shape”. The letter *ku* bears resemblance to “<”. Opposite *ku* would look similar to “>”.

406 2012 °F.

407 2 in.

408 2012+ °F.

The spiraled rough rope burned and carbonized and the cement/clay mortar mixture steamed as it dried. However, because the entire chimney was wrapped with wire, even if small cracks appeared in the *toukan* sections themselves, they could not collapse and the chimney retained its integrity.

For several hours during this unusual situation, the kiln was stuck at about 1150 °C[409]. Then suddenly the temperature started rising and in the end, [the kiln] achieved the desired temperature.

A firing usually takes from four days and nights to four days and five nights to finish. This time, the unexpected chimney construction took a day and the firing itself extended to five days. I was exhausted. Regardless, as I expected, this kiln produced interesting *youhen* pottery.

When I think about this now, the kiln structure was in an unstable condition for 10 – 12 hours. I presume that the structure and the excessive firing time had a positive side effect on the pottery.

In any event, even if a strange predicament arises, do not give up and extinguish the fire. I learned that it is necessary to make every effort until the very end.

B. Typhoons and Chimneys

One day, I decided to fire a kiln in the middle of the typhoon season. A typhoon with the potential to make landfall broke out in the Pacific Ocean. I started the fire in the kiln under very bad weather conditions.

CAPTION: *Toukan* Chimney Coated with Clay Mortar and Wrapped with Corrugated Metal.

409 2102 °F.

At the start, according to the weather forecast, there was an area of low pressure but I believed it would not affect the kiln firing very much. The next day however, it blew up into a typhoon and started moving north, aiming for the Shikoku area. I recall that the typhoon made landfall on Muroto Cape, went through Shikoku and the Chugoku area, before finally passing out to the Sea of Japan.

The sky become cloudy and threatened to rain, and the wind started blowing as well. At that time, the kiln was in the aggressive firing stage – the fire was burning vigorously and a pillar of fire about 4 – 5 *shaku*[410] long was blowing out of the chimney. It was during a very important point in the aggressive firing stage that a strong wind [began] blowing across the top of the chimney at 10 m/s[411] or more. Because of the strong wind, it looked as if the chimney mouth was being trapped in a cross-current of air and the flame coming from the chimney streamed horizontally.

The flame was being pushed down the chimney and [the kiln was] backfiring. It looked like it would set fire to the shed roof at any minute. If firewood was not thrown in, the kiln temperature would fall – if it was thrown in, [the kiln] backfired from the firemouth. After thinking deeply, I decided to attach a sheet of corrugated metal to the windward side of the chimney as a wind shelter.

The corrugated metal sheets were about 2 *shaku*[412] wide and about 6 *shaku*[413] long. I feared that because the wind was so strong, if the height was set too high, not only could the sheet metal blow off, but the chimney to which it was attached might also fall. So I laid two sheets together, overlapping the two at the halfway point of their width, and put these up on the windward side of the chimney with wire ties twisted together.

I attached these two overlapped 6 *shaku*[414] sheets to the chimney so that on the windward side, a 3 *shaku*[415] length attached below the chimney mouth, and a 3 *shaku*[416] length extended above the mouth of the chimney. In this way, the wind hit the corrugated sheets and scattered to the right and left. This allowed the flame blowing from the chimney to settle down a little and it made the firing a bit easier.

CAPTION: Smoke During a Strong Wind

410 3.9 – 4.9 ft. (1.2 – 1.5 m).
411 22.4 mph.
412 23.6 in. (60 cm).
413 5.9 ft (1.8 m).
414 5.9 ft (1.8 m).
415 3 ft. (90 cm).
416 3 ft. (90 cm).

However, the direction of the wind shifted with the movement of the typhoon. There was a one in 10,000 possibility that I would orient the corrugated sheets to catch the wind – it that was the case, the wind would shoot down the chimney causing a backdraft, and a fierce flame would blow out the firemouth. It would be a disaster. So, with the winds constantly changing direction, I had to constantly adjust the position of the metal sheets so that they pointed upwind.

The time period for the strongly blowing side-wind was only about 30 minutes to a little less than an hour. By following this strategy, it didn't affect the kiln very much and I managed to cope with the typhoon.

C. Attaching a Tube Wind Shelter to the Chimney

The geographical location for building a kiln is sometimes not ideal. For example, if the kiln is built in a place where the wind changes depending on the season, it is inevitable that the shifting wind will sometimes blow down the chimney and cause backfiring. Compensation is possible even if a kiln is built in such a place by modifying the chimney structure.

Using a large sheet of stainless steel, make a tube with a radius about 20 – 25 cm[417] larger than the outside diameter of the chimney. Its length should about 6 *shaku*[418].

Outside the chimney, assemble a circle of steel poles 20 – 25 cm[419] from the chimney [sides]. Leave an appropriate space so that the steel poles can be used as a frame to place outside the stainless steel tube. The tube extends about 5 *shaku*[420] past the top of the chimney with the lower 1 *shaku*[421] portion overlapping the chimney. Prevent the tube from blowing away in a strong wind by securely attaching it to the steel poles. Between the tube and the chimney, there will be a 20 – 25 cm[422] space.

If constructed in this manner, air will be drawn up from the lower gap between the chimney and the stainless steel tube. There is no effect on the strength of the chimney's draft and it continues to perform its job. The stainless steel tube surrounding the chimney acts as a wind shelter and wind will not blow down the mouth of the chimney even if it is blowing from any direction.

CAPTION: Emergency Solution in Case of Strong Wind

417 7.9 – 9.8 in.
418 5.9 ft (1.8 m).
419 7.9 – 9.8 in.
420 4.9 ft. (1.5 m).
421 11.8 in (30 cm).
422 7.9 – 9.8 in.

Also, if there is a residential area nearby, the flame blowing directly from the chimney cannot be seen. It camouflages the flame so that one can fire the kiln [without being bothered by neighbors]. This is one strategy born out of my experiences during the typhoon seasons like I mentioned before.

The height of the chimney can be decided with this method as well. In the first firing, the height of the chimney is set based on past experience. However, with a new kiln design, it is extremely difficult to choose an appropriate height. Also, sometimes everything is right about a kiln but because of the way it was loaded, or or the type of pottery loaded, the chimney's draft might be worse than expected. In such cases, I will explain one of the ways [to cure the problem].

The method is easy. Wrap corrugated sheet metal around a chimney which is pulling badly. That's it. Doing this while firing allows the height of the chimney to be adjusted up or down. The length of the corrugated sheets varies from 6 *shaku*[423] up to 12 *shaku*[424] in 1 *shaku*[425] increments. They are very convenient.

With this method, the height of the corrugated metal marks the height that the chimney should be. Then, when the firing is complete, correctly extend the the chimney's height. This is another technique born from typhoon season experiences.

D. Fully Underground Anagama

This story overlaps my earlier description in a previous chapter. However, I have special memories of this very unique kiln so I would like to talk about it in a little more detail.

Some ten or more years ago, I built an anagama completely underground in a small village in Shigaraki called Hata.

Around that time, I heard that Koyama Fujio Sensei was explaining that *hi iro* was deeply affected by ground moisture. As a result, at least once, I wanted to build a kiln in damp ground.

CAPTION: Tube Capped Chimney

Left Side Arrow: Chimney Cover (Stainless Steel)

Top Arrow: Angle Iron

Top Section of the Tube: About 150 cm[426]

Bottom Section of the Tube: About 30 cm[427]

Bottom Arrow: 20~25 cm[428]

423 5.9 ft (1.8 m).
424 11.8 ft. (3.6 m).
425 11.8 in (30 cm).
426 59 in.
427 11.8 in.
428 7.9~9.8 in.

A kiln cannot be built in completely swampy ground. I spent many hours searching for a place at the foot of a mountain – one with an appropriate slope so that the firemouth area could be in a low place. As a result, I decided to build the kiln in Hata.

Fortunately, that mountain was made of clay soil. The slope and the other conditions matched [my needs]. Over the course of many days, I tunneled out the shape of the kiln.

By the time I finished digging almost 2/3 of the kiln, too much ground water began seeping in. I wanted to finish the digging quickly so I could burn a fire [in the kiln]. The fire would firm up the ground and minimize seepage to the extent possible. [Unfortunately], I could not finish the digging [in time] and it caved in.

So, using some construction machinery of the type used in large scale engineering work, I dug a deep trench. In this way, the anagama could be built completely into the trench using the same methods of anagama construction [that I have described in this book, i.e.,] by laying bricks. When this was finished, I buried the entire kiln with the excavated soil so that the slope of the mountain returned to its previous state.

The chimney was built out of bricks and then firmly backfilled with soil so that it took the same form as a hole in the slope.

The ground contained a lot of moisture. It was impossible for the kiln to fully dry naturally. I burned firewood for many days producing a low temperature to force the drying process. Choking steam belched from the mountain slope over the kiln as it started to dry out.

However, despite the fact that the upper part of the kiln looked dry to some extent, the lower part near the firemouth [was very wet]. When firewood was burned and the area dried out, even by the next day there would already be a lot of moisture there. When digging into the kiln floor with a trowel, water would appear in the hole.

With a kiln like this, I though that many flaws would appear if the pottery was not bisque fired. Consequently, in the first firing, I loaded the kiln half with bisqued pieces and half with pieces that were not bisqued.

CAPTION: The North Side of the Completely-underground Anagama (Hata, Shigaraki)

Preheating was difficult – half the smoke went through the chimney and half blew out the firemouth.

Because it was the first firing of the kiln, preheating took a little more time than usual. The preheating fire burned for two days in the lower firemouth area (note: the upper firemouth was kept open during preheating). On the third day, when the kiln reached the point at which it was time to raise the temperature, I started stoking a lot firewood. However, when the aggressive firing stage began with stoking through the upper firemouth (that is, after the kiln heated up to a bisque temperature of 800 – 1000 °C[429]), the temperature started rising much faster than I anticipated. Even firewood which would not burn completely earlier, started burning well. It appeared that the embers were burning up and that the kiln would not build a good ember bed. I could not predict anything because it was the first firing of the kiln and consequently, I had a lot of firewood ready. Once I started firing, the temperature rose higher than I expected and on the third day, the kiln was already at its necessary temperature.

Although the temperature rose easily, the ashes did not cover at all. Because it was the first firing of the kiln, I loaded many types of pieces made with different clays. Among those, even the lower-fire clays which easily develop *shizenyu*, did not build up an ash glaze.

I tried to throw in as much thick unsplit firewood as possible in order to build embers. Because this kiln does not have a *sutema*, oxygen deprived black smoke blew from the chimney mouth. When it combined with the surrounding air, it burst into flame outside the chimney. The huge fire lit up all the surroundings bright as day. When this pillar of fire burst into flame, it made the same muffled "thump" sound that occurs when a gas flame is lit.

In the end, after the method of the throwing in thick firewood did not raise the temperature, I went back to burning split wood to reach temperature and finish the firing.

After the firing ended and a three day cool-down period elapsed, I unloaded the kiln. [The kiln] cooled quickly and there was already moisture at the feet of the pottery up front near the firebox. I could unload these pieces with my bare hands.

Upon unloading, as I expected, bright beautiful *hi iro* appeared. However, no ashes covered the pieces and it was a result quite different from my goals. Additionally, although there were no abnormal marks on the bisqued pieces, there was an extreme amount of cracking at the bottom of the unbisqued pieces..

CAPTION: *Hi Iro Hitoeguchi*[430] *Mizusashi*

429 1472 – 1832 °F.

430 This is one style of mouth. The rim is not folded toward the inside nor is it curved outwardly. Instead, it is cut so the rim stands straight.

A kiln with the same capacity as this one typically consumes 200 – 250 bundles of firewood. For this kiln however, the amount was far less than I expected – only 100 bundles or so.

I fired this kiln three times. In the second and third firing, the *hi iro* tone changed in comparison to the first firing. I could not fire pieces with a result I really wanted. However, I have left the kiln as it is. It is still there and if I get the time, I would like to try it again.

E. Building a Kiln for Disabled People

About ten years ago, I went to Sapporo to make pre-arrangements for an exhibition in Hokkaido. Although I have often exhibited in Hokkaido, it was the first time I went during winter when there was snow.

After the pre-arrangement meeting, someone took me skiing at Teine Mountain. It was my first time skiing there and I injured a ligament. I ended up returning to Shigaraki on crutches and for the next three months, I spent my life on those crutches. This negatively impacted my preparation for a solo exhibition of my work at a gallery.

I managed to be patient about my leg pain and finished making the pottery. At the loading stage however, I could not do anything and my anxiety mounted as the days passed.

The ceiling of my anagama was particularly low. I had to crawl inside the kiln with pieces in my hands and then stack them. However, it was absolutely impossible to stack in a crouching position because I did not have full use of my leg.

CAPTION: Teine Mountain Ski Resort

The exhibition was drawing near but I still could not fire the kiln – I was searching for a solution. In the end, I landed on the idea of building a structure similar to an electric kiln by removing the ceiling. It would be possible to stack the kiln without crawling inside, rather, the kiln could be stacked from above, the ceiling replaced, and I could fire the kiln even while sitting in a chair.

The structure had the same floor slope of an anagama: 3 *sun*[431]. It was made in the shape of a trough 2 *shaku*[432] wide and the sides were built by laying bricks. The firebox and the stacking space comprised a single chamber with the length of the stacking space being about 5 *shaku*[433]. For the ceiling, I used electric kiln doors made from refractory materials. These had a 1 *shaku* width, a 2 *shaku* 5 *sun*[434] length, and a thickness of 3 *sun* to 3 *sun* 5 *bu*[435]. From the floor to the ceiling (in other words to the electric kiln doors) the height was about 1 *shaku* 5 *sun*[436]. Of course, the firemouth was built at the lower end just as in any other anagama kiln.

[Even] while walking on crutches, additional bricks could be laid on the side-walls to match the height of the pieces loaded [in the kiln]. In this way, the height of the ceiling could be freely adjusted and it was a very convenient kiln.

Structurally, the kiln was small and required skill to fire. Still, I could fire a full range of pottery. Many pieces were covered by *shizenyu* while others developed a *youhen* result.

However, the small kiln cooled quickly. The problem with quick-cooling is that *hi iro* is not very good. However, for the exhibition, I was able to display unique pieces which were different from my past work.

I wrote about this in a previous chapter but it was such a memorable event, that I wanted to write about it in greater detail here.

CAPTIONS:
Top: Electric Kiln Door
Bottom: A Solo Exhibition at that Time

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431 3.5 in (9 cm).
432 23.6 in (60 cm).
433 4.9 ft (1.5 m).
434 29.5 in. (75 cm).
435 3.5 – 4.1 in. (9 – 10.5 cm).
436 17.7 in. (45 cm).

F. Diagnosing Ms. M's Multifunction Kiln

Ms. M. is a Brazilian woman of Japanese descent living in Japan. She has been studying Japanese pottery and she is a steady worker. Over the course of almost ten years of study, she has mastered various types of pottery including *shino*, *oribe*[437], *yakishime* and other Japanese craft pottery types.

Everyone comes up with the idea of building a kiln that can fire *haikaburi*, *youhen*, *shizenyu*, *hi iro* and other types of pottery simultaneously. Ms. M. built such a kiln but because she could not fire the pieces she desired, I examined this anagama.

According to her story, even the pieces which were stacked in the front near the firebox (close to firemouth), received only a little *shizenyu*. Further, Shigaraki style *haikaburi* and *koge* were almost non-existent. Depending on the type of clay, the pottery occasionally developed a beautiful *hi iro* finish. However, Ms. M. could not fire the *sutema* as she wished. The temperature was always deficient – she said it was very difficult to raise the temperature.

I would like to discuss the good and bad points of this kiln in a simple and understandable manner.

Ms. M.'s kiln, as shown in the diagram [on page 180], is very similar to the multipurpose kiln I built a long time ago. As a result, I understood her feelings very well. Kilns such as this have too many "attached options". [Take as an example], an electronic appliance with a great number functional capabilities. It is necessary to thoroughly read the instruction manual before using such a device. Unfortunately, operating manuals for anagama kilns are almost completely unavailable and even if a person owns a good kiln, if it is not used properly, it is like a "rotting treasure".

CAPTION: Consignment Shop Near Mashiko (Tochigi Prefecture)

437 A high-fired ware that originated around 1600. This ceramic style is named after tea master and warrior Furuta Oribe (1545-1615). General features include a dark green copper glaze, white slip, underglaze brush work, and use of clear glaze.

If Ms. M.'s kiln was a simple anagama, the kiln's characteristics could be understood at some level after firing it many times. In this case however, too many complicated adjustment controls were built into the kiln. Such complicated firing methods do not connect to the results in a straight-forward manner, and the same mistakes tend to be repeated. As a result, I think it is impossible to master the control and operation of this kiln over its useful life.

Regarding the structure and operation of the kiln, let me point out some characteristics which I especially noted.

The ash pit that is shown at ② on the next page, as I explained before, is useful for getting good *hi iro* results depending on how it is used. [Also note] that the *sutema* greatly stabilizes the firing conditions of the anagama body.

The gate damper at ⑧ and the passive damper at ⑨ serve the same purpose. They may be convenient depending on the situation, but I would say that having two different dampers is not necessary.

In the context of creating *hi iro* pottery, if the wall holes at ④ were an appropriate size and if only the anagama's main body was fired, they would have the advantage of allowing incompletely burned gasses to escape. In this case however, the size of the holes is a problem.

The hole in the ceiling [at ⑥] is effective if opened during preheating to allow moisture to escape. Also, when the pressure in the firing chamber is high (reduction atmosphere), flames will blow out that hole[438]. On the other hand, when the pressure in the firing chamber is low (oxidation atmosphere), if the hole is left open, cold air can enter and cool down that area of the kiln. This hole is advantageous for determining the conditions inside the kiln but I would say that there are some bad points besides its good points.

CAPTION: Ms. M.'s Multifunction Anagama

438 This allows one to know whether the kiln is in reduction.

Next, after finishing the firing of the [main body of the] anagama, I presume that several problems would arise during the stage of firing the *sutema*.

As shown in the illustration of the anagama, there are three air inlets: ① the firemouth, ② the preheating firemouth, and ③ the ash pit. A big issue revolves around whether secondary air should be brought in through ①, ②, or ③ in order to make the wood thrown in through firemouth ⑩ burn well and raise the temperature [of the *sutema*].

It seems that in particular, the holes at④ in the partition wall between the *sutema* and anagama body prevent the *sutema* temperature from rising. I would like to write about this in more detail.

About 30 minutes before the firing of the main body of the anagama is finished (for experienced people, right after it is finished), wood is thrown in through firemouth ⑩ to fire the *sutema*. At that stage, for the wood thrown in through ⑩ to burn vigorously, secondary air must be provided from the front area of the anagama.

However, inletting secondary air causes the main body to cool quickly. This makes it impossible to get good results on the pieces in the main body of the anagama which were meant to have a *hi iro* finish. Therefore, in order to prevent that situation, it is necessary to avoid, as much as possible, a decrease in the amount of embers stored in the firebox of the anagama. This requires cautious firing and much consideration regarding whether air should be brought in through ①, ②, or ③.

CAPTION: Front View of Partition Wall and Side View of Ms. M.'s Multipurpose Anagama

The air that passes through ③, the ashpit, will burn the embers. Therefore, when the firing of the anagama is finished, the amount of embers remaining is only a temporary condition. Although the embers can maintain the anagama temperature for a very short time, once they shrink too much, the kiln will not hold heat and it will quickly cool down.

If the air is brought in through ②, the preheating firemouth, although the effect is not as extreme as inletting through ③, it too will cause the volume of embers to decrease and is also not preferable.

Considering these factors, it is best to allow air to enter from the ① firemouth. However, the size of the hole is problematic. If the size of the hole is larger, wood thrown in through ⑩ will burn well and raise the temperature of the *sutema*. However, the embers in the main body of the anagama will quickly burn up and cause the kiln to cool rapidly. Therefore, the ① firemouth must be no larger than is necessary to burn the wood at ⑩. The ① firemouth must be as small as possible.

The most serious problem of Ms. M.'s kiln are the ④ holes. It would not be a problem if the entire anagama was fired for *hi iro* pottery. When firing the *sutema*, the air brought through ① will not go go through the ⑤ *sama ana* but instead will make a beeline for the ④ holes.

If this happens, when wood is inserted at ⑩, the secondary air will not get to the areas needed to cause the wood to burn well. The wood dropped near the ⑤ *sama ana* will burn poorly and cause the atmosphere to become oxygen poor. Moreover, the air passing through ④ cools down the kiln's interior.

Therefore, the ④ holes are absolutely unhelpful for firing the *sutema*. By closing the ④ holes, the poorly firing *sutema* will become one which fires well.

Be aware of these points and consider them in conjunction with the type of clay used and the loading pattern. In order to fire well, one must know the kiln as if it were a part of one's body, and also understand which characteristics of the kiln are good and which are bad.

CAPTION: Ms. M.'s Pottery

G. Kiln Ceiling Expansion

As I explained in the chapter about building the kiln, the wall bricks expand and contract in every firing of the kiln. Because of this, if the same kiln is used for many years, it will develop deformities over time through repeated expansion and contraction.

Especially during the first firing of a kiln, the amount of expansion is large and the ceiling will crack at various angles. When this happens, people feel uneasy and they are tempted to fill the large cracks with kiln-clay. However, if the cracks are filled [when the kiln is hot], because the kiln shrinks as it cools down, even if the kiln wants to return to the original shape, the filler will make that impossible. Instead, the kiln will remain in the expanded condition.

If the expansion cracks are repeatedly filled with kiln-clay, the outside surface will become distorted with swollen lumps that look like shallow wash basins. This will contrast with the kiln's original form which was in the beautiful shape of a ship's hull. This happens because when the kiln shrinks, it tries to go back to its original shape. However, where the cracks are filled with kiln-clay, bulges appear in the places where the kiln-clay prevents the shrinking.

When looking inside such a kiln, the undersides of the partially bloated lumps do not show. Instead, it appears as if the whole ceiling is hanging low.

The temperature rises more in the ceiling above the firebox [than other parts of the kiln] during firing. The difference between the inside and outside temperatures of the kiln is very large here. Deformations will occur where the bricks repeatedly expand and contract and the bricks may crack and break at a point about 1/3 their length.

With such cracks, the interior ceiling may look like it is collapsing while the outside of the kiln rising. If the kiln is fired in such a condition repeatedly, it invites a dangerous ceiling cave in.

CAPTION: Kiln Ceiling Crack

Usually, anyone would think that if the ship's hull shaped ceiling appears to be moving lower, it is a sign that it is caving in. However, hardly anybody would think that if the ceiling is rising up on the outside, that it is in danger of caving in.

I have never fired a kiln until its ceiling caved in so I have never experienced the ceiling suddenly falling. However, the bricks weaken [over time] and start crumbling. At the stage where many lumps appear on the outside of the kiln, it is inevitable that on the inside, bits of the bricks will peel off, or fine brick dust will drop from the ceiling onto the pottery below. When this happens, the works [in the kiln] turn into failures.

Even when cracks appear on the kiln, do not fill them with kiln-clay or anything. Leave them as they are – it is safer. In order to prevent cracks, the kiln should be cooled down gradually. When the kiln cools down, it shrinks naturally. Even large cracks will return to normal and become almost invisible.

To have the kiln cool down very slowly, after sealing the firemouth put a kiln shelf on the chimney as a lid. This strongly slows the cooling period.

[Capping the chimney] is easier when the chimney is short. With a tall chimney, tie a kiln shelf to the end of a bamboo pole. Use vinyl tape to tie the kiln shelf so that when it is positioned right above the chimney, the heat will cause the vinyl tape to burn off and allow the kiln shelf to rest on the chimney. In this way, even a kiln without a damper is very easily closed.

If kiln maintenance is done correctly, the kiln can be used for some time. However, if it appears that the size of the lumps is growing, it is better to think that the kiln is about to die, and that it is time to enjoy thinking about a new kiln design.

CAPTION: Putting a Kiln Shelf Lid on the Chimney

H. Story of Collapsed Shelves

As I explained before, *hitotsu narabe* is one method of loading. Another is to use posts and a combination of shelves to build many levels.

I presume that for the most part, people who have experience loading and firing noborigama kilns, electric kilns, gas kilns or any of the many other types of kilns available, will have experienced collapsing kiln shelves to some extent. Especially during an anagama kiln's first firing or the first firing after replacing the floor sand, failure of the kiln shelves is most likely.

After the kiln is built, finish the floor sand by stepping on it and pressing it by hand to make it firm. Compression will depending on the moisture or other conditions.

Lay sand on the floor after a new kiln is built and pack it into a firm foundation. It will be 3-4 *sun*[439] at its deepest. When the kiln is fired and the temperature rises, the floor sand gradually sinks. Also, if the layer of floor sand becomes too shallow in the front area where the temperature gets a bit too high, it will become hard and tight just like pottery.

I mentioned earlier that this floor sand is a by-product of refined Shigaraki clay. If the silica content is high there will be no problem. Depending upon the quality however, the feldspar content may be high. In this case, extra caution is necessary because the area on which the posts stand is narrow. The thin posts must support the weight of the shelves and there is a possibility that they may penetrate the ground. As the temperature rises more and more, the risk of this problem increases. [To address this issue,] bury cracked kiln shelves or other wide fire resistant objects under the floor sand. This allows the posts to stand on a wider area.

When constructing shelves, the foundation of the posts near the front area where the fire burns is especially problematic. When peeking through the firemouth at the stage where the firing is almost complete, it may sometimes seem that the position of the kiln shelves is a bit different from what it was the last time they were checked. Because one cannot peek inside the kiln for a very long time, even if it feels like something is a little wrong with the shelves, one must throw in wood anyway. When that wood burns out and the next peek into the kiln is had, if the tower of shelves in the front is already tilting toward the firemouth, it is too late.

CAPTION: Collapsing Shelves

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439 3.5 – 4.7 in. (9 – 12 cm).

Because the shelves are tilting toward the firebox, one cannot continue throwing in wood. There is no choice – the firing must be stopped and there is no use in regretting it. It is ironic that when kiln shelves crash and destroy pottery, [when the shards are examined,] the pieces always have a wonderful color.

Once a person has this bitter experience, he or she will make the foundation of the kiln shelves as strong as possible. Also, if the spaces between the wall and both sides of the kiln shelves are narrow, wedges made from kiln shelf or brick fragments can be inserted there. This will prevent the shelves from moving side to side. Develop many strategies for loading.

I. *Haikaburi*, *Sunakaburi*[440]

As I explained in the kiln building chapter, I cover the bottom of my anagama kilns with sand which is a by-product of refined clay. The shelves or the pottery placed *hitotsu narabe* style, are stacked over this sand.

When a kiln is fired, the floor sand is replaced[441]. The reason for this is that even though the floor sand is highly fire resistant, it is not pure silica sand and has a large feldspar content. Consequently, it is not as refractory as pure silica sand and if the kiln is fired with the same floor sand three or four times "as is", areas of the floor sand will clot together in every firing. [These areas] must be cracked and cut out and replaced with new floor sand.

CAPTIONS:
Top: Wedge for Stabilizing Shelves
Bottom: Silica and Feldspar Sand Which Is Used for Floor Sand

440 A pun. Instead of ash glaze, *sunakaburi* is "sand" glaze.

441 This is a very literal translation, but from Furutani's other comments, it would seem the floor sand is replaced periodically – not every time.

One day, I fired a kiln in which there was newly-exchanged floor sand. As usual, the firewood was burned over the sand and the ashes stirred during the firing with a stainless steel pole. Near the final temperature peak, the ashes started to cover well.

However, when looking at the pieces through the firemouth when wood was thrown in, although the ash had melted and had a bright glossy shine, its surface was rough. The condition of the pottery was not what I was thinking it should be. Judging from the color of the fire, the kiln had reached its final temperature, but in spite of the fact that it was unnecessary to fire longer, the pieces in front were very rough.

I felt something was wrong. I thought that perhaps the amount of ash built up was too small so I again stirred the embers and continued firing.

Even then, the rough surface did not melt and smooth out. Then I remembered that I had replaced the floor sand. “Shoot!” I thought, but it was too late.

The newly installed floor sand was especially fine grained. When I used the stainless steel pole to stir up the bottom embers and make them burn, I did not realize that the tip of the pole also stirred the floor sand. This stirred up floor sand stuck to the ash glazed surface of the pottery, but the rough silica sand could not melt. When I finally noticed, it was too late.

CAPTION: *Sunakaburi* Piece

I stopped the firing and when I unloaded the kiln, *sunakaburi*, not *haikaburi* pieces appeared. All I could do was smile wryly. It was a total failure.

J. Firing the Kiln in Shifts

I take about four to four and a half days to fire the kiln. It is absolutely impossible for one person to fire the kiln from beginning to end. Consequently, after the preheating stage is completed and the real firing begins, my wife and I set up a shift schedule for firing the kiln. In this way, while I am napping, my wife takes a turn firing the kiln.

In the morning, my wife sees our child off to school and finishes the house chores around 9:00 o'clock. She is not busy around this time so she takes a turn firing the kiln. I take a morning bath, have a little *sake*, eat breakfast, and start napping. Then, around noon, my wife and I trade places and I fire the kiln.

After supper is made, my wife eats first and then at about 7:00 p.m., she takes over the firing. Again I take a bath, have some *sake*, finish supper, and take a nap.

I get up and we exchange places again sometime between 11:00 p.m. and midnight.

The same schedule repeats on the following days. I rest from 9:00 a.m. to noon and fire from noon till evening. In the evening, my wife again takes her turn. I then wake up in the late night for my shift at firing the kiln. Consequently, I take a bath twice a day and drink twice a day. When the kiln is fired, I feel very much like Ohara Shousuke San[442].

In one firing, my wife will lose approximately 2 or more kg[443]. There is no more effective way of losing weight. My wife says she is confident that every time she fires the kiln, she becomes more beautiful. I wonder if we should fire more often.

CAPTION: Shift Change

442 It is unknown whether Ohara Shousuke actually existed but his character was made famous in a song known by all Japanese. It is said that he was very fond of a morning nap, a morning bath, and morning *sake* or other strong drink (he was reputed to have a very high tolerance for alcohol). Unfortunately, his habits caused him to go bankrupt in the end. However, he was a very generous person and many Japanese men idealize his character.

443 4.4 lbs.

K. No Roof, No Money, No Firewood

Many years ago, when I was still young and did not have any disposable income, we experienced a nationwide oil crisis. Although I could build a kiln, the situation was so bad I could not even get a loan to put a shed over it. I remember that I covered the kiln with a tarp and fired during seasons when the weather would be sunny for a long time.

There was a shortage of oil and gasoline during the oil crisis and at the same time, other types of fuel became scarce. The market price for firewood rose every day because of inflation. Additionally, it was natural for people who sold firewood to expect the prices to continue rising and refuse to sell. It was difficult to buy firewood.

Consequently, I decided to look for a fuel to substitute for firewood. As luck would have it, wooden utility poles in my area were being replaced at that time with concrete poles. I thought it was a lucky break so I negotiated with the utility people and I bought the old wooden utility poles for almost nothing.

With these old utility poles, I was able to prepare the necessary amount of firewood for a kiln firing. The utility poles were free of knots and I chopped the poles into the firewood of the correct size with an axe. It was very easy to prepare enough wood for one kiln firing.

CAPTIONS:
Left: Utility Pole
Right: Making a Kiln Without a Shed

The wood was mostly cedar so I wasn't really expecting it to have as much heat potential as [pine] firewood. When I fired the kiln however, the fire was much more powerful than I expected and the temperature rose almost exactly as if I was firing with pine. However, this firing strength was due to the preservative injected into the utility poles.

In comparison to pine firewood, about twice the amount of black smoke blew out the chimney. When the wood lid was placed in the firemouth, the oil preservative bubbled and spit out of the butt ends of the wood. This oil then caught on fire because of the kiln heat and dripped in burning drops over the firemouth area.

The heat generated was intense and it seemed that the rate at which the temperature rose was better than with pine firewood. I thought that the firing would succeed if the temperature continued rising at the rate it was going, but I worried about the thick black smoke blowing from the chimney.

Suddenly, the western sky clouded up and a hard rain started falling. I did not think that the black smoke billowing out of the chimney caused the rain, but it began raining so hard, I had to lay many old corrugated metal sheets over the kiln. As I continued firing, I got soaked to the bone[444]. The wet kiln looked like a dim sum[445] steamer cooking sweet rice. Between the black smoke and the steam, I could hardly breath and I just barely managed to finish the firing.

When I unloaded the kiln, the *hi iro* was a dark black. I assume this was a result of the preservative. The *shizenyu* color was also bad. Every piece I unloaded came out completely different from what I had intended.

CAPTIONS:
Top: Guest House Built with Utility Poles
Bottom: Inside of Guesthouse – The Pillars Are Utility Poles

444 For those with a love of idioms, the literal phrase was: "I became a wet mouse."

445 "Traditional Chinese food consisting of a variety of items (as steamed or fried dumplings, pieces of cooked chicken, and rice balls) served in small portions." MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY 326 (10th ed. 1994). Note: and delicious at good Chinese Restaurants.

The next time I fired this kiln, I used pine wood and the result was very different from that obtained by burning the utility poles. The results were very good and I have a happy memory of finally being able to build a simple roof over the kiln with the proceeds.

At the time, I used the remainder of the numerous utility poles I purchased as pillars for a guest house which, as a Sunday carpenter, I built in the front garden of my workspace.

L. Story of Terror

I built a new kiln this summer in order to take pictures of the kiln-building process for this book.

The poles of the kiln shed are about a meter away from the kiln foundation. Consequently, I thought there was no risk that the kiln shed could catch fire.

My Brazilian friend, who is a potter in Mashiko, invited me to an exhibition party which was scheduled for the day after my firing finished. The firing ended smoothly late at night and so I took the first morning bullet train to Mashiko. On the way, I felt a premonition about the kiln so I called home from the bullet train. No one answered the phone – I waited a short time and then tried again. I had to try several times before someone finally answered.

My wife yelled "fire! fire!" and when I asked her what was wrong, she said the studio was on fire. However, it wasn't the kiln shed which covers the kilns which was burning, it was one of the shed's poles located near the new kiln. My wife saw puffs of smoke rising and when she checked the source, smoke was blowing out of one of the shed poles.

CAPTION: Anagama That Caused Terror

I thought there would be no problem because the kiln was built over untouched ground. However, when I built the kiln, I buried many brick fragments from an old kiln as well as pottery fragments in the foundation. These left open spaces through which the heat traveled until it reached the root of the pole. The underground portion of the pole had started burning.

I sensed no problems at all when the kiln was firing and about 10 hours had passed after the firing ended. Nevertheless, the pole had started to carbonize from the excessive heat and smoke blew out from the ground.

It could not be put out with water. I heard that it was necessary to dig out around the root of the pole and coat it with a slurry of wall clay. It was extinguished just in the nick of time.

Fortunately, there was no wind that day and the fire did not blowup to disastrous proportions. If it had been windy, I think the pole would have caught fire and burned. [However,] it was noticed before it became a disaster and the fire was prevented.

I never had that kind of experience before. According to many Shigaraki potters, when a kiln shed is rebuilt and the poles of the prior shed dug out, many times the underground portion of the poles are burned and there is only a core left. Depending on the conditions, the heat spreads more than expected and one should be cautious about fire.

This following problem has not happened to me. The bottom level of the firewood left outside to dry naturally, absorbs moisture from the ground. When the kiln is fired, if the damp firewood is mixed in, people tend to place it on the kiln unconsciously.

After the firing is over, the area surrounding the kiln is cleaned up and water is sprinkled around as a preventative measure. Because of exhaustion and a feeling of having successfully completed the kiln firing, people sometimes forget about the wood laid on the kiln. Over the course of several hours, it first smolders and then starts burning. This is the most common cause of fires and I am especially careful to prevent this.

CAPTION: Firewood Drying on a Kiln Ceiling

M. Firing in Summer

As I explained before, when firing the kiln during summer time, the Chimney's draft is very poor. This makes it more difficult for the firewood to burn, and as a result, the temperature does not rise easily. It's hard work.

It is troublesome if firing in mid-summer is unavoidable. The corrugated metal shed becomes so hot it can cause burns when touched. The kiln temperature is 1000 and some hundreds of degrees Celsius[446] and just getting close to the kiln is exhausting. Therefore, one should take plenty of salt because dehydration may occur if one drinks only water. It also makes sense to eat various kinds of food and consider the salt content in selecting appropriate food for maintaining one's physical condition.

Although it has never happened to me, I have heard stories about people who became so dehydrated because of the heat during summer, that they had to be taken to the hospital by ambulance.

The worst problem I suffer with in summer time firing, is heat rash because of the large amount of sweating. One time, a friend of mine in Wakayama asked me to lend him enough wood for a kiln firing. He came with a truck and picked up some miscellaneous hardwood and pine firewood.

Some days later, he told me that although the firing itself was successful, he had discovered a problem. According to his story, 5-6 people helped fire the kiln and it took them 4-5 days to finish the firing.

Right after finishing the firing with the Shigaraki firewood, every one of them came down with the same heat rash in the same part of the body – they just ran to the hospital. After being tested at the hospital, it was discovered that some unseen insect living in the wood was the cause.

Until then, I thought this was just a heat rash (it had been my worst problem). Thanks to the good doctor in Wakayama who discovered the real cause, I was able to get some medicine from my friend in Wakayama and it has eased my pain greatly. However, how to cure the problems stemming from these insects is still awaiting a solution.

CAPTION: Ambulance That Carried a Dehydrated Person

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446 1000 °C = 1832 °F; 1100 °C = 2012 °F; 1200 °C = 2192 °F; 1300 °C = 2372 °F.

Firing the kiln in summer is hard work but it has the advantage of producing *youhen* pottery.

There is one other advantage according to my wife – it is very good for losing weight and she can lose at least 2 kg[447] in one firing. For me, the taste of beer is excellent after finishing the firing.

N. Firing in Winter

Late on a midwinter night, about 1:00 or 2:00 a.m. when it becomes very cold, the kiln roof makes a rustling noise. Meanwhile, the firewood burning in the kiln continuously makes a pleasant crackling sound and burns comfortably.

When firing the kiln in winter, [it is natural] to get close to the firemouth for warmth. However, while the front of one's body becomes very warm, one's back becomes unbearably cold. A strategy [for alleviating this] is to stack firewood in the surrounding area and cover it with a tarp or something similar. This blocks the spaces between the pieces of wood and blocks out the wind. Such a structure is like a fort kids often build and it makes a good environment for firing the kiln.

During winter firings, I think about many things. When it starts snowing, background noise is silenced. I hear only the sound of the burning wood and the sound of the corrugated metal rustling. It is at moments like these that I spend time thinking. I think about the pieces in the kiln, their conditions, and how I hope they turn out. I think about kilns, the shape of kiln ceilings and wonder if those ideas would result in good *hi iro*. I think about many things and when new kiln designs come to my mind, I sometimes make drawings of the new ideas on sheets of paper I keep available.

CAPTION: Firing a Kiln During Winter

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447   4.4 lbs.

In the 5-10 minute intervals between throwing firewood into the kiln, I think of various things and dream up various ideas. It is a very enjoyable time. It is during these times that I thought up and designed all the new kilns I built in the past, and all the new kilns I will build in the future [will certainly come out of these times].

Firing anagama kilns has an enjoyable charm in itself but the best part is sitting by myself late at night, listening to the burning wood and feeling its heat. Everyone should experience such a wonderful night at least once.

O. Thundering Kiln – Spider Web Story

Firing a kiln is easier in winter and harder during the summer. Several years ago, I was firing a kiln on a hot and humid midsummer night. The smoke blowing out the chimney would not rise and made a dull stagnate haze around the kiln site.

This situation began when the kiln temperature was around 1000 °C[448] during the time of aggressive firing. I suppose that the way the kiln was stacked combined with the chimney's very weak draft caused the problem. Every time wood was thrown in, the kiln made a "chug chug" sound like a steam train going up a hill. As the kiln labored under these extremely bad conditions, it puffed out flame and black smoke from the firemouth accompanied by a sound like a heartbeat.

In order encourage the firewood to burn well, I threw in only small amounts. I also split the wood as thinly as possible and laid the pieces individually in a criss-cross pattern. Even though the wood could burn more easily the kiln temperature still did not rise.

When the wood burned out and I peeked inside the kiln, it looked as if all the pottery was swaying front to back like a goldfish in a goldfish bowl. I thought something was strange but I could not keep the firemouth open for too long. I threw in another load of wood and waited for the next chance to peek inside.

CAPTION: The Rumbling Kiln Sounded Like a Steam Train (Picture Used with Permission of Shigaraki Town Hall)

448 1832 °F.

After that load of firewood burned out and the flame disappeared, I could look all the way through the kiln. The swaying of the pottery was more pronounced – it looked like a spider web or water plant waving in a stream. The pieces were swaying in the direction of the chimney as if they were blowing in a wind. Additionally, it seemed that the chimney had absolutely no power along the direction of this stream.

The chimney was pulling abnormally badly and the inside of the kiln was severely deprived of oxygen. The soot didn't finish burning but stuck to the pieces and stayed there unchanging.

I had never experienced such a situation and I did not know how to fix it. I kept splitting firewood into small pieces in order to make it burn faster, but still, it took longer than usual for the wood to burn out and the stoking rhythm slowed. I tried to clear the inside of the kiln as much as possible but it had absolutely no effect.

I peeked again as soon as the firewood burned out. The pottery and shelves were swaying in unison and gave the impression of a spider web hanging from a haunted house at a carnival. The swaying motion was intensifying.

At this moment, the chimney was pulling weakly and the wood was not burning out well, so the kiln was building up a lot of embers.

I had already widened the lower firemouth by removing two bricks but the additional secondary air did not seem to have any effect. I wrapped the chimney with corrugated metal to raise its height. Unless the pulling power of the chimney improved it would be hard to burn out the soot gathering inside.

I fired with the worm-eaten firewood in order to reduce the amount of embers. It burned out well but had no effect on the chimney's pulling power.

CAPTION: The Pieces Behaved Like a Spider Web

I wanted to make the embers burn out a little faster and make the stagnate flame stronger. I thought of many things but finally settled on a strategy of using the rotary burner which is used to preheat [the kiln]. I disconnected the oil so it that it would operate as a blower to forcefully inject secondary air into the kiln.

The worm-eaten firewood was light and the chimney had been lengthened with the corrugated metal. For 30 minutes, I used the blower and stoked when the wood had burned down. Suddenly, from under the kiln came a weird rumbling sound in the earth – it sounded like "doh doh doh doh doh doh". I could feel the sound in my stomach. I was very startled and I got away from the kiln in a hurry. When I looked at the chimney, there were flames and showers of sparks pouring out like fireworks.

I had never experienced the rumbling earth noise nor the showers of sparks. My heart sank and I felt very uneasy. All I could do was sprinkle water around the chimney – I even forgot to peek inside the kiln.

The rumbling and shower of sparks lasted only one or two minutes and then stopped. Still, it felt like such a long time.

After I calmed down a little, I peeked inside the kiln. Not long before, the entire inside of the kiln had been swaying and the flame had been dull and stagnate, now the flame color was better and brighter.

Depending on the season, the correct balance between oxygen, fuel quantity, stoking rhythm, and chimney draft, changes. It seems that the phenomenon [I described here] can occur if all four are out of balance. Only by using the oil burner to force air into the kiln, was the oxygen deficiency overcome and the soot burned out. Luckily, I managed to get through the situation but I cannot express in words how terrified I was.

CAPTION: State of the Chimney When the Temperature Was Not Rising

The thundering earth sound is one which old potters have described. Although I experienced this ominous and sinister omen, the pieces which came out of that firing were completely the opposite of unlucky. Wonderful pottery resulted from this experience and from that point on, I felt as if the kiln god had given my kiln and pottery an unexpected power.

P. The Hearth Caretaker Bug Story

Currently, I own three different kilns near my house in Shigaraki. In addition to those, I have the completely-underground kiln in Hata, and I have two other kilns in Marubashira, Iga. That makes six in total.

Once, at a good time in the autumn, I decided to fire the center kiln of the three side-by-side kilns near my house. It had been more than a year since I had last fired that kiln.

I opened the mouth of the kiln in preparation and shined a light inside. Right after I turned on the light, I saw hundreds of insects which looked like long legged crickets. I looked up this insect and discovered that in Shigaraki, it is called a "hearth-caretaker" (*kamadouma*).

The kiln provided a good environment in terms of moisture and temperature for the insects. Many grew there and they flew all over my head and face.

Because these were called "hearth-caretaker" bugs, I could not start the fire and kill them. I got my child's net for catching insects and attempted to catch them in the narrow area of the kiln. Although I could catch some in the main body of the kiln, both the *sama ana* and *sutema* are too narrow for a person to fit through and I couldn't catch the ones who lived there. I was at a loss for what to do.

CAPTION: Three Kilns at My House

So, just like smoking raccoons out of a hole, I burned a fire to smoke out the hearth-caretaker bugs. They would die if the smoke was too strong so I made just a little smoke. Unfortunately, the bugs would not come into the main body of the anagama – instead, they went deeper into the kiln.

The smoke was going to make all the caretaker bugs die, so I changed my strategy. I brought out a big vacuum cleaner and inserted the hose into a *sama ana* and tried to suck them out.

The hearth-caretaker bugs had been protecting the kiln for more than a year. Between the smoke and sudden vacuum treatment, I think they had deeply hurt feelings.

The caretakers who left the kiln survived but there was no way I could save those who went deep into the *sutema*. I decided to wait for them to come out – I gave them a reprieve and postponed the loading for one day. The next day I ran a flashlight beam around the inside of the main body of the kiln. Dozens of caretakers came out from the back of the kiln and I could save those. However, I felt so sorry for the ones who stayed. I said a prayer for them.

Q. Big Herd of Newts at the Iga Kiln Site

It was the rainy season and so it was probable that rain fell during the kiln firing. To prevent the dry firewood from getting wet, I protected it with a big tarp and carried the wood as needed to the kiln.

At my kiln in Iga, although there is a house next-door, it is near a mountain and some distance from the village. Behind the kiln is a large pine forest, and further back on the east side, is a deep valley which gets little sunlight. The kiln site conditions are not excellent, but I can fire the kiln without being disturbed. The smoke drifts into the pine forest without any risk of bothering neighbors – this is its advantage.

CAPTION: Hearth-caretaker Bug

At first, the owner of the pine forest was worried that the smoke would kill the pine trees. However, the pine eating worms were getting close to this area and the pine trees which received the kiln smoke were, I assume, fumigated because the needles grew green and thick. Depending on the location however, some trees were partially blackened by the smoke. Please forgive me.

This is the type of place in which I fire my Iga kiln. It was late at night and as usual, I was by myself burning pine and listening to the crackling sound of the fire, when, without any notice, I saw two or three newts around me. Because it was the humid rainy season, they had probably been sticking to the firewood. Viewed from any angle, newts are not cute animals. When I looked at them closely, they gave me a rather weird feeling.

Then, when I used a stick to push them away, they showed their vibrantly red stomach. The contrast between the black color of their backs and their red stomachs gave me a very strange feeling as well. I found one or two more rustling around me and I tried to shoo them away with the stick.

CAPTION: Scenery Surrounding My Kiln in Iga

When the firewood near the kiln was gone, I carried more wood over, bundle by bundle. While I was doing this, at one point I looked around in the area lit by the flood-light. There was a surprisingly large assembly of newts gathered there, rustling about and consulting with each other. It looked like they were plotting about something and it was a very unpleasant scene.

In the morning I went back to the area where the newts had congregated but they had vanished and I could not find a single one. I wonder what the gathering of newts was all about?

R. Story of The Man Buried in a Kiln

A few years back, a certain publisher printed an interview of of me. I briefly talked about the anagama-building process and told some other stories. This interview was printed and the book in which it appeared was sold.

One person who read the article, used the discussion printed in the book to make an anagama by himself. In the end, when the kiln was done, he went inside the kiln to take out the framework that held up the ceiling. The ceiling suddenly collapsed and buried him alive while he was taking out the main post. Fortunately, someone nearby was able to save his life just in the nick of time. At that time, I had built dozens of kilns and I had never had a single experience like that.

When that person read the article in the book, he may have became confused or misunderstood something. I still don't know the definitive reasons but I wonder if he used incorrect methods to do the work.

[In terms of potential causes for the collapse,] first, I can think [of possible problems] related to how the bricks and mortar were used when building the ceiling. In other words, the thickness of the kiln-clay could have been thicker than the bricks, or perhaps the kiln-clay was not completely dried out. If the support posts were removed forcefully with a crow bar, it could push the ceiling up. Alternatively, the curvature of the ceiling arch may have been small, i.e., almost a flat ceiling. I imagine any of these could have been the cause.

CAPTION: Newts' Gathering Place

If the arch was not extremely flat, then perhaps the side-walls may have been very weak. In that case, they would not have had the strength to sustain the ceiling arch. Other than that, I cannot think of other causes.

When looking at [a properly constructed] ceiling from inside the kiln, no mortar should be seen between the bricks. Ideally, all the bricks contact tightly with each other. Everyone who reads this book and builds a kiln, please do not let an accident like this happen to you. I beg you to thoroughly read my poor writing and [understand it] well before beginning the work.

At the same time, if I tell a story like this, people say "then I shall ..." and some people think about coming to see me and study my kilns or write letters asking questions. This disturbs my production a great deal. I beg you to hesitate before doing this.

S. A Summertime Incident at the Studio

Because of its geographical location, Shigaraki's weather is usually cold in the winter. Summer days are hot but it is cooler and comfortable at night. Kiln firing during the hot summer is extremely physically exhausting. In my case, I usually fire the kiln with my wife. I try to avoid getting help from a third person by taking turns with my wife and getting enough rest. That way, I can finish the kiln firing.

Before my wife takes her turn, I transport wood to the kiln with a wheelbarrow filled with a couple bundles of wood. I pile a certain amount of firewood by the kiln and when [my wife] has completely burned this small pile, I take make my turn. This is the method I use.

CAPTION: The Article in The Book Regarding How to Build Anagama

It was summer time. As usual, after carrying firewood to the kiln, letting my wife take over, having my morning bath, morning *sake*, and morning nap, I was feeling very much like Ohara Shousuke[449]. I was listening to the sound of firewood burning and was just starting to feel drowsy when I heard my wife screaming in terror.

"Fire?" I thought. I jumped awake and hurried to the studio. My wife was mumbling something with a voice so ghastly, it sounded as if someone had put a noose around her neck. I could not understand anything she said and rushed to the kiln nearby. It was all about a snake – a big snake had been hiding in the pile of firewood. After dropping the wood lid, she was just about to reach into the firewood pile to get some wood to throw in, when a long thin piece of wood started moving. "Where is it?" By the time I was ready with a long thin stick in my hand, the snake had already fled to the mountain and vanished.

This incident occurred while firewood was being thrown into the kiln. The most important thing was that the firemouth was left open. I immediately threw in firewood and managed to get through the incident. The scene of my wife screaming and running around nearby was both funny and sad. My drowsiness blew away. Of course, the snake was surprised too.

It is a very common to hear about snakes hiding in piles of firewood – it is not a rare story in Shigaraki. It must have been a huge snake. This doesn't happen in winter firings. Snake incidents are completely unique to summer time.

There is more to the snake story however. The fourth day had passed as a very hot and humid summer day. I was extremely exhausted. Coincidentally, Mr. A., who likes pottery, came to visit me. He could not bear seeing me so exhausted. So, he put on work gloves and started helping me. He was warm hearted, and kindly decided to carry firewood. It was hot, and although I felt sorry about it, his assistance helped me fire painlessly.

CAPTION: Using a Wheelbarrow to Carry Firewood

449 See footnote 442 page 187.

Carrying firewood from the garden to the kiln was tiring and Mr. A had beads of sweat on his forehead. At one point, when I looked over, I saw a rope hanging from the bottom of the firewood he was carrying in both arms. The rope was dragging on the ground except that instead of trailing, it was “dragging” toward the kiln. Because he couldn't see it, he was not aware of it. At any moment, he could have stepped on the tip of the rope. Sometimes, it is better not to know.

Looking carefully, the rope was not only swinging, the tip of the rope was trying to rise up. It was lifting its neck to look around! The rest you can imagine yourself.

Instantly, the beads of sweat on Mr. A's forehead seemed to change into a cold sweat. I felt very sorry for him. After this incident, he never got close to the firewood again.

T. Drum Kiln

A long time ago (20 or so years ago) before I became independent, I spent two years visiting potters all over Japan. I traveled by bicycle on a “no-money” trip (this is an old saying). During my journey, I met Ayako Tsutsumi in Kasama, Ibaraki prefecture. At that time, Tsutsumi San was making pottery in a unique kiln of a type most potters would not think up.

Holes were made to form a grate in the bottom of a drum which was stood on end. In other words, a grate was made and then the inside [of the drum] was filled with pottery and charcoal. She was firing unglazed pieces.

[As a side note, one way to smelt iron, is to] lay iron bearing sand over charcoal and then over that, more layers of charcoal and iron bearing sand. When this is fired, a lump of iron results. This is the *tatara* iron making process from the old Izumo region where the technique is presently preserved. Plainly, the lump of iron [which results], shows that the charcoal reaches a high temperature. Likewise, this demonstrates that Tsutsumi San's charcoal fired drum-kiln can also reach high firing temperatures for pottery. The firing temperature has gotten so high in fact, that the drum can itself has melted. Consequently, the inside of the kiln is coated with refractory cement to prevent it from melting. Tsutsumi San did much experimentation, and at last, half buried the kiln in a hole.

CAPTION: Tsutsumi San's Drum Kiln

Page 204

If the drum can is buried underground and fired, the clay which touches the can vitrifies and becomes hard. Focusing on this phenomenon, Tsutsumi San is presently burying her original and unique type of tube kiln underground. She is currently specializing in this type of kiln which she uses to fire almost all of her unglazed ware.

Biographical data regarding Furutani Michio[450]

- Born: 1946 Shiga Ken Kouga-gun Shigaraki Machi
- 1964 apprenticed to Uchida Kunio
- 1970:
  - Built his own unique anagma and became independent
  - Japan Tradition Technical Prize
  - Shigaraki Ceramic Most Outstanding Prize, Twice
  - Seibu Industrial Grand Prize Exhibition, Best Prize
- 1984:
  - Built an anagama in Iga Maruhashira
  - Kinki Region 20th Japan Traditional Industrial [Arts], Kinki Prize
  - Kyoto Educational Committee, Head of Committee Award
- 1996:
  - Shigaken Cultural Encouragement Award
  - Solo exhibitions held at Nomura Museum and other places all over Japan
- Books:
  - Co-authored: Looking at Pottery From the Kiln, Kougei [Press]
  - Tou (Kyoto Shoin)

450 From the unnumbered page, 2nd leaf from the back of the book. This is the page with the ISBN number and copyright notice printed at the bottom.

Translation Ends Here

Note: the remaining pages are simply advertisements for other books published by Rikogakusha. This section is not translated.

Glossary of Japanese Words Used in this Book

Bi-doro**:** From the Portuguese "vitrol" meaning "glass". This refers to glossy streams of natural-ash glaze (*shizenyu*) which terminate in a shiny bead of glass. They may flow over areas on which little or no natural-ash glaze has developed. Sometimes, the streams of glaze drip over area2s where the underlying ash-glaze has a contrasting matte finish. It is important to note that Furutani did not refer to streams of glaze with a matte texture as *bi-doro*. Instead, depending on the qualities of such a drip, he would have used the terms *haikaburi*, *shizenyu*, or *youhen*.

***Botamochi* Shape:** Round rice-cake shape.

Bu**:** Old Japanese linear measurement. There are 10 *bu* per *sun*. As used in this book, it is approximately 0.12 in. (0.3 cm).

Chawan**:** Rice bowl or tea bowl.

Endou**:** The sloping flue between the kiln and the chimney.

Fukidashi**:** Typically, a row of holes at the bottom of the last chamber of a noborigama which allows venting of fire and smoke.

Gairome**:** Literally, "frog's eye". There are a couple definitions of this clay. "[C]lass of kaolinic, vitrifiable secondary clay only partially decomposed through transport. Consequently, it tends to include much mineral debris from the parent rock, including quartz, feldspar, and sericite mica." Richard L Wilson, Inside Japanese Ceramics, A Primer of Materials, Techniques, and Traditions 44 (1st paperback ed. 1999). Penny Simpson et al., The Japanese Pottery Handbook 52 (1979), defines *gairome* as "ball clay".

Gotoku**:** Three or four pronged stand placed in a *hibachi* to support a kettle above the layer of coals. See diagram on page 108.

Hagi**:** A white crackled and/or crawled glaze. With *hagi* ware, the color changes over time as it is used.

Haikaburi**:** Literally: "ash-covered". In wood-fired kilns, wood ashes fall on the pottery during firing and melt into a natural-ash glaze. *Haikaburi* is one type of natural-ash glaze which has as its fundamental characteristic, a matte texture. This matte texture results when the ash deposits which pile up on the pieces do not fully melt into a glossy surface. *Haikaburi* and *shizenyu* occupy different points on the natural-ash glaze continuum. *Haikaburi* is simply less melted. It may be helpful to imagine *haikaburi* as being the precursor to *shizenyu* (*shizenyu* being a type of natural-ash glaze which has fully melted and begun to stream down the sides of the pottery).

Hanaire**:** These are vessels for flower arrangement. Materials include metal, porcelain, stoneware, bamboo, and wood.

Hi Iro: Literally: "fire color". This is perhaps similar to "flashing" in the West, but Furutani's examples of *hi iro* seem to have additional characteristics *Hi iro* refers to changes in the color of the clay body itself due to the interaction between the flames and minerals in the clay. *Hi iro* pottery does not have a buildup of ash glaze. In fact, if ash glaze does develop, the *hi iro* tends to be obliterated. Furutani developed specialized kilns and firing techniques to attain *hi iro* effects.

***Hibachi*:** Traditional *hibachi* are round ceramic utensils used for boiling water or as a heater. Do not confuse these with the "Hibachi" brand charcoal grills. For an example, see the diagram for "Charcoal Brazier" in PENNY SIMPSON ET AL., THE JAPANESE POTTERY HANDBOOK 85 (1979).

***Hibuse*:** Hibuse is a term reserved for certain fire-effects that are produced in noborigama kilns. Noborigama kilns can be used to produce glazed pottery. However, because noborigama kilns are fired with wood, there is a risk that ashes falling on the glazed pottery could cause unwanted effects in the glaze. In order to protect the glazed pottery, unglazed pottery is placed at floor level right next to the "firebox" (in reality, this is an open space traveling the width of the chamber into which wood is thrown – it is not physically separated from the loading area). The unglazed "guard" pots are placed in front of the glazed ware and stand between the burning wood and the glazed pottery, thereby protecting the glazed pieces. The unglazed "guard" pots are greatly affected by heat and ash from the wood burned in the chamber. As a result, these pots may develop effects akin to *bi-doro*, *haikaburi*,*koge*, *shizenyu*, and/or *youhen*. For pottery fired in noborigama kilns, these effects are collectively referred to as "*hibuse"*. Please take note however, *hibuse* is not used to describe these fire-effects for pottery produced in anagama kilns. For further discussion and picture, see: JACK TROY, WOOD-FIRED STONEWARE AND PORCELAIN 3 (1995).

***Hiki Dashi Kuro*:** This method involves removing the pottery from the kiln during firing to make the pottery very black through sudden cooling.

***Hitoeguchi Mizusashi*:** This is one style of mouth. The rim is not folded toward the inside nor is it curved outwardly. Instead, it is cut so the rim stands straight.

***Hitotsu Narabe*:** Method of loading pottery directly on the kiln floor without shelving. Literally means "standing in one line".

***Iga*:** Unglazed high fired ware that appeared first in the 16th century in the Iga area of Japan. Furutani used this term in an manner individual to his own work. He built a unique kiln in Iga and fired it in a unique manner (see page 109). Usually, the pottery he fired in the Iga kiln, was made of clay mined in the Iga region. However, Furutani also sometimes referred to pottery made out of Iga clay but fired in one of his Shigaraki kilns, as Iga pottery. Finally, Furutani would refer to pieces as Iga pottery when the pieces were stylistically similar to Iga pottery and possessed Iga firing effects. The stylistic characteristics of Iga pottery include lugs ("ears") attached to the pieces and thick, abundant, flowing shizenyu effects.

***Iwagama*:** Name of a specific kiln. Literally means "rock kiln".

***Jagama*:** Snake kiln.

JIS Bricks: Japanese Industrial Standard. JIS bricks are 230 mm long, 114 mm wide, and 65 mm thick. In other words, approximately 9 x 4.5 x 2.5 in.

***Ken*:** Old Japanese linear measurement. There are 6 *shaku* per *ken*. As used in this book, it is approximately 5.9 ft. (1.8 m).

Koge**:** Pots near the firebox may be covered with embers during the firing. Burying pots in embers causes cooler firing temperatures for those pots (or the buried portions of those pots). When natural-ash glaze is not allowed to develop on the pieces buried in embers, burial in embers causes the clay to develop dark charcoal-colored or pastel-hued qualities. On the other hand, if *haikaburi* or *shizenyu* is allowed to develop prior to burying the piece in embers, and the firing temperature is sufficiently high, the buried portions of natural-ash glaze will develop a coal encrusted surface. Note that a piece which is partially buried may exhibit *koge* on the buried portion and *haikaburi* or *shizenyu* on the exposed portion.

Mizusashi**:** One of the tea utensils. This lidded vessel holds the water supply to be heated for tea and also holds water for rinsing the *chawan*. The *chawan* are not rinsed in the vessel, it simply holds the water that will be used in rinsing.

***Mousou* Bamboo:** *Mousou* refers to a type of bamboo in the sense that "maple" refers to a type of tree. This is the most common type of bamboo available in Japan. The full word is, *mousoudake*, "*dake*" meaning "bamboo". This type of bamboo originated in China and as an interesting side note, it is a type Pandas like to eat. Importantly for kiln building, it is elastic.

Oribe**:** A high-fired ware that originated around 1600. This ceramic style is named after tea master and warrior Furuta Oribe (1545-1615). General features include a dark green copper glaze, white slip, underglaze brush work, and use of clear glaze.

Rokkouyou**:** The six famous ancient kilns of Japan, i.e., Seto, Tokoname, Shigaraki, Echizen, Tanba, Bizen. Louise A. Cort, Shigaraki, Potter's Valley 20-22 (1st Weatherhill ed. 2000).

Sama Ana**:** Openings at the bottom of the kiln wall which vent fire and smoke.

Shaku**:** Old Japanese linear foot. As used in this book, it is approximately 11.8 in. (30 cm).

Shino**:** Pottery which was made in Mino during the Momoyama period (1573 – 1603). The technique was imported from China.

Shizenyu**:** Literally: "natural glaze". In the case of wood-fired kilns, a natural ash glaze develops when ashes fall on the pottery and melt. *Shizenyu* usually develops in the hotter parts of the kiln and refers to natural-ash glazes which are fully melted and glassy. *Shizenyu* and *haikaburi* occupy different points on the natural-ash glaze continuum. *Shizenyu* is simply more melted, glossy, and shows more streaming than *haikaburi*.

Sun**:** Old Japanese linear measurement. There are 10 *sun* per *shaku*. As used in this book, it is approximately 1.2 in. (3 cm).

Sutema**:** This is a small chamber immediately behind the main anagama body which stabilizes the firing conditions. Pieces may be fired in the *sutema* but it is typically not used for firing pottery.

Takiguchi**:** Firemouth.

Toukan**:** Fired ceramic pipe sections.

Tsubo**:** From ancient times, vessels with a mouth which is comparatively smaller than their rounded bodies have all been called *tsubo*. These have been made not only from clay, but out of lacquer ware and metal as well.

***Uma no Tsume*:** Literally, a horse's hoof. In this case, it is a stand placed on the lower end of the slope beneath an individual pot to give that pot a flat place to rest. See page 100 and the top diagram at page 101. Further discussion can be found at LOUISE A. CORT, SHIGARAKI, POTTER'S VALLEY 84 (1st Weatherhill ed. 2000).

***Waritake*:** Cut bamboo.

***Yakishime*:** After a piece is formed out of clay, it is fired "as is" without the addition of glaze.

***Youhen*:** Literally: "kiln change". This term refers to pieces which undergo unexpected changes in color and/or texture during the firing. Note that textural changes in natural-ash glazes are almost always accompanied by color changes. This effect can be seen in the transition zones between *shizenyu* and *haikaburi* or *haikaburi* and *koge*.