

**THE ANATOMY AND HISTORICAL DEVELOPMENT
OF SINHALA TYPEFACES**

S. S. M. R. Samarawickrama

(118044K)

Degree of Doctor of Philosophy

Department of Architecture

University of Moratuwa

Sri Lanka

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Start by doing what's necessary; then do what's possible;
and suddenly you are doing the impossible

- Francis of Assisi

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the PhD thesis under our Supervision.

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ABSTRACT

Keywords: Type Anatomy, Typeface, Sinhala Typography, Letterform and Sinhala letter

This thesis is an epistemological study, which presents various knowledge-building activities for Sinhala typography. Initially, it presents a historical analysis on Sinhala typefaces and the morphological characteristics of letters. These characteristics articulate the anatomy of Sinhala.

The historical outline on the Sinhala letters and typefaces are discussed in relation to the introduction of the printing press and various technological developments. Using this a chronological timeline of Sinhala typefaces was developed. Followed by gaps in the current typographic knowledge, and its limitations are analyzed and discussed. The core contribution of this thesis is a comprehensive study on the anatomy of Sinhala based on distinct visual properties of each letter. We report how these visual properties are manifested in typefaces from 1737 CE to 2013 CE. These visual properties are also compared with existing typographic knowledge systems from scripts around the world.

We suggests 59 (sub categorized into 19) visual properties distinct to the Sinhala letter. We believe that our research on the morphological characteristics (visual properties, referencing lines, grid and vocabulary) that defines the anatomy of Sinhala fill up the existing knowledge gap in Sinhala Typography.

The thesis reveals that the existing typefaces were developed intuitively by designers or copied, adapted to overcome technological changes. It also speaks of an absence of formal knowledge on Sinhala typography, more specific to typefaces design. As a result, the number of typefaces designed today (considered as original typeface designs) is lesser than of what was found prior to the introduction of digital (Sinhala) typefaces used as body text.

The thesis primarily contributes knowledge towards building a theoretical framework for Sinhala anatomy, it also contributes knowledge to type design process, typographic pedagogy, typographic history, and methodology that can be adopted by other scripts to define the anatomy and to analyze typefaces.

Dedication to my husband, my inspiration,
to Mikhail and Raphael

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LIST OF ABBREVIATIONS

AS	- Ascending stroke
BS	- Base Stroke
CABS	- Colombo Auxiliary Bible Society
CC	- Combined or Conjunct Consonants
CTTA	- Kotte
DF	- Distinct feature
DNA	- Department of National Archives
DS	-Descending stroke
DVP	- Distinct visual Properties
GP	- Government Press
MNLSI	- Ministry of National Languages and Social Integration
NAS	- Non-alphabetical signs
NEC	- National Education Commission
OSS	- Other special signs
RL	- Root letter
VP	- Visual Properties
VS	- Vowel signs
WMP	- Wesleyan Mission Press

Chapter one

INTRODUCTION

This thesis contributes to the field of typography, in this case Sinhala typography. It is an epistemological study, which presents various knowledge-building activities for Sinhala typography. The core contribution of this thesis is a comprehensive study on the anatomy of Sinhala based on distinct visual properties of each letter. Theory on Sinhala typography is sparse unlike the standardized sets of typographic theories used by other scripts of the world. The thesis aims at examining morphological characteristics of Sinhala letters that articulate the anatomy through a historical outline on Sinhala typefaces. The thesis presents how that knowledge contributes towards the process of Sinhala type design. This is achieved by building a theoretical framework for the Sinhala anatomy, and by documenting literature on Sinhala typefaces relevant to Sinhala typography. Therefore, the thesis fills the existing gap of formal knowledge on Sinhala typography.

Background and Context

To understand the components of the Sinhala letterform we looked at knowledge on type anatomy. Carter states that each letter has a distinct nature. He explains this within his work on legibility of type and states that there must be a sufficient contrast between letters. He illustrates how the top stroke of the letter *a* becomes the ascender of the *d*, and due to insufficient contrast, we are left with intermediate forms which misleads the reader (figure 1.1) (Carter *et al* 2007:74) Therefore, to identify each letter from another, the distinct nature plays a vital role. Frutiger explains the 'distinct nature' as the nucleus of the letter. He describes this distinct nature by superimposing eight typefaces on a grid. Due to the overlapping of the letters a dark area was formed making it look like a skeleton. He denotes that skeleton as the elemental form of the letter in the reader's subconscious, and this he terms as the nucleus (figure 1.2) (1989: 64-69). Thus, we understand the nucleus or the distinct nature that Carter acknowledged above conveys the *elemental form* of the letter that distinct each letter from another, and from a script. This fundamental

knowledge, such as letterform, type anatomy plays an important role in the development of typographic epistemology.



Figure 1.1: Distinct nature of the Letterform
Source: Carter R., et al (2007)

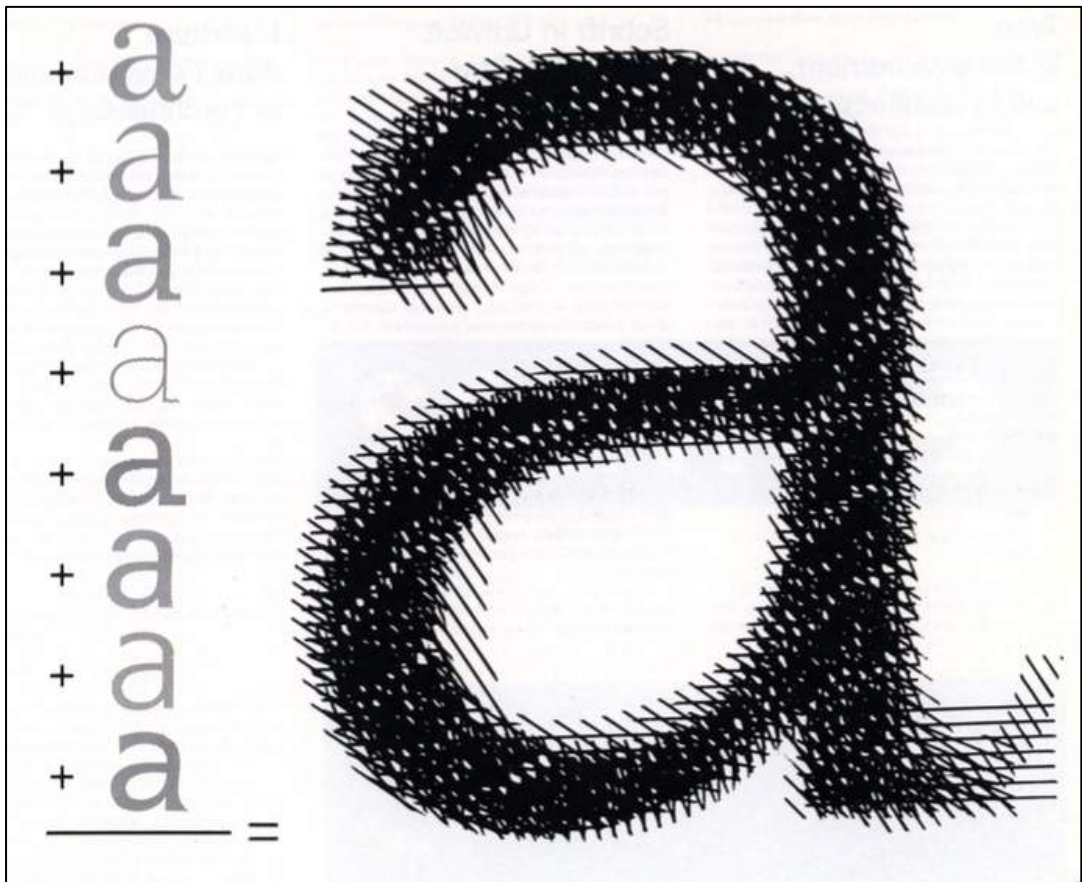


Figure 1.2 : The nucleus of the of the Letterform *a*
Source: Frutiger A., (1989)

Carter *et al*, speak of letterforms as the central component of all typographic communications and includes nomenclature, measurements and the nature of the typographic font as factors of the anatomy (Carter *et al* 2007:29). Dalvi defines the anatomy as a system, which depicts the structural makeup of a letter that describes key parts within the letter for a given typeface (Dalvi 2009: 30). Therefore, the other aspect about the anatomy is the *type* or *typeface*. It is referred to as the face of the letter, either on a piece of metal, negative of a film or a set of digital codes in a computer. Kinross explains that each typeface has its own visual properties that are common within the typeface (2011:116). Therefore, we understand that a typeface is made up of individual letters and with each typeface certain visual properties differ. In the case of Sinhala typefaces we find no formal knowledge or literature (See Chapter 02,03) on the historical development of the existing Sinhala typefaces. The existing typefaces were developed intuitively by designers or copied, adapted to overcome technological changes (See Chapter 03). As a result, an absence of formal knowledge on Sinhala typography, more specific to typeface design is evident. The number of typefaces designed today (considered as original typeface designs) is lesser than what was found prior to the introduction of digital (Sinhala) typefaces used as body text.

However, the limitations of formal typographic knowledge are found in most Indic scripts, due to the late introduction of the printing press compared to the West. Dalvi has based his definition on the anatomy on the Devanagari letterform, even though the concept of anatomy was derived from the long printing traditions of the Latin script. We understand that the expansion of knowledge in the field of typography had extended to other scripts. Visual grouping of the Tamil anatomy is identified (Kumar 2010: 109-116). Bengali Script too defines its anatomy with visual elements across its script (Chandra *et al* 2015:). The knowledge on the anatomy assists type designers to design typefaces from conception to its final letterform, as it formulates the structure of letterform (Ross *et al* cited in Chandra *et al* : 2015: 238). Therefore, it can be agreed that the notion of anatomy is important, and that it can be built on a *system* specific to a script and it assists the type design process.

To clarify the element of the anatomy — ‘the system’, as defined by Dalvi, has several components. We identify the x-height, reference lines, grid and terminology as they are constantly in use when describing the anatomy within other scripts. Ambross explains the x-height to be the height of the lowercase ‘x’, and this is considered as a relative measurement that varies from typeface to typeface (Ambross *et al* 2006:61). Kumar refers to x-height as *pa*-height in the Tamil script, based on similar grounds as the Latin script, and speak of the letter *pa* touching the main reference lines (Kumar 2010:162). The x-height in this regard, goes hand in hand with a particular letter, its size and reference lines as a means of measurement.

The *terminology* used to describe these lines or the letterform is a whole new discussion. Mclean, states that there is no definitive nomenclature for describing all the letter parts (Mclean 1996: 74). And, Tracy states that the terminology is illogical since it had come a long way in reference to Latin:

“terms used in discussing type design and typographic practices are illogical, or have more than one meaning, or mean different things in different places. They have come into currency in the talk of master to worker, journeyman to apprentice, through the five hundred years of the craft of printing – or industry, as it now is. Most of the terms are serviceable enough, so they continue in use even though the practice of making type and using it is now chiefly a matter of electronic and computer technology, optics and photographic chemistry, which have added their own terms to the vocabulary” (Tracy 2003: 13)

Yet, we find, Tracy himself defining *bowl* as “the curve part of the letters B, P, R, b, p, q and a”, and *Swash*, as the fancy alternative in the italics of book types; Garamond and Caslon” (Tracy 2003: 13). Dalvi, on the other hand, speaks of Latin having a fairly standardized vocabulary to describe letterforms due to its long and elaborate printing tradition and the comments made on Arabic letter part being termed as shoulder, eye etc. as in the anatomy of Latin typography (Dalvi 2010: 140). Such similar terminology is found with the work of Kumar on Tamil (2010), Chandra *et al* on Bengali (2015) and Thai. This knowledge on the anatomy leads to the assumption and to a much larger question as to what constitutes the anatomy of the Sinhala letter, despite its long tradition of writing and transition to type.

However, the existing documentation on the Sinhala letter does not do justice to identify anatomical features, relevant to Sinhala typography. The reason for this is because Sinhala as a 'letterform', meaning its visual representation, is studied under subject areas (not relevant to typography), while Sinhala as a 'typeface' is rarely documented. The limitations of literature on the field of Sinhala typography affect several areas in typography, more specifically to type design. Therefore, we believe that there is a genuine need for an academically validated theoretical framework that would contribute to Sinhala typography.

Anatomy plays an important role in the practice and education of typography as the anatomy of type conveys fundamental knowledge to typographers, type designers and graphic designers. It also helps type designers to begin the process of type design and type users to select typefaces for the purpose of design. Anatomy consists of anatomical properties of letters, visual variations of typefaces, relevant script, and a vocabulary to define. In order to identify the anatomy of Sinhala, there should be clarity in the Sinhala letterforms, typefaces and a vocabulary. Therefore, building a theoretical framework on the Sinhala typography, will help define, articulate and expand the field of Sinhala typography. This thesis, with the help of experiments and surveys attempts to bring about such a discussion in the field of Sinhala typography.

1.1 Scope of Study

The main focus of this thesis is the anatomy of type. Yet we restrict it to the anatomical features of the letter, visual variations of typefaces and vocabulary. However, to determine the anatomy, the study focused only on body text, referring to typefaces that are used for the body of the text and, overlooks bold, italic and display typefaces etc. The sources that contain the body text are examined within a chronological timeline, starting from the inception of the Sinhala printing press till the current time (typefaces from 1737 CE to 2013 CE.). The chronological documentation helped to link the literature with the primary sources, making the observation of typefaces comprehensive.

However, the sources were from selected publications such as bibles, tracts and *plakkaat* (before the first Sinhala newspaper) and newspapers thereafter (from 1860-2013). Still, we must mention that source material that contains typefaces range from books, posters, administrative documents etc. Nevertheless, newspapers and selected publications were considered as the primary source because of its availability and, the systematic documentation at certain archival collections (Such as the Colombo National Museum Library, Department of National Archive and the National Library, Colombo).

1.2 Hypothesis

To achieve the epistemological knowledge on Sinhala typography, we believe that a theoretical framework on the Anatomy of Sinhala would help comprehend a formalized knowledge in Sinhala typography.

1.3 Aim of the Study

The aim of this study is to build epistemological knowledge-building activities for Sinhala typography through a theoretical framework. This framework is made up of a historical analysis on Sinhala typefaces and the morphological characteristics of the letters. The function of the framework is to comprehensively capture and define the distinct visual features of each Sinhala letter, the visual variation of typefaces and, thereafter, to use the findings to articulate the anatomy of Sinhala. As part of building the anatomy we investigated on the existing (limited and varying) terminology used to describe the visual features of the Sinhala letter. It was then compared with terminology used by other scripts of the world. The aim of doing this was to create a 'unified vocabulary for Sinhala typography.' With the development of the theoretical framework we were able to document the chronological development of Sinhala typefaces (based on meta-data). To validate this theoretical framework, the anatomical properties of Sinhala were used in an experiment to create the 'root letters' for Sinhala. And as a result, two sets of root letters for Sinhala were presented to initiate the type design process.

1.4 Research Questions

Based on the above factors, the specific research questions explored in this study are as follows:

1. What are the existing theories on Sinhala typography? What are the anatomical features that describe the Sinhala letter? what terminology is used to define these morphological features of the Sinhala letter?
2. Can we expand and build a theoretical framework that can present the various aspects of Sinhala anatomy?
3. What are the current systems in use that describes letter-parts, visual variations and terminology? can that be articulated as formal knowledge in type designing? If yes how can we validate it?

1.5 Methodology

The study is built on qualitative and quantitative research techniques to collect data on the appropriate attributes of Sinhala letterforms, and to synthesize the theoretical model. This is discussed in three parts.

Part 1: Defining the problem

Three main aspects are discussed through our literature survey. They are:

- (a) the inadequate knowledge on the visual description of Sinhala letterforms
- (b) lack of documentation on Sinhala typefaces and the inclusive type designing, and
- (c) the anatomy of other scripts that can influence Sinhala typography. All this is discussed and compiled across chapter 02, 03, 04 and 05.

To understand the first, we looked at Sinhala language and grouped the Sinhala letter according to its visual properties biased to Sinhala script. An experiment was conducted to capture how experts on the selected subjects, termed Sinhala letterforms to understand the existing terminology on the Sinhala letterforms. This is then cross-analyzed to understand the existing terminology used by experts and the existing literature on Sinhala letterforms, which provided insight on the informal practices, the availability of data that contribute to the Sinhala letterform (See Chapter 02).

In the second part of the literature survey, we looked at the chronological development of the Sinhala typefaces and understood the areas we could observe Sinhala typefaces. This is discussed against the technological changes the letterform goes through, and the practices in type design. With the existing literature and availability of print material we synthesized and grouped three printing phases to discuss in the latter part of the research (See Chapter 03, 05).

In the third part of the literature survey, we explain the rudiments of available literature biased to Sinhala typography, and we compiled them together and understood the possibilities of constituting an anatomy of the Sinhala compared with other scripts (See Chapter 04, 05).

Part 2: Identification of Anatomical features

We propose the development of a theoretical framework as a solution in response to the non-standardized knowledge on the Sinhala typography, more specific to anatomical properties.

To achieve this, a combined research method was developed. The research spiral method used for sociological research was amended to support the visual analysis, where each letter was examined within different contexts. The relevant context included each letter and tested upon the reference lines, letterform, and proposed grid. As a result, the identification of the distinct features of each Sinhala letter was listed. The terminology to describe the distinct features was achieved by using the expert interview method.

This was followed by a detailed visual analysis, conducted with a cluster analysis, together with the technique of stimulus cards for sorting. To understand the visual variation of typefaces, data was initially collected by photographing and scanning the primary sources which were available at the Colombo National Museum Library, Department of National Archives and the National Library, Colombo, Sri Lanka. The data was then prepared for visual analysis by compiling selected letters from the primary sources into stimulus cards for a qualitative cluster analysis.

Part 3: Testing of theory

The theoretical knowledge is tested as the third part of the research. It describes the implementation of the findings. The anatomical properties identified were used to identify the root letters for Sinhala type designing. This was conducted with a combination of a qualitative and a quantitative method. Two methods were used to test the concept of identifying a minimum set of letters with maximum properties. The first method tabularized the distinct features and categorized them by using two techniques; ranking data and descriptive data. The second method was based on a visual analysis by reconstructing the letters on the proposed grid. The competency of both methods was tested quantitatively to identify the minimum letters that have the maximum letter properties. It was tested on the maximum letter range and the maximum property range the letters can generate. Results of both methods convey similar results against two different approaches.

1.6 Organization of Chapters

The thesis is organized into seven chapters, which include the introduction and the conclusion. The introductory chapter outlines the knowledge gaps in Sinhala typography in comparison with the more formalized knowledge on Latin typography. It proposes the theoretical framework on the anatomy of Sinhala and presents the aims and objectives of the research. The chapter states the situation of the Sinhala letterform, the research problem and methodology adopted.

Chapter two examines on how Sinhala script and letterform have evolved as a visual representation; this was conducted as a background study on the Sinhala script and the letterform. The chapter is divided into three sections. The first section looks at the history of Sinhala language, Sinhala script, and speaks of the mediums it was written on. The Second section looks at the letterforms as a representation of sound in language. It discusses the visual representational forms; alphabets, letter parts and how letters are formed as a combination of vowels, consonants, vowel signs and non-alphabetical signs. The third section looks at the Sinhala letterform and explores the existing terminology used to describe these letter parts. This was

done as a survey to identify existing nomenclature of Sinhala letterforms that contribute to type design.

Chapter three gives a historic overview of Sinhala typeface. It examines on how Sinhala type had evolved across a chronological timeline. This is discussed under three sections. First section discusses the introduction of the press to the country and the first type designer. The second section is a visual survey on how the Sinhala letterform converts into a typeface and how the first type designer understood the letterform. The execution process of the survey explains the limitations of existing literature on Sinhala letterforms. The third section discusses the chronological development of the Sinhala typefaces and the growth of type within the country, from a socio-political viewpoint. Then, it discusses the technological changes the Sinhala type goes through, that resulted in the growth of typefaces and the current status. It explains the type design process to be confined, abrupt, and that there is a need for a standardized system to define Sinhala type.

At the end of the literature study in both chapters - two and three, the knowledge gap – the inadequacy of literature on the Sinhala letterform was established. Chapters four and five examine the letterform and typefaces that contribute towards building the anatomy of the Sinhala type.

With the observation of *Sinhala letterforms and the background on Sinhala typefaces* we start the Chapter four with a discussion of the anatomy of type of other scripts. The determining visual properties of the Sinhala letter that contributes towards building the anatomy is discussed here. The second part of the chapter is a pilot visual survey to identify the visual properties of Sinhala letterforms through a syntagmatic analysis. As an outcome of the pilot survey, suggestions were noted down to build a new research method. The new method observes each Sinhala letter using the research spiral method. Each letter was examined through a repetitive spiral and tested on three contexts. Within each spiral, the letters go through a cycle of diagnosing, planning, taking action and evaluating. As a result, a list of distinct

visual properties of each letter was identified. The visual properties were detailed out and examples of letters that have similar features were also presented.

Chapter Five defines the identified visual properties and proposes a common vocabulary to facilitate the suggested anatomy of Sinhala. This is discussed on the terminology determined by an expert interview, and non-expert interview, together with terms used by other scripts. The second part of the chapter is a survey on the existing Sinhala typefaces from the inception of the printing press. It discusses the meta-data of the selected typefaces. The third part of the chapter is a visual survey on the visual variations of the Sinhala typefaces, as a contribution towards the theoretical framework on the Sinhala Anatomy.

Chapter Six discloses the influence of the anatomical features towards Sinhala typographic knowledge and validates the knowledge. Therefore, the chapter uses the identified Sinhala letter properties to identify the root letters for the Sinhala type design process. It was tested on the concept of identifying a minimum set of letters that have the maximum properties. This chapter concluded with the perceived advantages of knowing the anatomy of Sinhala within Sinhala typography. Chapter Seven presents an overview of the study and summarizes the conclusion. It also outlines the contribution of the present research and discusses future areas of research.

1.7 Defining Key Terms within the Thesis

Letter-parts: Separate parts that complete the Sinhala letter such as vowel signs, Non-alphabetical signs and Combined Consonants.

Letterform: Is referred to as the structure, or form of the letter relevant to the script. This is specified as the Sinhala letter before the introduction of the press.

Non-alphabetical : Writing compositions of consonants that are not included in the Sinhala alphabet, but are commonly used in practice. Such as *Yanshaya, Repaya and Rakaranshaya.*

Plakkaaten: Is a Dutch term to describe placards. Placards are notices hung at public spaces, to convey messages, rules and regulations imparted to the public by the administration. (Dutch: singular: *plakkaat*)

Scripts : Is used to describe letterforms of (other) language.

Type: Is regarded as the metal body that hold the relief of a letterform.

Typeface/s: Is the face of the letter, either on a piece of metal, negative of a film or a set of digital codes in a computer, it is also used to describe the font/s.

Visual property: include the letter property and the typeface visual property that together makes them as part of the anatomy of type.

Visual variations: Minute visual features of typefaces, that are unique to the specified typeface/ font.

Root letters: A set of selected letters that contain common visual properties among other letters.

ORIGIN OF THE SINHALA LETTERFORM

This chapter deals with the inception of Sinhala letters and how the letter as a visual form and representation of sound in language contribute to knowledge of Sinhala typography. This is discussed under three sections. The first, documents how the Sinhala letter was written on different mediums (surface, tools etc.) before the introduction of the printing press. The second discusses how the letter as a symbol represents sound in Sinhala language. It is examined in relation to current letterforms to understand how Sinhala letters are constructed (as letter-parts) in written Sinhala. The third part, reviews the letter-parts through a ligature survey on the existing terminology and how the terms had derived. The chapter is concluded by identifying the knowledge gaps in Sinhala letter-parts and limitations in terminology that are needed to develop the anatomy of the Sinhala script.

2.1 Introduction to the Sinhala Script

The term ‘Sinhala’ is used to describe the majority race of people known as the Sinhalese living in Sri Lanka, as well as the script that is used to write the language spoken by them. This term derives from several etymological aspects and, the commonly accepted interpretation is the direct translation of the two words; *Sinha* (lion) and *la* (slayer) and together means Sinhala (people of the lion slayer), referring to the mythological evolution of the Sinhalese people as descendants of a lion (Balagalle 2014:11, Gunasekera 1891:1). Another interpretation leads to the *Siv* and *hela*, meaning *siv* (four) and *hela* (inhabitation); which depicts the four tribes (*Raksha, Yaksha, Deva, Naga*) that existed in the Island before the arrival of the Northern Indian settlers. The Islanders were called Sinhala and their descendents, the modern Sinhalese, are referred to by the same appellation. The word Sinhala originates from Sanskrit and is interpreted in Pali as *Sinhala* and *Helu* or *Elu* in Sinhala itself (Disanayake 2012: 287).

The Sinhala script is the systematic symbolic representation of the Sinhala language widely spoken by the Sinhalese people of Sri Lanka. The geographical

positioning of the Island of Sri Lanka had brought numerous invasions by people of different ethnicities as early as around the 6th century BCE.

Vijaya, a decedent from the city of Vanga, located in northern India is regarded as the first king known in history, to have established a united Sri Lanka. It is believed that the language spoken by these first north Indian settlers was one of the Middle Indo-Aryan dialects of India known as Prakrit (Masica 1991:45). The chronicles of Sri Lanka the *Dipavansa* and the *Mahavansa* prove the existence of writing and communicating with letters from Sri Lanka to India, was in practice during the time of the early north Indian arrivals. The earliest archeological evidence of the prevailing script in the Island belongs to the period of the 3rd century BCE (Fernando 2008:12) and the script used, is a variation of the script that prevailed in India known as Brahmi. Scholarly chronological divisions of the Sinhala language by Geiger and Balagalle affirm the Sinhala Prakrit stage as 3rd century BCE– 4/5th century CE, as the characters illustrate an evolution from the Brahmi script.

It is by the 6th century CE that the Prakrit characteristics of the original Sinhala language started disappearing and began to show “Proto-Sinhalese” characteristics in both language and script (Gunasekera 1999:95). Geiger and Jayathilaka confirm this fact:

“for this period is of the greatest importance for the history of Sinhalese language, in as much as those centuries just cover the period where it underwent the most characteristics changes, both phonological and morphological, and developed from the Prakritic stage to that of a modern India idiom.” (Geiger, Jayathilaka 1937: 27)

2.1.1 Development of the Sinhala Alphabet

The core set of characters that represent all native phonemes of the Sinhala Prakrit stage is found in the *Suddha Sinhala hodiya* (pure Sinhala alphabet) or *elu hodiya* (Elu alphabet) which consists of 32 characters. Prose literature and religious texts in both Sanskrit and Pali consisted of an extended set of characters that were added between the 8th century CE to the 13th century CE, known as the Medieval Sinhala period

(Balalgalle 2010:62). The extended set is known as the *misra Sinhala hodiya* (mixed Sinhala alphabet) of fifty-four characters.

In the prose literature works and in inscriptions from around the 8th century CE, the use of the *misra Sinhala hodiya* is evident, but the verse literature was written using the *Sidath Sangarava hodiya* during the 13th century CE. The *Sidath Sangarava* was written with 30 characters of the *Suddha Sinhala hodiya* (pure Sinhala alphabet) with the exclusion of two characters æ (අඞ) and ǣ(අඞ̄), and with this we find the establishment of the *Sidath Sangara hodiya*.

Sinhala script reaches its current appearance by around the 14th century CE (Fernando 2008: 90) and the current Sinhala alphabet consists of sixty characters with the addition of pre-nasal sound characters and the letter ‘f’ (ඞ). The National Education Institute officially recognized this in 1989 (Disanayaks 2012: 548). The development of the number of characters according to the chronological divisions of the Sinhala language time periods (Balalgalle 2010:62) is described in annexure 01.

2.2 Inspection of the Sinhala Letterform and Written Mediums

It is popularly assumed that the writing tradition was introduced to the Island with the arrival of Arahant Mahinda on the mission to introduce Buddhism to the Island during the 3rd century BCE. Since it was the Indian Emperor Asoka’s governing tradition to issue mass scale proclamations on the teachings of Buddha, similar proclamations and practices were evident within Sri Lanka. Vijaya, who is believed to have arrived in the Island around the 6th century BCE, writes to King *Pandya* of South India to take his daughter’s hand in marriage. This demonstrates the practice of writing within the island followed by several historical and legendary evidence described in the chronicles of Sri Lanka; the *Dipavansa* and the *Mahavansa* before the 3rd century BCE. Fernando further contributes to this thought by assigning the existence of a writing tradition to be not earlier than the 3rd century BCE, and states that among the earliest immigrants were Brahmins, who brought with them, ‘knowledge of all the branches of learning’ which they had acquired in India (Fernando 2008: 02). Deraniyagala’s findings on the excavations at the citadel of

Anuradhapura, documents writings on potsherds found in the island, and dates back to around 6th -5th century BCE (Deraniyagala 1991:745).

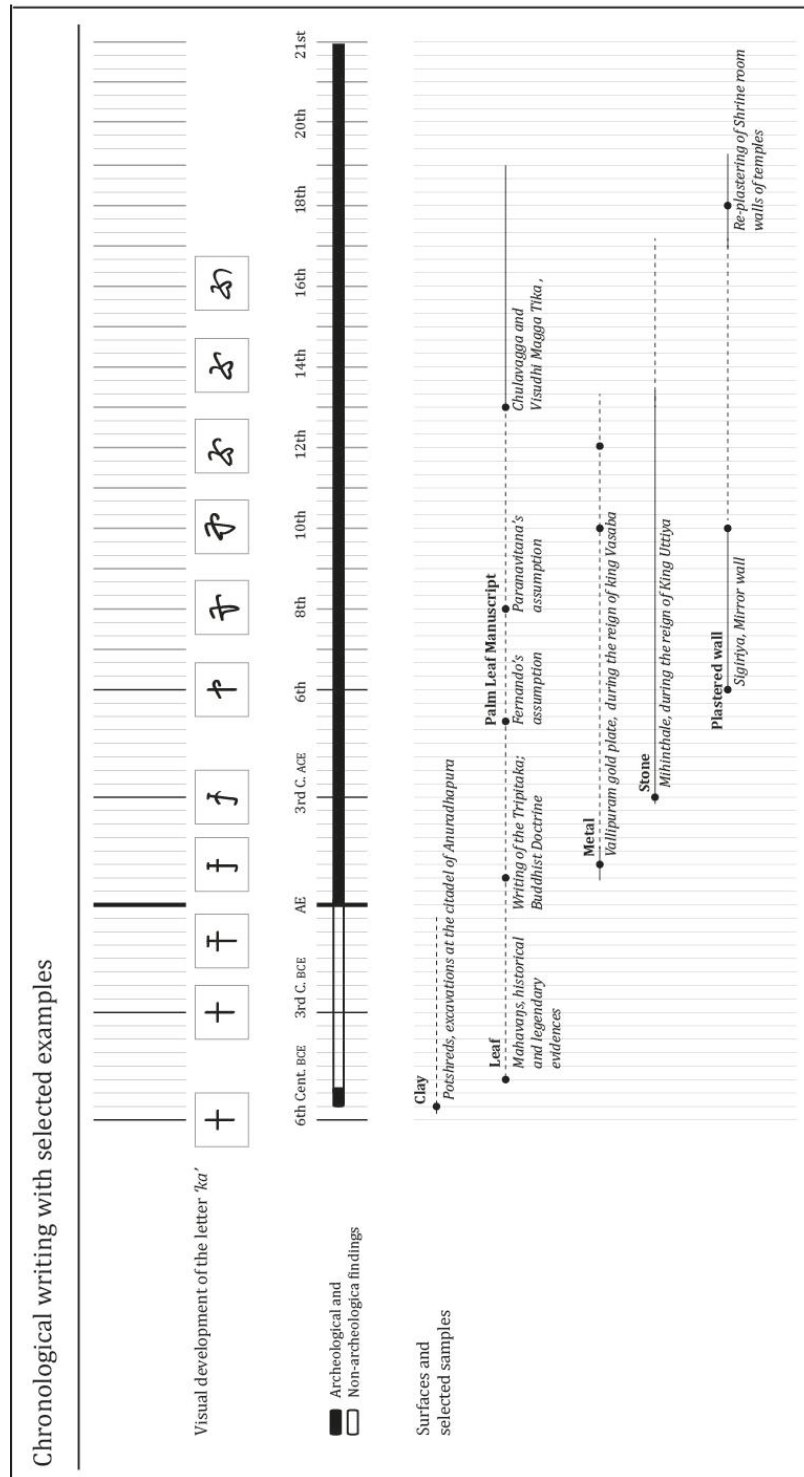


Table 2.1: Use of surfaces in Sinhala writings, with selected examples

The 3rd century BCE markings can be described as Brahmi script adopted in Sri Lanka. When compared with a parallel timeline - Brahmi script used in inscriptions of the Asokan Empire in India and Brahmi script employed in Sri Lanka, it shows character variation of the vowel *i*, consonant *ma*, to name but a few (Fernando 2008: 04). This explains its long practice of writing. Thereafter, we find the letters inscribed on different writing media within the island before it reached its current form. The surfaces are discussed here, to understand how the letter was written; it is explained with selected samples in Table 2.1 to understand the surfaces and tools used in writing. First, the lithic surfaces, second, the other surfaces; such as the mirror wall and metal *sannas*.

2.2.1 Lithic Surfaces

Among the earliest writings, lithic surfaces document an unbroken chain of records from the 3rd century BCE, starting with cave inscriptions, followed by pillar, slab and other hard surfaces simultaneously.

Cave inscriptions - Handing over of caves to the Buddhist missionaries was inscribed above drip ledges of caves informing the public on details of the incumbent, presenter of the cave etc. As the majority of the cave inscriptions are beyond human reach, it can be assumed that inscribing was done by hanging from the top of the cave or with the provision of assistance from the ground level. Nevertheless the tools used to mark these static giant surfaces would be a sharp tool such as a chisel and a hammer to enforce pressure. Rajan (cited in Kumar, 2010) in reference to Tamil stone inscriptions explains having:

“three stages and three different people to execute them namely *composer* (text provider), *scriber* (one who writes on the stone) and *the engraver* (one who scribes on the stone). Before inscribing, the stone is first dressed (made into a flat surface) by chiseling and polished by rubbing. The content is then written with ink or paint with brush. Once the text is written, a scribe engraves the drawn text with a pointed chisel. (p. 08-09).

S. Rajagopalan and Rajan further state the use of a draft text written on palm leaf manuscript before engraving Tamil text (cited in Kumar, 2010), while another view was the use of a stencil in copper (Fonseka 2007: 67-78). Nevertheless, the

inscriptions on caves are usually read from left to right, with the exception of some letters horizontally or vertically flipped due to the ignorance of the engraver. The oldest documented cave inscription during the reign of King Uttiya (1st century BCE) is found in *Mihinthale*.

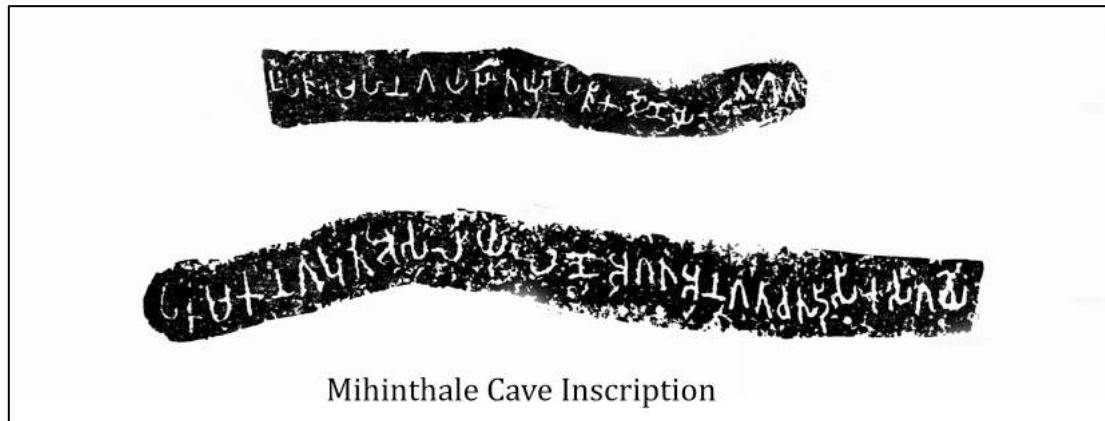


Figure 2.1 Writings on Cave Drip Ledges

Source: Fernando, P. E. E., (2015)

Pillar inscriptions and Slab- inscriptions - can be considered as rock surfaces that are also prepared by chiseling and polishing as cave inscriptions. The difference would be its surface, with a pillar having a four-sided surface, tall in height, small in width and breath, while the slab surface contains a single face with a larger width and breath and shorter height. The surface space is usually larger in slab inscriptions compared to pillar inscriptions.

By around the 9th century BCE several pillar edicts are recorded. Termed as *attani kanu* (අත්තනි කණු), literally meaning; immunity pillars. This implies that the decree inscribed on the four faces of the pillar was intended to be a Royal Proclamation (Suraweera 2008:21).The compositions of the pillars are written from left to right and from top to bottom. It is read from one side after another, and the surface is made of solid rock sliced into pillar shape. The letter proportions are fairly large but smaller than cave inscribed letters. The groove of the letter on the surface is less deep and the breadth is smaller, indicating a smaller chisel width. The letters are composed according to the space available on the pillar with no uniform letter or

word spacing. In some cases, there are illustrations of snakes, crows and dogs, which record certain warnings, threats and curses for those violating the regulations, to be born as a dog and crow etc.



Dedigama Pillar Inscription



Kottange Slab Inscription

Figure 2.2 Writings on Pillar and Slab Inscription

Source: Fernando, P. E. E., (2015)

Slab inscriptions state the code of conduct for the Buddhist clergy; they do not carry signatures of Royal officers unlike the others. Yet the king uses these stone surfaces for political advantage by showing his subjects that he was a ruler working for the welfare of the *Sangha*(clergy) and the *Buddha sasana* (Buddhist ministry). King Parakrama Bahu during the 11th century CE selects the most impressive sloping rock surface to communicate this. H.C.P Bell states:

“...the most impressive antiquity, par excellence to be seen in the Island of Ceylon, and possibly not rivaled throughout the continent of India’(Suraweera 2008: 43).

We also find the largest number of epigraphic records edited by one ruler in the history of Sri Lanka during the reign of King Nissañkamalla (12th century CE). He showed novelty, creativity and verbosity, with records of epigraphy extending beyond 72 lines and over 4300 letters, perhaps the longest ever established in Sri Lanka (Suraweera 2008:47). Suraweera explains the composition of this work as:

“The upper surface of the slab have been smoothed and divided into three sections representing a palm leaf book with two wholes at the center points. Both sides of the stone are decorated with bands of swans and at the middle of each side is placed a figure of Goddess Lakshmi upon which a pair of elephants pouring water with a pot.”(2008:47)

Studying the surfaces and the tools compared with the evolutionary chart of the Sinhala script is a separate task, but it is discussed here in order to indicate that the form and the shape of the letter had gone through several surfaces. The chisel as a tool goes through different surfaces of stone and rock from the roughest, hardest to the smoothest. According to the scale of the letters, width and depth of the grooves, show the use of a variety of chisels and tools. Starting with the smoothing of the surface, writing, scraping of mistakes etc. had influenced the script on lithic surfaces.

2.2.2 Other surfaces

Other surfaces documented here are metal, cloth and wall (lime stone).

Metal surfaces range from copper, silver and gold. The structures of these metal inscriptions are usually smaller than lithic surfaces due to its easy portable and physical properties. In most cases, the layout of the metal takes the shape of a palm

leaf manuscript. The metal surfaces are usually found as flat sheets, the terms 'leaf' and 'plate' are used to describe them. In most cases the letters are found carved and some embossed with the use of a sharp tool similar to a metal stylus. The earliest record of metal surface: gold plates are recorded from *Vallipuram* during the reign of King *Vasaba* (1st century CE). Even though there are records of copper and silver plates, physical evidence of copper is found only around the 10th century CE at *Panakaduwa*. The most recent excavations in Anuradhapura portray work on gold plates, each 25in long, and 2.3in broad and around 5cm in thickness, which is larger than an *ola* leaf. By observing the script on these gold leaves, scholars date it back to around the 10th century CE (Jayasuriya 1987:3).

Cloth has the least amount of records as the writing surface; the treatment of this surface could have been similar to the practices in India. Kumar states that the surface was prepared by sizing with wheat or rice pulp, then dried and polished with conch-shell (Kumar 2010:11). Suraweera describes the use of cotton and silk as the base material and gives records of the plan of the *Lovamahapaya* being illustrated during the reign of King Dutugamunu and a few examples on the chronicles of Sri Lanka (2011:38); the tool with which it was written would have been a brush or charcoal.

Plastered wall – The oldest form of such surface are found between the 6th -10th century CE on the mirror wall in Sigiriya. The wall was coated outside and inside with lime plaster, and was so highly polished that even today one sees one's reflection, which explains its name. The surface is believed to have been used by sightseers for the purpose of a visitor's book. The script on the wall also termed as 'Graffiti', is inscribed by *ulkatuwa* (metal style), in ordinary manuscript size (Paranavitana 1983:09). Suraweera cites Paranavitana on the use of a red ink for the drafting purpose and then carving out the letters using sharp pointed objects. The script used on this wall shows a more cursive form, while the scale of the letters is very small, sometimes smaller than the standard *ola* leaf manuscript letter.

By around the 18th century CE, we come across the refurbishing and re-plastering of temples and its shrine rooms during the reign of King Rajadirajasinghe. The shrine room walls are beautifully painted with *Jathaka* Stories for public viewing; in some cases, there is script written on white with black ink, the writings are usually written in a box within the mural strip or at the bottom of the strip. The letters were drafted using charcoal and painted on top with the use of a brush.

Summary of the Lithic and other mediums used to document letter form

To understand this chronological development of the Sinhala letter form, work of scholars on the subject of epigraphy, H.C.P. Bell, P.E.E. Fernando, S. Paranavitana and D.M. de Zilva, had contributed by documenting the visual representation of the Sinhala letter through an evolutionary chart. This is documented at the Department of Archeology, Sri Lanka, and was based on these archeologists' and epigraphers' findings on lithic, metal and wall inscriptions. The chronological chart is the only source that depicts the transformation of script from ancient to present. This chart does not discuss beyond the 15th century CE, therefore, there is no systematic (chronological) documentation of the Sinhala letter form after this time period. We find some evidence of the use of palm leaf writing that go hand in hand within this time line, and after the 15th century CE. Nevertheless, the next section discusses palm leaf manuscripts in order to know the transition of the Sinhala letter form, followed by the way it changed from a ridged form to circular form.

Media and tools of Sinhala writing				
	Media	Surface	Surface layout	Tool
Lithic		Cave	Static large surfaces	Chisel
		Pillar	Four-sided surface, tall in height, small in width and breath	
		Slab	A single face with a larger width and breath and shorter height	
Other	Clay	Potsherds	Earthenware	Bone
	Cloth	Silk Cotton	–	Brush
	Metal	Gold/ Silver/ Copper	Flat portable surface, composed as plates and leaves	Metal stylus
	Leaf	Palm leaf	Treated palm leaves, composed into a book of multiple leaves.	
other leaf		–	–	–

Table 2.2: Media, Surface, Tools of Writing

2.2.3 Palm leaf manuscript writing and Sinhala Numeration

While writings on the surface of a leaf were practiced as early as the 5th century BCE, yet we find physical evidence only in the 13th century CE due to the decaying nature of the surface. The evolutionary chart of the Sinhala script, prepared by the Department of Archeology, Sri Lanka, concludes by the 15th century CE, because the sources contribute to epigraphic studies and archeological evidence (lithic, metal and the graffiti of the *Sigiriya* mirror wall). Therefore, we find a gap from then to now, on the transformation of the Sinhala letter, especially on the palm-leaf manuscripts of Ceylon.

Palm leaf manuscript

The earliest physical evidence of a palm leaf manuscript is found at the Colombo National Museum: the *Chulavagga* and *Visudhimagga Tika* at the Library of the University of Peradeniya, Sri Lanka. These manuscripts are also termed as *Ola-leaf*

manuscripts with its Tamil derivation. '*Puskola Potha*' conveys the Sanskrit meaning '*Pustaka*' meaning book. Gunawardana discusses the significance of palm leaf manuscripts from its calligraphic art and paleographic point of view (1997: 07). She elaborates on the content ranging from Buddhism, Sanskrit literature, social practices, herbal medicine, cookbooks, music, sculpture and architecture, folk beliefs etc.

Preparation of the manuscript surface: The surface on which these contents are written comes from a young Talipot palm tree with unopened leaf buds. Another type of surface is the Palmyra tree, although it is not used for the purpose of writing important books. The leaf bud of the Talipot tree is ten to twenty feet in length and contains eighty to a hundred leaflets. "the leaf blades which fold on either side of a rib in each leaflet are smooth; strong and of a cream colour...the material aimed at is one that is light in weight, even in colour, strong in texture and durable in quality" (De Silva 1938 : xiii). The preparation process of the surface starts off with the selection of the tree that shows signs of a leaf bud about to open. This then is cut, slit open into separate individual strips with removed midribs. Then, the loose leaves are individually rolled, boiled, dried under the moonlight; followed by the smoothing and the finishing process. Smoothing is usually done by applying a weight on one side and pulled from the other on a cylinder of wood (usually a trunk of an areca palm). The prepared leaves are cut into the desired length and compiled with the relevant number of leaves. Thereafter, it is punched with two holes and two pegs are passed through each hole towards the wooden boards (covers) on either side. The bundle of leaves are pressed tightly and burned at the ends of the leaves to remove the imperfections and give uniform length and width. The burning process preserves the leaves from dampness and moulds (De Silva 1938 : xiii-x). Following are a few defined rules observed in composing palm-leaf manuscripts:

- The distance at which the holes are punched in each leaf
- Uniformity of the size of the letter that is written
- Pagination pattern
- Correction of manuscript – *daru pela*– child line
- Omitting of word, passages with double brackets

The tool with which the writing is done is called a stylus. It is a metal point that is sharpened when the need arises with an oiled stone. The stylus is made of gold, silver, copper or brass. A skilled scribe uniformly places the letters on the leaf and applies an ointment of black charcoal to reveal the inscribed letters. The average length of a book leaf ranges from 9" to 32", and a width range of 2" to 3 ¼". The usual size of the letter is seven to eight letters within an inch, and eight to ten lines for a page of 2" to 2 ½", although there is an exception of manuscripts that exceeds this size/dimensions. Lagamuwa explains the skill to write on palm leaves is a result of constant practice. The skilled scribe trains students by getting them to write and re-write on top of the '*Guru akura*' (teachers letters), written by him. This type of writing is usually a form of engraving (2006: 125).

The Sinhala letterforms in manuscripts: Lagamuwa continues on three decisive letter forms practiced in schools within the island. Letters that emphasize on the corners are described as '*mul akuru*' and they were found at Ruhuna. The second style of writings is more rounder, '*vata*' (round), found in the *Maya rata*, and this is termed as '*Sihakuru*'—lion shaped. The third style is '*Akandakar*' (oval shape) were used in the *Pihiti Rata*, and termed as *Gajakuru*—elephant shaped (Lagamuwa 2006:129). The three categories of schools are explained by De Silva as *Hansa-Swan*, being thin and narrow, second as *Sinha*—Lion, being oblong. The other style is *Gaja*—Elephant, they are full and round (De Silva 1938 : xiv). Although both authors neither show samples nor elaborate on the letter from a paleographic or a typographic view point, this knowledge contributes to what influenced the Sinhala letterform.

Sinhala Numeration: The bundles of leaves in palm-leaf manuscripts are systematically compiled. The first page is usually left blank and the subsequent page writes the auspicious word *Svasti* and, at the bottom starts the marking with the first consonant *ka* followed by the thirty-four consonants of the Sanskrit alphabet with 16 vowel combinations (Annexure 2) making a total of 544 marks. When the

manuscript is compiled with more than 544 leaves, it starts again with the *ka*(ක), with the word *dva* (second), if it goes to the third, the word *tri*(third) appears.

Wijayawardhana mentions four other forms of numeration in Sri Lanka as Sinhala numerals, *Lith Illukkam* (ephemeris numerals), *Katapayadia* and *Bhootha Anka* (2009: 24). The Sinhala numerals are a set of unique symbols that represent each numeral. This was spoken of by Gunasekera (1891:144) and De Silva misinterprets them as *Lith illakkam* (1938 : xvi), nevertheless the Sinhala numerals can be composed as Roman numerals after the numeral ten. *Lith Illukkam* on the other hand uses a specific Sinhala letter to represent each numeral and this system is used only in astrological tables and calculations. *Katapayadia* is a numbering scheme where numbers one to nine and zero are represented with Sinhala consonants, while *Bootha Anka* are represented with words (Wijayawardhana 2009: 41-43). Wijayawardhana discusses the proposal on Sinhala numerals by Mr. Michael Everson, to be included in the Universal character set of the Unicode Standards. He continues on several other South Indian languages that have their own numeral system, which indicates the importance of including the Sinhala numeral into this system. Since the glyph set relevant for typeface design contributes to the character set for Unicode, knowledge of the Sinhala numerals is an essential element that needs to be looked at under typographic education. Therefore, it was included here, even though this numeration scheme is not popularly practiced in the country and, scholarly knowledge in this area is rare.

Punctuation: The most evident form of punctuation mark is the *kundaiya*; serpent shape (De Silva 1938 : xiv), Kularatne terms this as the ear-drop due to its shape (2006:05), commonly found in palm-leaf manuscripts. This mark is used to indicate an ending of a paragraph. The following denotes the application of the multiple use of the *Kundaiya* for conclusion of sections and chapters. Double and triple denotes conclusion of a section, double of two or triple denotes conclusion of chapter.

Omitting of words or passages are denoted using double brackets known as *varahan*. While double commas described as *kakapada*(crows' feet) denote an end of

a sentence, it appears as double commas. And when words or sentences need to be repeated the *Peiyala* is used. Its visual form is constructed with two *Kundaliya*'s on either side of the consonant 'pa' (ප) (Kularatne 2006: 05).

Since the research is towards learning how the Sinhala letterform is documented, so as to learn from its history and summarizing the above, by discussing the earliest visual transformation of the Sinhala letter.

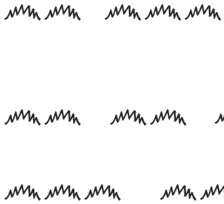



Use of Punctuations	
<u>Use of <i>Kundaliya</i> (Serpent shape)</u> Double and triple denotes conclusion of sections Double of two or triple denotes conclusion of chapter	
<u>Use of <i>kākapada</i> (Crows' feet)</u> Double comma denotes end of a sentence	
<u>Use of <i>Varahan</i></u> Omitting of words or passages	
<u>Use of <i>Peiyāla</i></u> Repeation of words or passages	

Table 2.3: Use of punctuation marks in palm leaf manuscripts

2.2.4 The Overall Transformation of Sinhala Letter form

The letters used to write Sinhala contains short vertical and horizontal strokes from around the 3rd century BCE to 7th century CE. And the cursive nature starts appearing thereafter, and becomes much fuller and round by the 10th century CE (Fernando 2008:62). It is mentioned that the visual form of the letter was influenced by the surface it was written on, and on the sociopolitical influence.

By observing figure 2.3 and the graphical development of the letter ‘ka’ within the chronological timeline, it is evident that the structure of the letter from its short, horizontal and vertical strokes changes its form into a more cursive form by around the 8th century CE. Paranavitana says that the main reason for this change is due to the influence of the surface and the tool used in writing. He explains this by mentioning the cursive nature of the shape of the letter due to the difficulty of writing vertical and horizontal lines on the palm-leaf. Paranavitana presents another reason; he speaks of the cursive nature of the Pallava script of South India and its influence on the Sinhala script (Paranavitana E.Z., Vol. iv, 115-118). While Fernando disagrees on the difficulty of writing vertical and horizontal strokes on the leaf, and dates the practice of palm-leaf manuscript writing to be around the 5th-6th century CE (Fernando 2008:48-51) (Suraweera 2011: 11) by referring to experts and literary sources. On the other hand, Subramanian (cited in Kumar 2010: 09) speaks on the writing of vertical strokes on the palm leaf taking a slightly curved form in writing Tamil letters. Nevertheless, the most influential visual change to the current (cursive) form is seen after the Pallava invasion, and the current appearance of the Sinhala script reached by around the 14th Century CE (Fernando 2008: 90).

We conclude this section with the Frutiger statement on the influence of earlier scripts to understand the forms of today. He states “the use of wide variety of material and writing techniques had given a new appearance and style to letterforms over different periods (Frutiger, 1989:159).

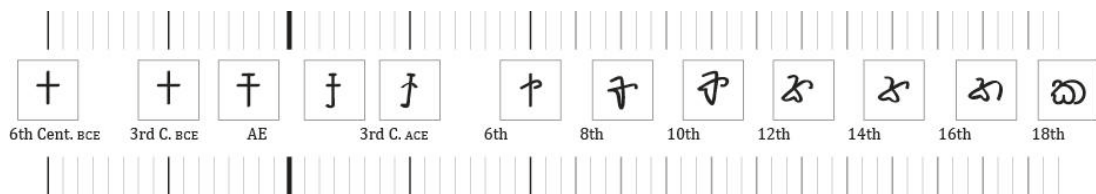


Figure 2.3 : Graphical development of the Sinhala letter: eg: letter *ka*

2.3 Sinhala; Phonetic Language and its Characters

Since the letterform based on epigraphic studies is limited to the 15th century, we look at another area where we find visual documentation of the Sinhala letter form. And this would be to observe visual representation of the Sinhala letter discussed under language studies, more specific to linguistics. This section is divided into two main sections; first to understand the phonetic application in the Sinhala language that influences the script; the second discusses the visual formation of the script to advance the study on typography.

2.3.1 Vowels and Consonants

Sinhala is read and written from left to write. The characters are curlicues with very rare straight lines and sit on a baseline. Sinhala is classified as an abugida as the consonant sounds are represented by phonemes and all have an inherent vowel a (අ). Each Sinhala character represents individual sound values according to the phonetic place of articulation and is called *Svara*(vowels) and *Vyanjana* (consonants). The vowel signs are used to alter the inherent a (අ) and assigned to their own vowel bearer.

Vowels

There is a total of thirteen vowel sounds in spoken Sinhala, but in writing, there are eighteen vowel characters. Each of these vowels except four (characters) syllabic variants is illustrated in the vowel diagram (figure 2.4). It is important to note that the open-mid unrounded æ (ඇ) short and long ǣ (ඈ) are commonly used vowels in Sinhala compared to other Indic scripts.

Each of these vowels is represented in its own form when placed at the beginning of a word, making it an *independent* or *initial* vowel. When the vowels appear as part of a consonant syllable, they are categorized as a *dependent* vowel. The *dependent* vowel sound is represented with a sign known as 'pilla' or 'pillama' in Sinhala (Disanayaka 2006:137) and is attached to a consonant to denote the vowel consonant combination. In current Sinhala writing, there are seventeen vowel signs illustrated in table 2.4.

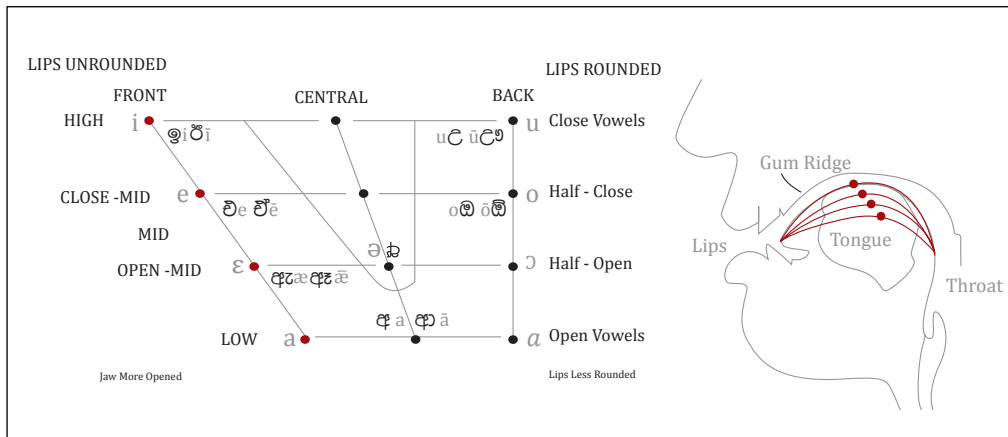


Figure 2.4: Vowel Diagram

Vowels (Swara)						
	Short		Long		Diphthongs	
	Independent	Dependent	Independent	Dependent	Independent	Dependent
Unrounded low central	अ ^a	अ	आ ^ā	आ		
Unrounded low front	अ ^{æ*}	अ	आ ^{ā*}	आ		
Unrounded high front	इ ⁱ	इ	ई ^ī	ई		
Rounded high back	उ ^{u*}	उ	ऊ ^{ū*}	ऊ		
Unrounded front	ए ^e	ए	ऐ ^{ē*}	ऐ	ए	ए
Rounded back	ओ ^o	ओ	औ ^ō	औ	ओ	ओ
Syllabic Variants	अ ^r	अ	आ ^{r̄}	आ		
	इ ^l	इ	ई ^{l̄}	ई		

Table 2 .4: List of vowels; *Independent and dependent (vowel signs)*

We find two or more visual forms of vowel signs to represent the vowel sounds æ (අෂ)*, æ(අෂ)*, u (උ)*, ū (උඹ)*, ē(ඒ)* due to the shape of the vowel bearer. It is important to note that, this is due to a gradual development of the vowel bearer over the Sinhala mediaeval period. This is demonstrated in figure 2.8 in the following section, to show why there is no uniformity of placement in vowel signs. This figure (2.8) includes the *hal sign orvirama* (sign for pure consonant) as it too works as a vowel sign when word clusters are formed. The *hal sign orvirama* is a special sign attached to the consonant that reduces the base consonant to a lone consonant to achieve its pure sound.

Special sign

The placement of the vowel signs of u (උ) and ū (උඹ) for the cerebral / (ඒ) is not the same as the other consonants. It is a different character that appears as /u(ඒ). The evolution of this character appears around the 12th century and is heavily used in Sinhala writing today. This character can be considered as a special sign as it is not included in the alphabet and is one of its kind.

It is evident that when similar shapes are in practice (during the development stage of the script) the scribe adapts new forms to identify each character and eventually this had taken the current shape of the letter. The visual development of /u (ඒ) is illustrated in figure 2.9.

Consonants

Sinhala script consists of 42 consonants and are grouped into six according to their place of articulation as gutturals, palatals, cerebrals, dentals, labial- dental and labials. The first four consonants within each group are divided into voiceless plosives and voiced plosives and further divided into pairs of unaspirated and aspirated. The last two consonants in each of these groups are nasals and half-nasals and are both voiced nasals.

Consonants									
Place of articulation	Voiceless		Voiced		Voiced nasals		Sibilants උෂ්ඨ	Voiced	
	Unaspirated අලිප්ප්ප්‍රාණ	Aspirated මහාප්‍රාණ	Unaspirated අලිප්ප්ප්‍රාණ	Aspirated මහාප්‍රාණ	Half-Nasals අර්ධානුභාසික	Nasals භාසිකය		Sonorants අර්ධ ස්වර අභ්‍යන්තර	Semi-Vowel
Gutturals කණ්ඨජ	Plosives ස්පර්ශ ශබ්ද						Fricatives ස්පර්ශ		
	කා (ක)	ඛා (ඛ)	ගා (ග)	ඝා (ඝ)	ඣ (ඣ)	චා (ච) / ො	ඞ (ඞ)	ඤ (ඤ)	ඞ (ඞ)
Palatals තාලුජ	චා (ච)	ඡා (ඡ)	ජා (ජ)	ඣඤ (ඣඤ)	ඤා (ඤ)	ඞා (ඞ)	ඞා (ඞ)	ඞා (ඞ)	-
Cerebrals මූර්ධජ	චා (ච)	ඡා (ඡ)	ජා (ජ)	ඣඤ (ඣඤ)	ඤා (ඤ)	ඞා (ඞ)	ඞා (ඞ)	ඞා (ඞ) / ඞා (ඞ)	-
Dental දන්තජ	චා (ච)	ඡා (ඡ)	ජා (ජ)	ඣඤ (ඣඤ)	ඤා (ඤ)	ඞා (ඞ)	ඞා (ඞ)	ඞා (ඞ)	ඞා (ඞ)
Labial-Dental දාන්තෝෂ්ඨජ	-	-	-	-	-	-	ඞා (ඞ)	ඞා (ඞ)	-
Labials මීෂ්ඨජ	චා (ච)	ඡා (ඡ)	ජා (ජ)	ඣඤ (ඣඤ)	ඤා (ඤ)	ඞා (ඞ)	-	-	ඞා (ඞ)

Table 2. 5: Consonant grouping

Pre-nasal known as *saññaka*

When a nasal character is placed before the third group of unaspirated pure consonant voiced plosives, a pre-nasal character is formed making it unique to Sinhala. These characters are known as *saññaka* (Balagalle 1983: 78) grouped as half-nasals. This combination is visually expressed in the character *mb*(ඞ) as it creates a new character with the combination of two consonants *m*(ම) and *b*(ඞ). Whereas the other four characters are formed with an additional curved stroke (shoulder/ *ura*) attached to the base consonant of the third group.

Voiced nasals	Voiced	Voiced nasals	Visual development
Nasals නාසිකාන්ධ	Unaspirated අලිප්පාණ	Half-Nasals අර්ධානුනාසික	
ඩී	+ ඉ	> ඞී	ඊ + ඉ > ඞී
ඞී	+ ඊ	> ඞී	ඊ + ඊ > ඞී
ඞී	+ ඩී	> ඞී	ඊ + ඩී > ඞී
ඞී	+ ඞී	> ඞී	ඊ + ඞී > ඞී
ඞී	+ ඞී	> ඞී	ඞී + ඞී > ඞී

Figure 2. 5: Formation of half-nasals; *saññaka*

Anusavara and Visarga

Anusavara is a nasal consonant. This is always found after a vowel denoting its meaning in Sanskrit. In Indic alphabets, it is represented with a dot on top of the preceding consonant whereas in Sinhala and other Indic languages, it is always pronounced with the help of the preceding vowel sound. In writing, it is placed after a vowel character or a vowel sign attached to the base consonant (Balagalle 1983: 51).

Whereas *Visargaya* represented with two circles, one on top of each other is found only in Sanskrit words, since the *visarga* is an unvoiced velar sound there is a voiced velar sound too. The sound h(ඞ) and the rest of the non-occlusive consonants (semi-vowels) complete the final two columns in the consonant grouping diagram as fricatives. Consonants y (ඃ), r(ඊ), l(ඞ), l(ඞ), v(ඞ) are voiced sonorants, while sh(ඞ), ṣ(ඞ), s(ඞ), f(ඞ), are grouped as sibilant fricatives (Table 02).

Incorporation of new characters

The sound *f* is included in the Sinhala vocabulary by the 15th century CE with the influence of the West. Prior to the official introduction of the character *f* (ආ) it was written with a lowercase *f* inside the letter *p* (ආ) as it was the only sound that accommodates the *f* sound. (Dissanayake 2012: 552). The absence of the character *f* (ආ) was identified in 1891 by A.M. Gunasekera, yet it was nearly a century later in 1989 that the National Education Institute officially recognized the new character. The visual form has been derived from the lower part of a Sanskrit labial-sibilant called *upadhmaniya* (Gunasekera 1891:28).

At present, there is an absence of the letter ‘*z*’ in Sinhala. With the use of this letter English words such as *Zoo*, *Zone*, *Zest* can be accommodated. This sound is currently represented with the letter *s* (ආ) and as a result we find visual forms of *s*(ආ) with a dot on top or inside in practice, also we find the letter *ya*(ආ) horizontal flipped. Nevertheless, the visual representation of the letter ‘*z*’ in Sinhala is yet to be officially accepted. Meanwhile Balagalle categorizes this sound to be a dental, voiced fricative (1983: 51).

2.3.2 Non-alphabetical consonant signs

This section discusses the practices of ‘writing compositions’ of consonants that are not included in the Sinhala alphabet, but are commonly used in practice. The signs are grouped into three categories for easy reference. The first category is the most commonly practiced three signs; *yanshaya*, *repaya* and *rakaranshaya*. The second category includes combined or conjunct consonants (*cc*) (*baddha akshara*), and the final group includes the ligatures (*sanyukthya akshara*). As a result of the Sinhala writing tradition, there are instances where two or more consonants are written together to form one unit (*sign*). Since the mentioned units do not fall as a Sinhala letter, they are termed as ‘non-alphabetical consonant signs’ by the author. The visual composition of these signs is identified as:

- two or more consonants placed adjacent to each other
- two or more half/ halves of consonants combined together
- half of a consonant combined to a half of a consonant
- an additional sign (*repaya* or a curved stroke termed as the shoulder; *ura*) combined to a consonant








Non-alphabetical consonant signs			
	Visual composition	Placement	Examples
Combined or conjunct consonants (cc) (<i>baddha akshara</i>)	Two or more consonants placed adjacent to each other		ඝඞ
Ligatures (<i>sanyukthya akshara</i>)	Half of a consonant combined to a half of a consonant	 	ඞඞ ද්
	Two or more half of consonants combined together	 	ඞඞ ද්
	An additional sign (repaya or shoulder; ura) combined to a consonant	 	ඞඞ ඞ

Figure 2.6: Visual composition of non-alphabetical consonant signs

The earliest instances of writing cc were practiced as one consonant below another (vertically combined) and later the practice of writing two or more consonants combining on the same plane (horizontally combined) becomes common. It is important to note that the consonant *ñ* (ඞ) and *Jh* (ඞ) appear as two half of consonants, yet they are not considered as ligatures but as part of the Sinhala alphabet.

a). *Yanshaya, Repaya and Rakaranshaya*

The *yanshaya* and *rakaranshaya* signs are visually composed as a ‘half of a consonant’ bearing its literal meaning *anshaya*– half. Since these two and the *repaya* are the only three signs that have their own nomenclature, it is grouped as the first category. Some scholars describe them as ‘consonant strokes’ (Dissanayake 2012:675). Gunasekera discussed them under combined conjuncts and ligatures (1999: 82) while Fernando separates them as ligatures and uses its original term to explain them(2008: 59).

In Sinhala and selected Indic Scripts, these signs are used to represent the preceding or the succeeding place of the said consonant. The semi-vowel y (ය) when placed after a consonant other than the character r (ර) is written with a sign called the *yanshaya* (ය්). Literal meaning is half of y (ය) changing its visual form into half of its size as it represents the consonant y (ය). Yet the vertical combination of *yanshaya* sign is still evident in some cases. The *repaya* sign represents the pure consonant r (ර) and when placed before a consonant this stroke is placed at the top of a letter. When a r (ර) is placed after a consonant, it is written with a *rakaranshaya* literal meaning half of r (ර) and represents this consonant.

Non-alphabetical consonant signs - nomenclature					
	Represented Consonant		Placement	Consonant sound	
Yanshaya	ය් y	ය් ය ය්	○ ය්	ක්‍ය් $k\text{-}ya$	ක්‍ය් kya
Raka:ra:nshaya	ර් r	ර් ර්	○ ර්	ක්‍ර් $k\text{-}ra$	ක්‍ර් kra
Re:phaya	ර් r	ර් ර්	○ ර්	ර්ක් $r\text{-}ka$	ර්ක් rka

Figure 2. 7: Placement of *yanshaya*, *repaya* and *rakaranshaya*

b). Combined or conjunct consonants (*baddha akshara*) and Ligatures (*sanyukthya akshara*)

In Sinhala the combined or conjunct consonants (cc), were initially used to reduce time and space in writing the *virama* or the *hal* sign. It is believed that these consonant signs came into being to reduce time and space in *ola* writing (Dissanayake 2012:674). Fernando illustrates the use of such characters in Sinhala language being ‘highly Sanskritized’ during 11th -13th centuries ((2008: 49) explaining the use of cc and ligatures in Sanskrit and other Indic scripts.

The visual composition of two or more consonants placed adjacent to each other is defined as combined or conjunct consonants (CC). A ligature is formed when two halves of consonants are combined together or a half of a consonant is combined

to another half of a consonant. Since the term cc and ligature are based on the visual composition of consonants, it is impossible to list out a complete list under each section except the first category *yanshaya*, *rephaya* and *rakaranshaya*. The visual compositions of these signs are further discussed in the following section.

2.3.3 Visual grouping on the parts of the Sinhala letter

The previous section illustrated that the Sinhala letter, through its long history had evolved into a systematic set of symbols to represent the Sinhala language. Taking these symbols as 'letters' or 'letterforms' in its plural form, contributes to the domain knowledge of typography.

LINGUISTIC GROUPING	VISUAL GROUPING	VISUAL FORM SAMPLES	
Vowels	Letter : Vowels	අ, ඇ, ටී, උ, ඔ, ඩී,	
	Medial Vowel signs	කා, කැ ටා, ටැ	
Consonants	Letter : Consonants	ක, ච, ජ, ඛ, ඣ, ඹ,	
	Non-alphabetical consonant signs	(ක+ඡ) කඡ	ඡඡ
		(ක+ඡ) කඡ	ඡඡ
		ඡ (ක+ච) චු	චු චච
		(ඡ+ච) ච	චී චච
Other Special signs	කච්චර	චචචච	

Table 2.6: Visual grouping on the parts of the Sinhala letter

In linguistic studies, there are two types of sounds; vowels and consonants, and the two sounds are given a visual approach in typographic studies. Therefore,

the present study divides the vowels and consonants as the focal visual form and, groups, all of the other graphical elements (Table 2.6) as non-alphabetical signs and other special signs. This observation and grouping help to identify the parts that make the Sinhala letter and the initial set of glyphs appropriate for typeface designing.






Visual representation of vowels, vowel signs and consonants







At a glance, there are two visual compositions that can be observed within the 18 vowels and the vowels signs it represents. The composition of certain vowels, bears an additional visual form that appears as a vowel sign. These vowel signs are not always the sign that represent the vowel sound as in the vowel ā but take the appearance of a letterform. The second feature is that there are selected vowels that have two or more vowels signs depending on the vowel bearer (consonant), whereas the consonants are unique by themselves.

Taking all of this into consideration, one can accelerate the process of typeface designing by identifying letters that have similar features. Therefore, by omitting repetitive letters that have similar features, one can cluster sets of characters that contribute to the Sinhala typeface design process. Table 2.7, proposes three clusters of vowels, vowel signs and consonants that are exclusive of repetition. A total number of eight vowels, eighteen vowel signs and forty consonants are presented in table 2.7.

Visual representation of non-alphabetical consonant signs

This category elaborates on combined or conjunct consonant(s) and ligatures, which are visually divided in to four divisions as explained in table 2.6. It is important to know that the visual composition depends on the composer, the scribe, writer, type designer etc. Nevertheless, for type design education, it is important to know the structure of the consonants when composed as halves- ligature rather than conjunct consonant that are only composed when two or more consonants are placed adjacent to each other.

Table 2.8 explains how the visual combination of pure consonants and other consonants express the consonant sound either as a cc or a ligature. The consonant *ya*() and the pure consonant *ra*() stand out among the non-alphabetical consonants due to its nomenclature. *Rakaranshya* is placed when the *hal ra*() is written after a consonant. This is visualized with the bottom half of the *ra*() attached to the bottom right of a consonant. *Yanshaya* is also similar to the *rakaranshya* but the half of the *y*() is a horizontal split.

The *yanshaya* is composed in three ways; adjacent to another consonant, at the bottom of the consonant *da*, and attached to another half of a consonant. The *repaya* is always placed on top of consonants while the *rakaranshaya* is composed at the bottom, and the pure consonant *da* takes a half form when *rakaranshaya* is attached. The descending nature of the letter *da* shows a larger variation of compositions at the bottom half of the letter and yet, when combined with selected ascenders, an additional sign (*repaya* or a curved stroke termed as the shoulder; *ura*) is combined to the preceding consonant. Another exceptional composition is the combination of *ja*() and *nja* () that makes the ligature 'जे'. While selected consonants that are composed within the base height show variations due to its form, consonants such as *ka*() , *na*() , *tha*() , *ga*() , are a few examples that has this visual provision to attach another consonant.

A ligature is defined as “two or more characters joined as a single unit. Ligatures are a typographic refinement that compensates for certain letters that set

poorly when combined” (Craig 2006:14). Bringhurst elaborates this with examples of Latin Script *f*, and how certain combinations were added to early European fonts to add a touch of refinement (2012:50). Since one cannot list out the combined or conjunct consonants and ligatures in the Sinhala Script, it is essential for a type designer to know the principle of how consonants are combined and, what accommodates such combinations within the Sinhala Script.

Non-alphabetical consonant signs - combinations					
Conjunct Combination		Conjunct Consonant	Ligatures	Placement	
ය	ක් + ය	කය	ක + ය = කය		<i>yaṅshaya</i>
ඊ	ඊ + ක	ඊක	ඊ + ක = ඊක		<i>re:phaya</i>
ර	ක් + ර	කර	ක + ර = කර		<i>raka:ra:ṅshaya</i>
ඳී	ඳී + ය	ඳය <i>d-ya</i>	ඳී + ය = ඳීය or ඳිය <i>d-ya</i>		<i>yaṅshaya</i>
			ඳී + ය = ඳිය		
	ඳී + ර	ඳර <i>d-ra</i>	ඳී + ර = ඳීර <i>d-ra</i>		<i>raka:ra:ṅshaya</i>
			ඳී + ර = ඳීර		
ඳී + ධ	ඳධ				
ඳී + වී	ඳවී				
Selected ascenders (S.Asc.)	වී + ධ	වධ			S.Asc. + ධ = වධ
	ඤ්ඤී + ව	ඤ්ඤව	S.Asc. + ව = ඤ්ඤව		
ඒ	ඒ + ඤ්ඤ	ඒඤ්ඤ	ඒ + ඤ්ඤ = ඒඤ්ඤ		
Selected base (S.Base) cc	ක් + ෂ	කෂ	S.Base + S.Base = කෂ		
	ග් + ධ	ගධ	S.Base + S.Asc = ගධ		
	න් + න	නන	S.Base + S.Base = නන		
	න් + ව	නව	S.Base + S.Asc = නව		
	න් + ඳ	නඳ	S.Base + S.Des = නඳ		
Other combinations	න් + ඳී + ය	න්ඳය	S.Base + S.Base = න්ඳය		<i>yaṅshaya</i>
	න් + ඳී + ර	න්ඳර	S.Base + S.Base = න්ඳර		<i>raka:ra:ṅshaya</i>
	ඊ + ඳී + ය	—	S.Base + S.Base = ඊඳී		<i>re:phaya</i>

Table2. 8: Visual grouping of non-alphabetical consonant signs

2.4 Vocabulary to define Sinhala letter parts

This section examines the visual grouping of the parts of the Sinhala letter discussed in the previous section, as the theory and literature on this area is rare. It is conducted through a literature survey and a cross-examination on the works of three experts on epigraphy, language and standardization of language. It is focused on the vocabulary used to describe the vowel signs, non-alphabetical signs and other special signs (according to the visual grouping discussed above in Table 2.6). The visual grouping contributes to the knowledge on the features of the Sinhala letter and its identification of the morphological characteristics that form the anatomy of the Sinhala letter.

Among several experts on the subject of epigraphy and language studies, the most comprehensive authors were selected to cross examine with the third expert - the board of writers to the National Education Commission (NEC) on the standardization of the proportions of the Sinhala letter, and the board of writers to the Ministry of National Language and Social Integration (MNLSI) on the application of 'pili' (s.pilla) to the Sinhala letter. An earlier version of this analysis was published by the author as (Samarawickrama, Anatomy of the Sinhala letter, 2015)

2.4.1 Selection of experts and objectives

Epigraphic and paleographic research by pioneer authors H.C.P. Bell, P.E.E. Fernando, S. Paranvitana and, D M. de Zilva Wickremasinghe was examined and Fernando was selected as the expert to represent the category of epigraphy. He illustrates each letter and its visual development, while the other authors speak of the letter within a broader area of grammar through phonology, morphology and syntax.

One of the most elaborate descriptions on the evolution of the Sinhala script is explained in Fernando's *Origin and the Development of the Sinhala Script* (2008). The expert explains the development of the visual formation of the Sinhala script until the 15th century CE, which can be recognized by anyone who can read it today. The visual development helps to identify what parts (structural system) make up the

Sinhala letter and the author takes this as the main publication, the main point of reference in order to examine the existing terminology that is used to describe the features of the Sinhala letter. The objective of the literature survey on the first expert is as follows:

What are the parts that make up the Sinhala letter?

What are the parts that have an existing vocabulary?

The second expert's focus on language studies bridges the gap from where the first expert concludes (15th century CE) to the present. Language studies use script in aspects such as language form, language meaning, and language in context, and documents Sinhala script and its usages today. The largest number of literature was found within the second expert; language. Authors R. Arangala, V. Balagalle, J.B. Dissanayaka A.V. Suraweera and T. Kariyawasam were referred to, but none other than J. B. Dissanayake speaks on typology. Therefore, his work; on three publications by the author, newspaper article(s) included in the reference and a personal interview were referred in order to extend the current research.

Dissanayake expresses terminology in two stages. First, he constructs the letter within five guidelines and divides them into ascenders, descender(s) and baseline letters. He explains how the vowel signs are placed; either before, after, on top or bottom. Second, he gives a list of eight combined consonants defined as 'conjunct letters' (Dissanayake 2012:672-3) and five combined consonant signs described as 'consonant strokes' (Dissanayake 2012:491).

The objective of the literature survey on the second expert is as follows:

What are the new additions to the script that make up the Sinhala letter?

What are the parts that have an existing vocabulary?

2.4.2 Survey procedure

a). Literature survey: Epigraphic and Language

Fernando speaks of the visual development of the Sinhala letter from a paleographic approach. Therefore, the literature survey on the first expert focuses on visual

development of the Sinhala letter to identify the parts of the Sinhala letter and the terminology used to define it.

The five groups mentioned in table 2.6; the vowels, consonants, vowel signs (VS), non-alphabetical signs (NAS) and other special signs are represented by its sound. Therefore there is no significant terminology, VS and NAS have a specific terminology according to Fernando and is compiled in Annexure 3 with the findings of the other experts for cross analysis.

The visual development of the VS explained by Fernando helps one to know where they were initially placed (located; top, bottom, before or after). The strokes that illustrated these signs took different shapes (circular, oblique) due to the structural development of the vowel bearer; consonants. During 8th -10th century CE the script shows several structural changes and takes its current form by the 15th century CE. A sample of this visual development is illustrated in figure 2. 8.

Visual Development 8th -10th century					
The sign for 'pure' consonant			u (ඊ)		
ā (ආ)			ü (ඊඞ)		
æ (ආ)			e (ඊ)		
ǣ (ආ)			o (ඊ)		
i (ආ)			ṛ (ආ)		
ī (ආ)					

Figure 2. 8: Visual formation of selected vowel signs (VS) of 8th-10th century

The NAS are documented as a separate section as the findings do not contribute to the existing vocabulary, but support the visual development. The ligature signs *repaya*, *rakaranshya* and the *yanshaya* are grouped under non-alphabetical signs (NAS) because its visual construction is more specific to the

consonants *y*(ය) and *ra*(ර). The *repaya* is a replacement of the *hal ra*(ර) before a consonant.

Expert one : Epigraphy		Expert two : Language		Expert Three: Standardization
8th Century	9th Century			
• කෂ	රණණ	ඥ	ඝඨ	• කෂ
• චච	ඝඝ	චච	ඡඡ	• චච
• ඡඡ	ඡඡ	චච	ඡඡ	• ඡඡ
• ඡඡ	• ඡඡ	ඡඡ	• ඡඡ	• ඡඡ
• ඡඡ	ඡඡ	• ඡඡ	• ඡඡ	• ඡඡ
ච	ච	ච		• ඡඡ
ච	ඡඡ	• ඡඡ		• ඡඡ
ඡඡ	රඡඡ	ඡ		• ඡඡ
ඡඡ	ඡඡ	ඡ		
• ඡඡ	ඡඡ	• ඡඡ		
• ඡඡ	ඡඡ	• ඡඡ		
ඡඡ	ඡඡ	රඡඡ		

• Repeats

Table 2. 9: List of Combined Consonants (CC) by all Three Experts

There are no diacritic symbols in Sinhala, although *lu* is identified as a special sign. Fernando illustrates the visual development of the consonant *la*(ල), and its application of the *ū* vowel, which makes the sound *lu*. The *lu* appears as a letter, yet it is a sign (figure 2.9).

Special sign			
Visual development			
la ඳ	Brāhmī	8th Cent.	9th- 10th
	11th- 13th	14th- 15th	Today
	11th- 13th	14th- 15th	Today
lu	11th- 13th	14th- 15th	Today

Figure 2. 9: The application of the ū vowel, on the consonant la(ඳ)

b). Bridging the literature gap and identifying the variables

The research focused on identifying the visual features of the Sinhala letter and the terminology in relation to it. The visual forms; vowel signs (VS), conjunct consonant (CC), ligature and other special signs (OSS) dating up to the 15th century were extracted from the first expert and was noted down. Subsequently, the language research of the second expert facilitated in bridging the gap in the formation of Sinhala letters from the past to the contemporary times

At the conclusion of the literature survey, a summarized list of the parts that make up the Sinhala letter is identified. The list is compiled in Annexure 03 as the selected variables, and cross-examined with the third expert on standardization of language to identify other or similar terms used to describe them.

Two institutions, the National Education Commission (NEC) and the Ministry of National Languages and Social Integration(MNLSI) are identified as the third expert. A publication from the NEC on the standardization of the proportions of the Sinhala letter in 2005, and a publication by the board of writers to the MNLSI on the application of 'pili' (*s.pilla*) on the Sinhala letter in 2013, were selected. Both books are structured as a visual representation on how the Sinhala letter needs to be structured. The NEC publication illustrates all the letters in the alphabet and the medial vowel signs within five guidelines. The only terminology used within the publication is the medial vowel signs and a few selected combine consonant signs

included in Annexure 03. The vowel signs for *o*, *ō*, *ṛṛ*, *ai*, and the CCS *repaya* are also not visually presented. The missing VS were introduced in the MNLSI publication under two sections; a). defines the VS and 2). on the special Sinhala letters and strokes, and within this section of selected VS, a list of CC is focused. The terms that defined these visuals extends to Annexure 03 and gives a complete list of variables by all three experts.

2.4.3 Grouping and the understanding of the vocabulary

In order to standardize a vocabulary to describe the anatomy of the Sinhala letter, first, the author analyses the variable in table 2.6 and divides the variables according to vowel signs (VS), non-alphabetical signs(NAS) and other special signs(OSS).

The vowel signs

All vowels are represented visually with one vowel or with a combination of signs. Taking this into consideration and the behavior of the *hal* sign (*virāma* sign),the author discusses the use of terminology under three sub-groups as:

Group 1 : *ā*(අ), *æ*(ඇ), *æ:* (ඈ), *i*(ඉ), *ī*(ඊ), *e*(උ), *u*(ඌ), *ū*(ඍ), *ṛ*(ඎ),*ṛṛ*(ඏ),*au*(ඐ)

Group 2 : *a*(ඈ) and *hal* sign

Group 3 : *ē*(උ), *o*(ඌ), *ō*(ඍ)

1). Variables: vowel sign - group one : *ā*, *æ*, *æ:*, *i*, *ī*, *e*, *u*, *ū*, *ṛ*, *ṛṛ*, *au*




Vowels are grouped as short and long according to its pronunciation. The VS that represents these sounds too are termed accordingly, as *keti* (meaning short) and *deerga*, *degu*, and *dik* (meaning long or extended). In selected vowels, the visual expression of short and long vowel signs are termed according to its placement (location: side, top or bottom). *ā*(අ), *æ*(ඇ), *æ:* (ඈ)- *æla* (meaning slant, side), *i*(ඉ), *ī*(ඊ)- *is* (meaning head – symbolically top), *u*(ඌ), *ū*(ඍ)- *pa* (meaning foot, feet – symbolically bottom). Therefore, the long vowel adopts its terminology from its expression of voice and visual; *degu ada pilla* (voice expression: *degu*; long and as visual expression: *æla*; side) and this practice is common to vowels *æ:* (ඈ), *ī*(ඊ), *ū*(ඍ) (Figure 2.10). In the case of *ṛṛ* (ඏ) the long sound is expressed by repeating the sign (figure 2.11). The terminology that illustrates the voice expression for the long vowel

is common within all three experts, although the first expert uses the expression language origin; Sanskrit term *deerga*; the second and third experts uses Sinhala terms *degu*, *dik*. The term *keti* (short) is only used by the third expert and not a collective expression to signify the short vowel sound.

Short and long Vowel	අඳු	අඳු	ඉ	ඊ	උ	ඌ
	කැ	කැ	කු	කු	කී	කී
VOICE EXPRESSION	<i>keṭi</i>	<i>dik</i>	<i>keṭi</i>	<i>dik</i>	<i>keṭi</i>	<i>dik</i>
VISUAL EXPRESSION	<i>āla</i> (side)		<i>pa</i> (bottom)		<i>is</i> (top)	

Figure 2.10: Voice and visual expression in terminology in short and long vowels

Another form of visual expression is identified in vowels *e*(ඒ), *r* (ඌ), *au*(ඌ). The vowel sign *e*(ඒ) is represented with a *kombuva* (*p.kombu*) (meaning horn: musical horn or instrument of that shape). The sign of *r* (ඌ) is similar to the *āla pilla* but with a *gætaya* (*p.gæta*) (meaning knot). Therefore, so it is termed as the *gæta pilla* (side sign with a knot) and practiced within the second and third experts. The visual expression of vowel sign *au*(ඌ) is represented with a *gayanukitta*. This sign illustrates a rotated *ga* (ග) and written next to a consonant. *Gayanukitta* (meaning, the pilla with form of the letter *ga*). The term *kitta* originates from the Sinhala term *Kruthya*- කෘත්‍ය (meaning function), although due to semantic change in language, it means form-*Svarupa*. There is no other term to define it, except the term *au pilla* used by the second expert.

Vowel	ඵ	ඹා	ඹඹ
	ඹ ඹ	ඹ ඹ	ඹ ඹ
VISUAL EXPRESSION	<i>kombuva</i> (horn: instrument of that shape) 	<i>gatapilla</i> (side sign with a knot) 	<i>gayanukitta</i> (pilla shaped as the consonant ga) 





Vowel	උ	උඹ
	<i>vak</i> උ උ 	<i>kon</i> උ උ 
VISUAL EXPRESSION	 <i>Vakraya</i> (circle)	 <i>Konaya</i> (corner)

Figure 2.11: Visual expression in terminology: expression of shape

The vowel signs of *u*(උ), *ū*(උඹ) have had two visual forms from its inception and the third expert uses additional terms as *kon* (meaning corner) and *vak* (meaning curve – deriving from the term *vakraya*) in describing its visual expression.

Sinhala language is classified as an abugida, and it means that all consonants have an inherent *a* sound to it. Therefore, with the application of the *hal sign* or *virāma* (meaning stop, pause), the consonant stops the inherent *a* sound and achieves its pure consonant sound, and is known as *hal kirima* (figure 2.12). Nevertheless there are two visual forms to signify the pure consonant sign or the ‘pause mark’ due to its placement of selected consonants. When the sign is attached to an ascending consonant, it is illustrated as a *ræhæna* (meaning rope) and when placed on to a descending or a base consonant, it is illustrated as a *kodiya* (meaning flag). The visual form derives out of space constrains, and is illustrated in figure 2.13.

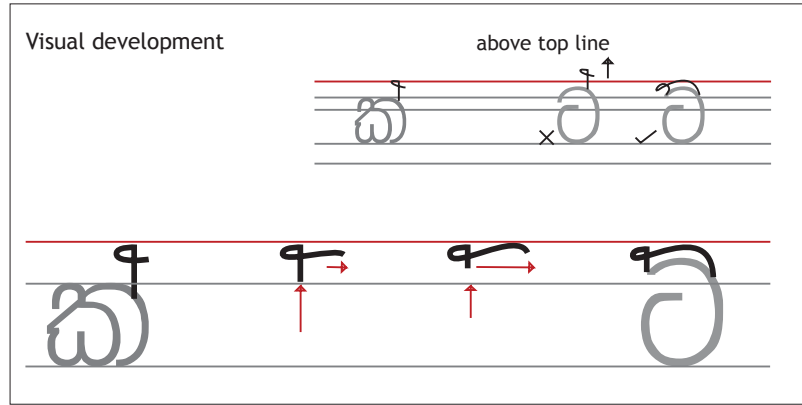


Figure 2.12: Visual development of the *hal* sign

When the same visual form of the *hal orvirāma* sign is used in vowels චී, චී, this sign is known as a *hal lakuna* (meaning 'lengthening mark') as the vowel makes a long sound. In the application of *ē* vowel, the sign takes two visual forms (*kodiya*, *ræhæna*) but when the *ō* vowel is applied it is placed on top of the *æla pilla* resulting in one visual form (*kodiya*).

The terms *ræhæna* and *kodiya* are visual expressions of the sign used by the second and third expert, while the second expert uses another term *al lakuna* to express the language sound.





<i>Virama sign</i>	<i>kodiya</i> (flag) ක ක 	<i>ræhæna</i> (rope) ච චී 
VISUAL EXPRESSION	 flag	 rope

Figure 2.13 : Visual expression in terminology: *hal* sign

2). Variables: Vowel sign - group three : ē(ඒ), o(ඔ), ō(ඌ)

The third group represents vowel signs that are made with a combination of signs. The common features within the three vowels are the *kombuva* before the consonant, and the first expert uses the term *e karaya*, for the vowels *e* and *ē*.

The signs on or after the consonants are named as *ā pilla* also known as *ākaranshaya*, *æla pilla*, *viramaya*, *hal kirima* in respect of each vowel. The term *dik æda pilla* is used by the third expert when the lengthening mark is on the *æda pilla*, as it is only practiced on the application of the vowel *ō*. The second expert breaks this combination and gives one term for each vowel sign as *ē pilla*, *o pilla*, *ō pilla*. Another expression is identified when the second and the third experts introduce two terms; *us pilla* (*us* meaning high, elevated) and *udu pilla* (*udu* meaning upper part) to represent the *hal* sign for the vowel *ta*.

By analyzing all the terms used by the three experts, several expressions are noted. The first expert notes the existence of most vowel signs, yet the publication does not give terms for the VS ං, ංං, ඌ and ඌඌ. Therefore annexure 2.3 indicates it as 'no term/ none'.










Virama sign			
Pause Mark		Lengthening Mark	
<i>Hal kirima</i>		<i>Hal lakuna</i>	
ක ඊ		Vowel	ඒ ඒ
		ං ං	ඌ ඌ
		 	← <i>Us pilla</i> (high, elevated)
		ං ං	ඌ ඌ
		 	← <i>Udu pilla</i> (upper part)
		 	
		 	

Figure 2.14: Virama sign – pause mark and lengthening mark

The common expression used for most vowel signs is the term *pilla* (meaning branch) since it branches out of the consonant, and to signify this, the second expert uses the term *pilla* after every vowel sound as *a pilla*, *æ pilla*, *æ: pilla*, *ē pilla*, *o pilla*, *ō pilla* etc. Yet, most terminology used by the second and the third expert are similar.

3). Ligatures and other special signs

The identified ligatures were the *repaya*, *rakaranshya* and the *yaṅshaya*. Yet the second expert introduces two more signs as *Takaranshaya* and *Dakaranshaya*. *Anshaya* (meaning half) depicts the visual expression of half of the letter *ya* and *ra* (Figure 2.7). Meanwhile the signs for *Takaranshaya* and *Dakaranshaya* introduced by the second expert do not contain half of *t* and *d*.

The term *repaya* represents its voice:*r* sound and the terminology of visual expression (half of the letter *ra*) is in *rakaranshya*. While the special sign *lu* is an expression of voice.

At the conclusion of this survey, several aspects were noted on the existing vocabulary of Sinhala letter-parts.

Documenting existing terminology - A list of nomenclatures that defines all vowel signs, non-alphabetical signs, and other special signs by three experts are documented, proving that there is no unified terminology and the need for a standardized system for typography.

Derivation of the existing terminology - The derivation of the existing terminology was identified as expressions of visual and sound. This finding can be used to develop a new nomenclature for the identified features of the Sinhala letter.

List of non-alphabetical signs -All the combined consonants used by the experts are documented for the benefit of the subject of Sinhala typography.

2.5 Summary and Conclusion of Chapter

This chapter presented the inception of the Sinhala letter form and earliest writing surfaces to understand the visual development of the Sinhala. The first part of the chapter summarized how the letter form is represented visually in the chronological (epigraphic) visual chart of Sinhala letters and that it concluded by the 15th century CE. It was also noted that other writing traditions (surfaces) existed parallel to epigraphic surfaces, although they did not record the letter's visual development. Another such area of the Sinhala letter form was identified in language studies, and existing knowledge on the Sinhala letter form showed bias to this subject. Therefore, we were left with insufficient literature in the documentation of the Sinhala letter form. Nevertheless, with the existing knowledge, the Sinhala letter was grouped, based on the language grouping to identify the formation of Sinhala letter in writing as; vowels, consonants, vowel signs, combined consonants, non-alphabetical signs such as *asrephaya*, *rakaranshya*, *yansaya*.

Next, through the literature survey we encountered informal practices in terminology that describes the letter-parts. This survey directly reflected the anatomy of the Sinhala letter, and revealed that current practices of naming letter-parts are based on the expression of visual and sound. As a result multiple terms to describe a single letter-part was built. Another aspect identified was that the existing vocabulary was limited to vowel signs and selected non-alphabetical signs. It clarified a void in existing terminology that describes the Sinhala letter form and its limitations. To bridge the gap, in this case, the absence of a unified set of terminology to describe the Sinhala letter proved a need to build a theoretical framework on what constitutes the anatomy of Sinhala. This knowledge will be brought forward to chapter four.

Meanwhile, in the next chapter, we continue the background studies, through a literature survey on how the Sinhala letter form transforms into a typeface. Through this we hope to investigate the journey of the Sinhala letters on a new medium (the printing press) and existing knowledge on typography.

Chapter three

DEVELOPMENT OF THE LETTERFORM TOWARDS TYPEFACES

The chapter begins with a brief historical overview of the introduction of the printing press. This is followed by a visual survey on the earliest (first) typeface and its implications. The visual survey explains how the existing letterform of the same era resembles the first typeface. Next, the development of typefaces is documented against the socio-political context to understand the growth of Sinhala typefaces and the related technological changes. The chapter declares the importance of knowledge of early Sinhala typefaces within the domain knowledge of Sinhala typography. It also states the limitations in literature to analyze letterform or typefaces, and the lack of knowledge on the structure of the Sinhala letterform. This background knowledge on the development of the early typefaces assists to locate where typefaces (as specimens) are archived and its chronological setting.

3.1 Political Change and the Need for a Press

From the county's administrative point of view, the first Europeans came in the island in the year 1505. The Portuguese, on their search for spices and mission of evangelization, took over the maritime belt of Ceylon. During this time writing was done on palm leaf manuscripts as the main writing surface. Yet, the Portuguese writing surface of paper and written in ink with quill, was a novelty to the locals. Paper, as a writing surface was flimsy and appeared less durable compared to the palm-leaves, which did not give the locals enough confidence to adapt to the new medium of paper. Gunawardana documents the easy availability and inexpensive nature of palm-leaves compared to paper, to be a reason as to why locals did not adapt (readily) to it (1997: 30). While Suraweera mentions the high esteem held by the locals towards palm-leaf manuscript, terming them as '*Poth-vahanse*' (Venerated Text) as they contained teachings of the Buddha. The use of manuscript writing and book copying was held at very high positions (Jayatilaka cited in Kularatne 2006: 07). Therefore, the locals did not approve of paper to be an accepted material to write such sacred work even though paper was introduced to the island by the Portuguese for their administrative work.

The credit for introducing printing with movable type is given to the Dutch. It is recorded that the Dutch set foot on the island in the year 1656 and captured the maritime provinces from the Portuguese, with similar objectives of (gaining the spice trade) and spreading of faith with governance. The governing body was 'The Dutch East India Company', NVOC (Nederlandsche Vereenigde Oost-Indische Compagnie) and they together with the Dutch Reformed Church used the church structure to fulfill their objectives. Therefore, the proselytizing programme of the natives continued, and as a result the establishment of schools attached to churches started. This was similar to the education system that prevailed in the island under the Buddhist clergy; however, the Buddhist education system that had been disregarded during this time yet, showed rudiments of literacy among a significant number of locals. Observing the literacy level of the locals as an advantage, the Dutch identified the need for a printing press to reach the locals in their native tongue. Parallel to this timeline we find evidence of writing by the Dutch within the island to have been ink on paper, while the practice of palm-leaf manuscripts continued. Kularatne states how the teachers were supplied with a set of Catechisms, Prayer books and one or two Gospels in manuscript, and that they were meant to be kept in school for the sole purpose of the teacher. This also explains the shortage of reading material that was an obstruction towards the spread of faith (Kularatne 2006: 11).

3.1.1 Initiation of the Printing Press

Dutch clergymen Simon Kat, Predikant Philippus Badaeus and Joannes Ruell are said to have worked tirelessly by learning the native languages, Sinhala and Tamil, towards the establishment of the press. And, thereafter, produced books for the use of the seminaries. As a result, the first book printed with Sinhala characters was published in the year 1708 in Amsterdam. The Sinhala type used in this book was individual (movable) woodcut letters and it was mounted with metal movable Latin type. The Sinhala letters are a direct copy of a handwritten style, which will be discussed in the next section of this chapter.

The plan to establish the press in the region is documented as early as 1624 in Batavia, at the headquarters of The Dutch East India Company (Jurriaanse 1943:135). Yet, the proposal for a press in Ceylon was initiated, nearly a century later during Governor Isaac A. Rumph's (1716-23) time, but was brought to a stop with his death. Citing J.van Goor, Kularatne says:

'in 1723 it almost looked for a while as though a printing press was going to be established but as a result of Rumph's death, the whole project came to fall into oblivion" (2006:14).

There had been several technical difficulties during the initiation process of the printing press with the lack of people to make Sinhala and Tamil type, and who had knowledge of printing, and printing machinery to take on the task. This was scarcely met till the *baas* (Dutch: Chief) of the Company's armory in Colombo comes forward. Gabriel Schade, like William Caslon the English type founder of the same era, would have had sufficient comprehension to work with steel. Jurriaanse states:

He must have been a man of intelligence and a fine craftsman with an exceptional interest in mechanic(s), otherwise he would never have succeeded in preparing the tools and moulds for fourteen large Sinhalese letters and another fourteen of a medium size... (Kularatne 2006: 15)

Schade's skill and effort was left short by the infamous Dutch Governor Petrus Vyust, as Schade was one of the officers who was seized, imprisoned and tortured for no fault. The cruel rule by the Governor was known as the 'reign of terror' (1726-29). Petrus was detained and removed from office for his rebellious and criminal nature. As a result, the work done probably between 1725-1729 by Schade on the Sinhala letter was stored at the armory and the 'establishment of the press was dropped altogether'(Jurriaanse 1943:15). At the arrival of the next Governor, J.C. Pielat in 1732, it is believed that Schade felt physically weak and retired. He was accompanied by two clergymen; W. Konijn and J.P. Wetzelius to inspect the moulds and the type at the Armory and to continue on the establishment of the press. Jurriaanse observes:

Schade who is the inventor of the above mentioned type of the roughly made implements belonging thereto, when asked if he would be able to resume and

complete the work he has started being successful, but agreed to carry on and complete the work of the establishment of the printing press on condition that he was supplied with the means” (cited Kularatne, 2006; Jurriaanse, 2006).

‘On the agreement and approval of the request’ means that, Schade continued this work and brought it to the final stage, and one can assume that Schade was assisted by Sinhala scribes and silversmiths (Kul 2006:15) “but his death about the middle of 1737 robbed him of the satisfaction of seeing the first Sinhalese book issued from the press a few months later” (Report of the Government Archivist cited in Kularatne 2006: 17). Nevertheless, he is given the honour of casting the first movable Sinhala type which led to the establishment of the Sinhala Press in 1736 during Governor Baron van Imhoff. The Council at Castle Batavia writes: “...we approve the establishment of a Singhalese printing office”. The casting of the letters is said to have been done at Batavia and the hand press, paper and ink are presumably from Holland. The first specimen printed at this press is believed to be the Lord’s Prayer on a single sheet of paper attached to a letter dated 29th December, 1738 from Tranquebar to its mission’s headquarters at Halle. In this letter it is said that the ‘first edited book will be followed shortly’ (Kularatne 2006: 17-18).

3.1.2 The First Sinhala Prints of the Press

Even though, the principal reason for the press was to facilitate the spread of Christianity by printing catechist material, the other advantage was the ease in providing administrative documents of the island. For example, the central and local government of Ceylon under the Dutch administration issued proclamations, publications and orders to its people with the use of *plakkaaten* (Dutch: singular: *plakkaat*). These were printed in three languages: Sinhala, Tamil and Dutch, and were usually hand-written and later printed. These documents that were hand written were generally large single sheets of paper written with ink and quills. In administrative offices located in Colombo, Jaffna, Galle and other areas, several clerks sat on high stools copying council minutes, letters and other documents day after day for the Dutch in the island, in Holland and to the natives (Jurriaanse 1947:135). With the establishment of the printing press, such work would have eased. As a matter of fact the oldest physically printed document of Sri Lanka is a *Plakkaat* dated 5th April

1737. Its content is on the enforcement of pepper cultivation in the south of the island, and this *plakkaat* is now preserved at the National Archives, Colombo. It is a single sheet of paper of 60cm (left to right) x 53cm (top to bottom), that contains the type set in a space of 43.5cm (left to right) x 48cm (top to bottom). This is important to this research as it contains the first Sinhala typeface.

Maria Wilhelmina Jurriaanse (M.W. Jurriaanse), compiled *The catalogue of the Archives; of the Dutch central government of coastal Ceylon 1640-1796* on the request made by the Government of Ceylon to The Netherlands in 1936. It is documented that she arrived on the 7th February 1937 and was appointed by the Chief Secretary of Ceylon as an Additional Assistant Archivist, and completed the catalog in 1943. Under lot 01, reference number (r.n) 2440 all collected '*plakkaaten*' found loose and crumpled up in boxes are bound chronologically. Most of the *plakkaaten* are repaired, as they would not have survived after being pasted on public buildings of the time, but ones that escaped the usual fate are at the Archives, catalogued, carefully repaired, and affords an opportunity of studying Schade's craftsmanship and several handwritten styles. Such a visual survey is discussed in the next section.

The 'first edited book' mentioned in the letter dated 29th December, 1738 was printed with Schade's workmanship and, it is documented as the first Sinhala book printed with movable type.

"It contains the Lord's prayer, morning and night prayers, grace before and after meals, 12 articles of the Creed and 10 Commandments of the God. It also has a short introductory note in Dutch and Sinhalese and runs into 41 pages, octavo." (de Silva 1972: 13)

Nevertheless it is important to note that the time it took from the first proposal to the establishment of the printing press in Ceylon was nearly two decades, and nearly one decade for the completion of two sizes of Sinhala type under three different Governors. (Figure 3.1) Jurriaanse and Kularatne speak of how the 1708 Sinhala type would have inspired Schade and, the negligence of a study on the craftsmanship and the skill of the first Sinhala type designer. Therefore, in the

following section, we take a closer look at what inspired the first Sinhala type, as Schade’s familiarity of the Sinhala language is doubtful. Jurriaanse mentions on his immense interest that may have led him to have the linguistic knowledge, but she also continues as “anybody can copy characters in a foreign script (1943: 136). So the question continues, if Schade copied characters in the 1708 book or was inspired with handwritten styles of the local scribes who now have adapted to the quill, ink and paper.

Time towards the establishment of the press

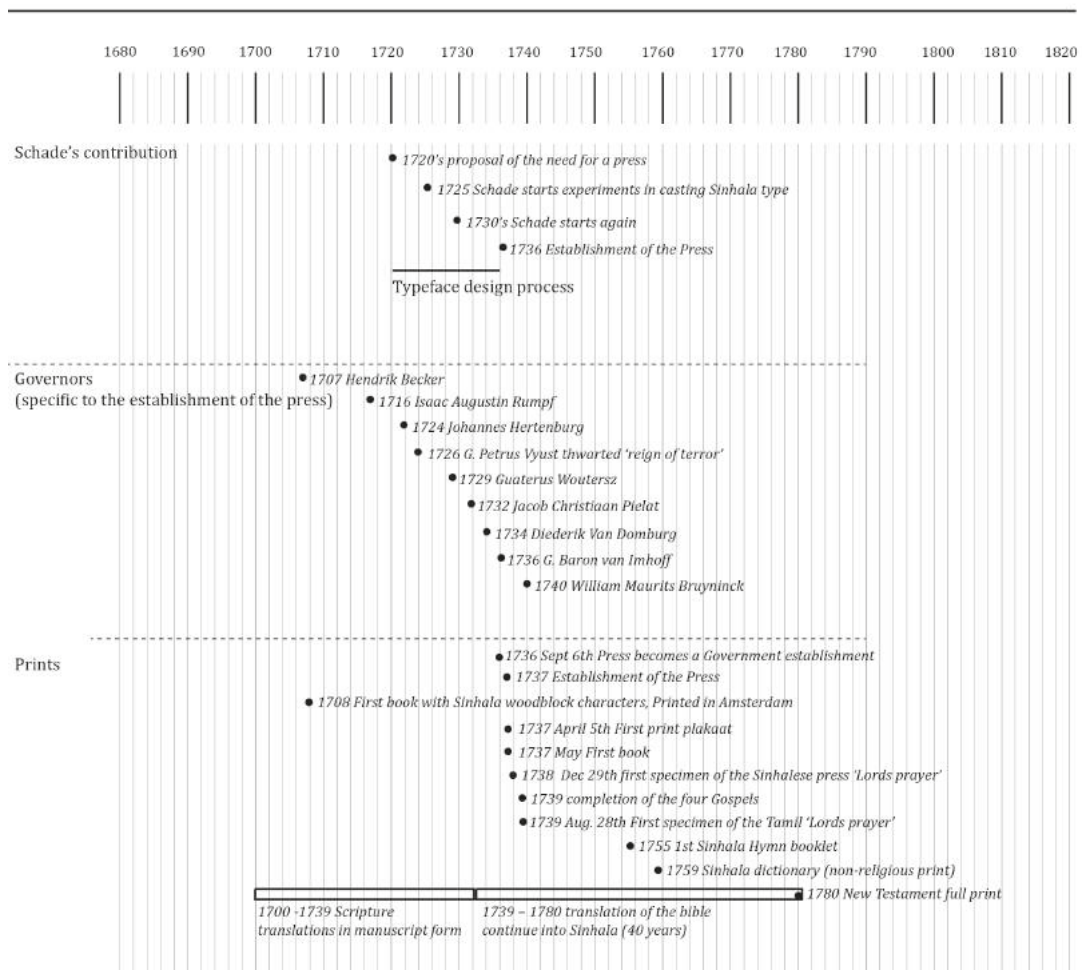


Figure 3.1 : Time Towards the Establishment of the Press

3.2 Survey on the First Sinhala Typeface and Letter Structure

One of the most common inspirations to develop a typeface would be to look at one's handwriting. The style of type is called Gothic or black letter is found in the first book printed with moveable type in the West—the 1455 Gutenburge Bible. This style of type is a duplicate of the standard book-hand employed in written manuscripts of the Gutenburge era. Therefore, to identify the visual similarities of Gabriel Schade's work (first Sinhala typeface) with handwritten documents of the same era, the following survey was conducted. The analysis of this was earlier published as 'development of a typeface from the handwritten Sinhala *plakkaaten* of Sri Lanka' and edited to support the overall study (Samarawickrama 2014).

3.2.1 Background to the Survey

To identify Schade's approach, reference number (r.n.) 2440 was observed. It is a 24"x 36" bound document with 67 *plakkaaten* at the Department of the National Archives, Colombo. This document contains *plakkaaten*, in Dutch, Tamil and Sinhala, some handwritten and some printed (Table 3.1). The importance of this document is that it contains the first Sinhala printed *plakkaat* (also considered as the first physical printed document composed with movable Sinhala type). Earlier we learnt that Schade started the type design process around 1720, while the *plakkaaten* here start from 1699, giving a good overview of what was accessible to him and parallel handwritten styles. Therefore, to examine the influence of the hand written letterform, with the first Sinhala typeface, the author focused on the 15 handwritten Sinhala *plakkaaten* compiled in r.n.2440.

SCRIPT	HAND-WRITTEN	PRINTED	TOTAL
Dutch	24	06	30
Tamil	13	00	13
Sinhala	15	07	22
missing			02
			67

TABLE 01 - Lot 01, Reference no.2440, the plakkaaten distribution

Table 3.1 Lot 01, Reference no. 2440, the *plakkaaten* distribution

A total of 15 out of 22 were handwritten. By using a loupe (small magnification device is used by current day printers), the handwritten styles were initially noted. They were termed as calligraphic style A and B with two *plakkaaten* for each style. Style A, has three *plakkaaten* with the evidence of two different scribes. It shows a variation of a detailed and controlled letters in *plakkaat* number (pl.no.5) while the others (pl.no.11) (pl.no.12) show speed with open and loose letters. *Plakkaat* no.5, the first Sinhala handwritten document in r.n.2440 dates as 1699. It is doubtful if this document was issued to the public or, if it was a piece used to practice (21x 3 inches) as there are few scribbles, whilst strokes of letters are not smooth. This observation demonstrates that the scribe was either an inexperienced one or whether he was new to the tool and material - ink, quill and paper. *Plakkaat* no.11 is the second handwritten document, scaling up to 33x 41.5 inches, a larger block of copy written one year later. A notable point is that the scale of the letters, the number of lines and the size of the *plakkaat* 05 and 11 vary immensely. Nevertheless, these three are included into one type of style: Calligraphic style A.

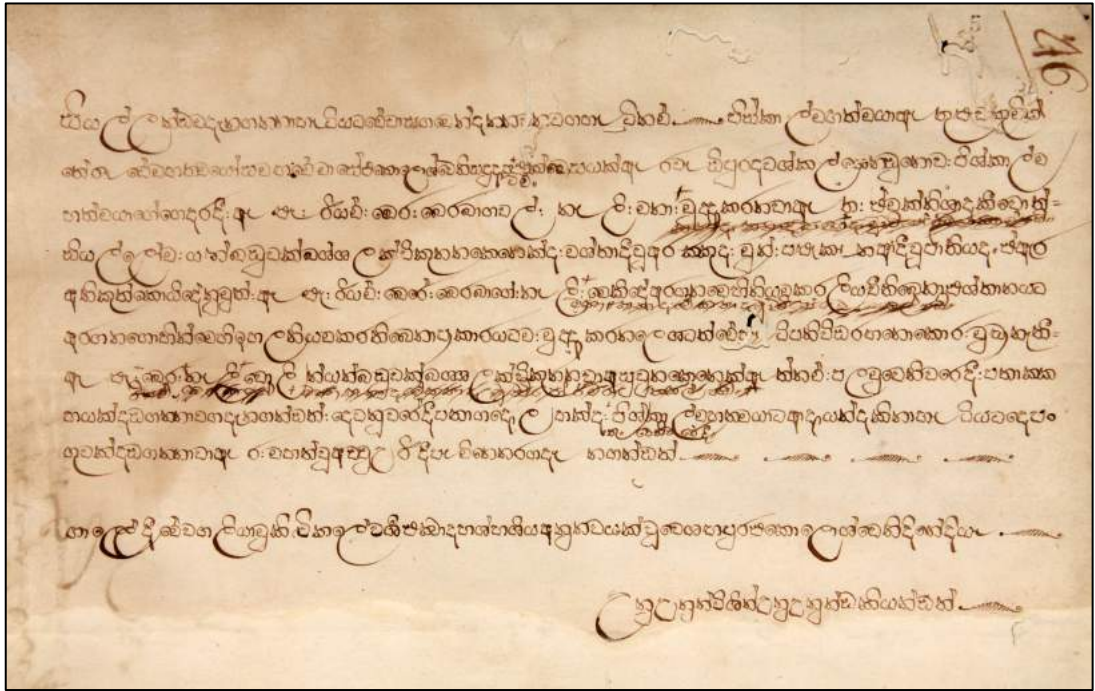


Figure 3.2 Style A : Sample of *plakkaat* number (pl.no.5)
 Source: Dept. of National Archives

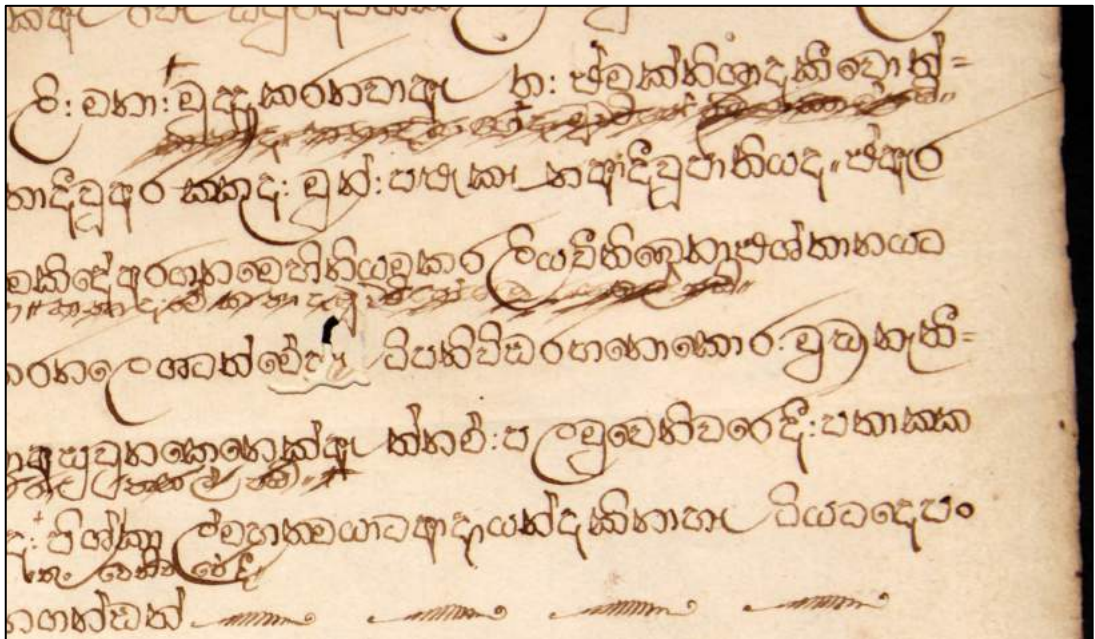


Figure 3.3 Style A : Close up of pl.no.05
 Source: Dept. of National Archives



Figure 3.4 Style A : Sample of *plakkaat* number (pl.no.11)

Source: Dept. of National Archives

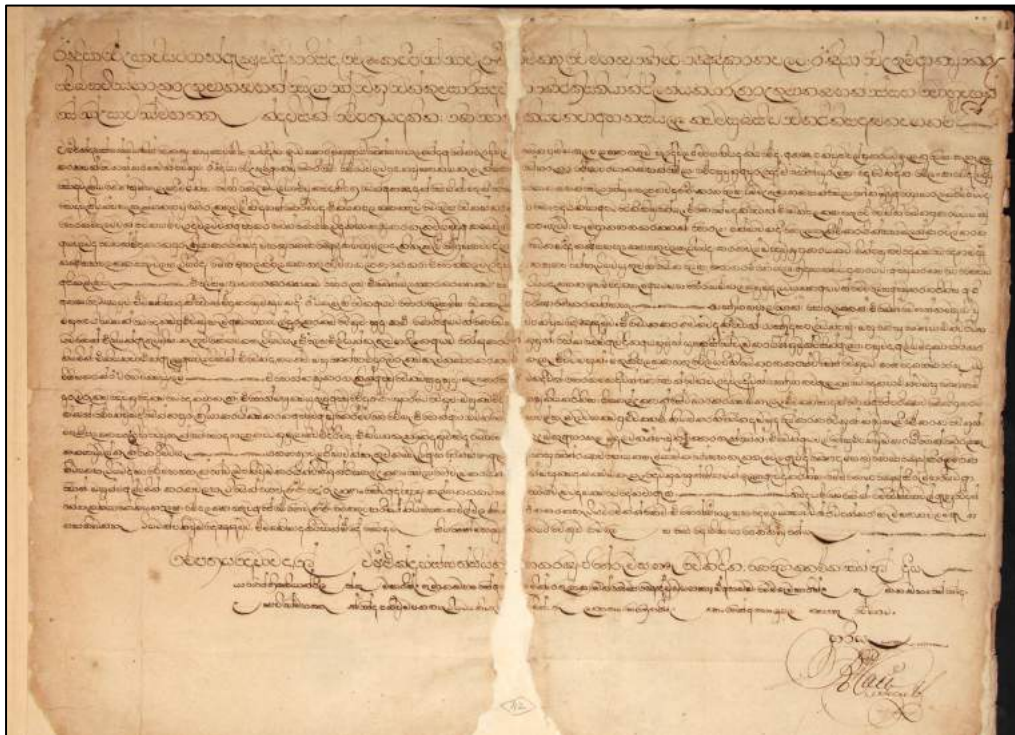


Figure 3.5 Style B : Sample of *plakkaat* number (pl.no.42)

Source: Dept. of National Archives



Figure 3.6 Style B : Sample of *plakkaat* number (pl.no.48)

Source: Dept. of National Archives

Calligraphic style B holds a larger number of *plakkaaten* as thirteen out of fifteen are of the same hand. It shows control and care, density in colour, with defined forms and proportions that vary. This hand was more experienced and was employed for the task of writing documents from 1720. Yet, the same letter is composed differently. This could be because of the hand pressure, writing speed, flexibility of the wrist, smoothness of the paper and flow of the ink.

3.2.2 Survey Procedure

To identify the exact visual variations or similarities within the letterforms of *plakkaaten*, the survey was narrowed and two *plakkaaten* were selected to represent calligraphic style A (no. 05, 11) and style B (no. 42, 48). Thereafter, a sample set of letters (figure 3.7) was compiled to observe and compare visual features of the handwritten letters and typefaces. To do this Dissanayake's 'ten divisional category of Sinhala letter construction of the start and end of the stroke' was reviewed (2006,

350-357) Figure 3.8. This work of Dissanayake, can be considered as the only available literature on the structure of the Sinhala letter that is useful to Sinhala typography. He illustrates how the current sixty-letter alphabet was grouped according to ten divisions based on the start and the end of the letter. Therefore, one letter was selected among the ten divisions giving us a sample of 20 letters. Among the 20 Sample letters, 2 letters were repeated, 1 was not in use at the time and 2 were rare within the *plakkaaten*. Thus, the sample set of letters was dropped to 15 letters.

The Dept. National Achieves, Colombo, on the request of the author for this purpose, digitally photographed the *plakkaat* no.05, 11, 42, 48. White balance of the photograph was adjusted for better contrast and compiled into a visual chart with five samples of each letter. Sections of the visual chart of *plakkaat* no.42 is documented in figure 3.9, and the overall sample of *plakkaat* 42 is included in annexure 3.1.

START FORM	letters/ characters		letters/ characters
	අ ආ ඈ ඈ උ ඌ ඩ ඌ කඩ ක ත න ත ඡ ජ වේ ඤ ඳ ඝ ඞ ජ ච ඩ සා සා ඡ ච ච භ ච ච ඩ		ච ච ච ච ච ච ච ච ච ච ච ච ච ච ච
	ඟ ග ග ග ට ට ධ ධ ග		ණ ණ ග ග හ හ හ ත ක
	ම ම ම ම ම ම		ප ප ග ස ස ය
	ර ර ර		ච ච ච ච ධ ඩ
	ඛ ඛ ඛ		ඳ ඳ ඳ ඤ
	ඉ ඉ ණ		ජ ජ ජ ර
	ල ල		උ උ ල ල
	ඳ ඳ		ඉ ඉ
	ඟ ඟ		ඟ ඟ
	ඛ ඛ		අ අ

Figure 3.7 Ten divisional category of stroke starts and ends of Dissanayake
 Source: Disanayaka, J. B., (2006)

START		END		
a ආ	i ඉ	va ව	ja ජ	● 15 selected
ga ග	la ල	na ණ	u උ	○ 02 Repeats
ma ම	la ල	pa ප	i ඉ	□ 01 Not in use
ra ර	fa ෆ	e ච	sa ස	■ 02 Rare
ba බ	na ඛ	da ඳ	a අ	

Figure 3.8 Selected Letters for Sampling





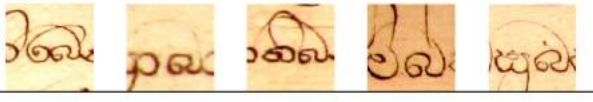

Calligraphic Style B	pl.no.42
a ञ	
ga ग	
ma म	
ra र	
ba ब	
i इ	

Figure 3.9 Section of the Visual chart of *plakkaatno.42*

3.2.3 Analysis of the initial visual survey

By observing the visual charts, it was evident that the same letter takes different stroke variations. Sometimes, it is written with a thick and thin contrast-stroke, giving the appearance of a modulated letter. Therefore, to examine this further, the letter was observed across two approaches. First one was to reconstruct the letter and to practice the hand. The second approach was to observe the ink trap, blot and the stress of the stroke.

Approach 1 - Understanding the Letterform: Reconstruction of Letterform

To document or to understand letterforms, the practice of reconstruction is discussed within typography. Joshi, scholar of Devanagari calligraphy, speaks of his process of documenting as follows:

After noting down date, period, basic size and margins, I used to observe for quite some time, many individual letters, through a magnifying glass, for

stroke structures and proportions. After the first excitement of revelation was over, I used to select a pen of the appropriate thickness, with a self cut nib.this was accompanied by my commentary notes regarding structure peculiarities, proportions, etc. after copying decorative and/or binding devices of interest, I used to copy a page or a portion from the manuscript (Joshi cited in Kumar 2010:91).

Joshi's practice would be successful if one knows how to write the letterform. Since the letterforms in the selected *plakkaaten* contain inkblots and irregular formation of letters, it was hard to understand the sequence of the construction of the letters. And, since there is no literature available on the construction of these early calligraphic styles, we selected one letter from the 15 letters mentioned above to analyze this further. The selected letter for this approach was the letter; *a(æ)* as it contains two features (start and the end) based on Dissanayake's division.

We constructed the letter *a(æ)* on the instructions of the NIE guidebook, as it explains how the letters are written. When writing or constructing the letter, we came across a few places that were doubtful. The flow of the stroke differed from the current practice. They were identified and circled in figure 3.10. Thereafter, the letter was constructed according to the instructions given by the NIE guidebook, but the result of the letterform was visually dis-ordered. To overcome this, we moved to the second approach. The second approach identifies the flow of ink and stroke of the letter. it was conducted by observing the ink blots that are made with the stress of the pen.

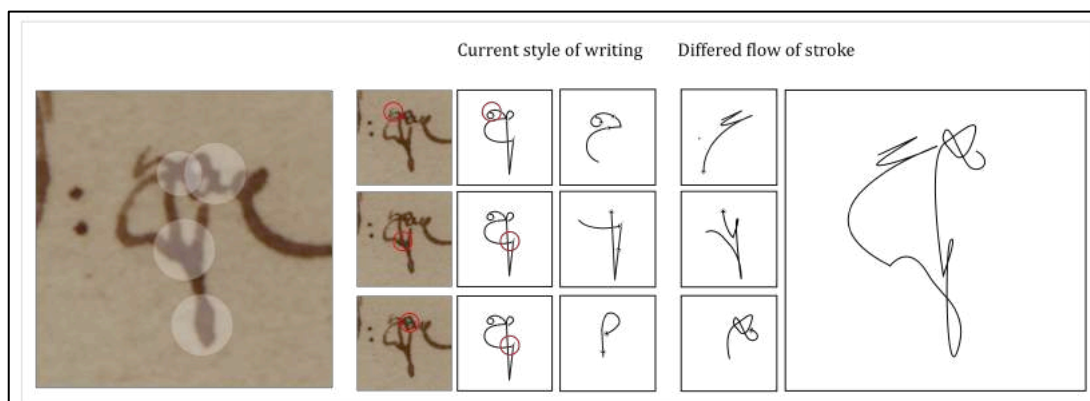


Figure 3.10 Disordered letterform in contrast to the current practice

Approach 2 - Understanding the Letterform: Identification of Ink Blots

It was evident in the earlier approach that the letterform contained inkblots, which confused the reader/observer on how the letter was constructed. Therefore, this approach was a study on how the Sinhala letterform creates inkblots. This visual study was conducted by re-drawing the letter by observing several letters and trying all possibilities of constructing the letter. Re-constructing the letters with ink, quill on paper, was then tested and notes were penned down. The results of inkblots are as follows:

Ink blot: The strokes darkest areas (high contrast areas) would be the places where the ink is either blot or, the stress is at an angle. This is explained digitally by increasing the white levels of the letter as they stand out (Figure 3.11).

In using the quill, the scribe dips the nib into ink and one of the most common problems in this practice is getting the ink to flow consistently from the nib to the paper. In case the flow is not steady, we are left with an irregular flow with scratchy, skipped strokes or the blotting of ink on paper. Yet, when the ink flow is constant (usually evident with experienced scribe), the flow of the ink can guide the flow of the stroke's end and the start. Such an experienced hand is visible in p.l no. 42. A single letter experiences a series of knots within the letter. These knots create ink traps resulting an inkblot. This form of knots is termed as an intersection by Kumar when explaining the Tamil script. (Kumar 2010: 119). Nevertheless, considering the flow of ink, pressure, stress of hand and the behavior of the stroke, an inkblot can be identified as follows:

- a. Overlapping of a continuous stroke creating a knot.
- b. Stroke placed adjacent or overlapped to another stroke.
- c. Conscious/ forced stop of the stroke by the scribe.
- d. Interrupted flow of ink at the start of the stroke.

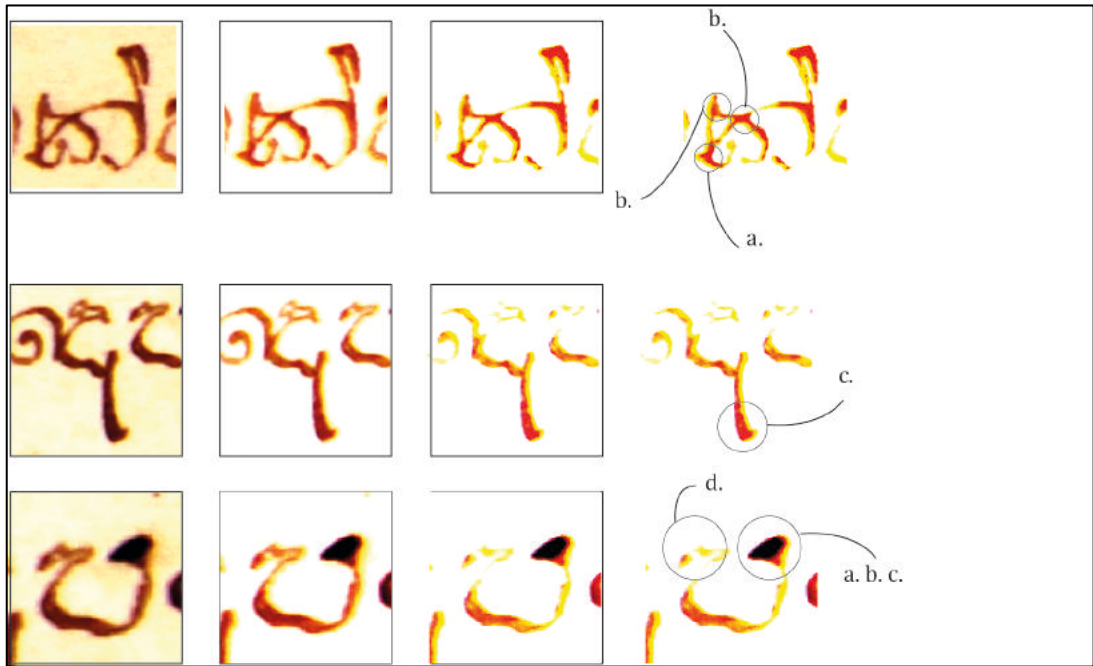


Figure 3.11 Types of Inkblots

The above four aspects are explained further:

- a. Overlapping of two strokes is common in most Sinhala letters. When the flow of the ink writes one on top the other, it wets the paper creating an inkblot. This form of a blot can be overcome by changing the angle of the nib like in the style B.
- b. Between the start and end of any letter, the stroke may overlap, creating a knot, or it would be placed adjacent to another stroke - one can observe an inkblot due to the trapping of ink between these strokes.
- c. This type of blot is common in ascender or descender Sinhala letters. When the stroke ends with pressure of hand, a blot of ink is identified, as the smooth flow of ink is stopped with force.
- d. An inexperienced hand, a new or unclean nib, type of ink with the type of surface (ink resistant paper) may cause this type of a blot due to the irregular flow of ink.

Inkblots, most commonly seen in pl. no. 05, are illustrated in figure 3.12. At the first glance the observer is unable to identify how the letter was written.

Nevertheless, this reconstruction of the letter helped to understand how the scribe had written. On the other hand pl. no. 42 illustrated in figure 3.13 is much clearer as the smooth flow of ink explains how the letter was constructed, which resulted in how the style B was written.

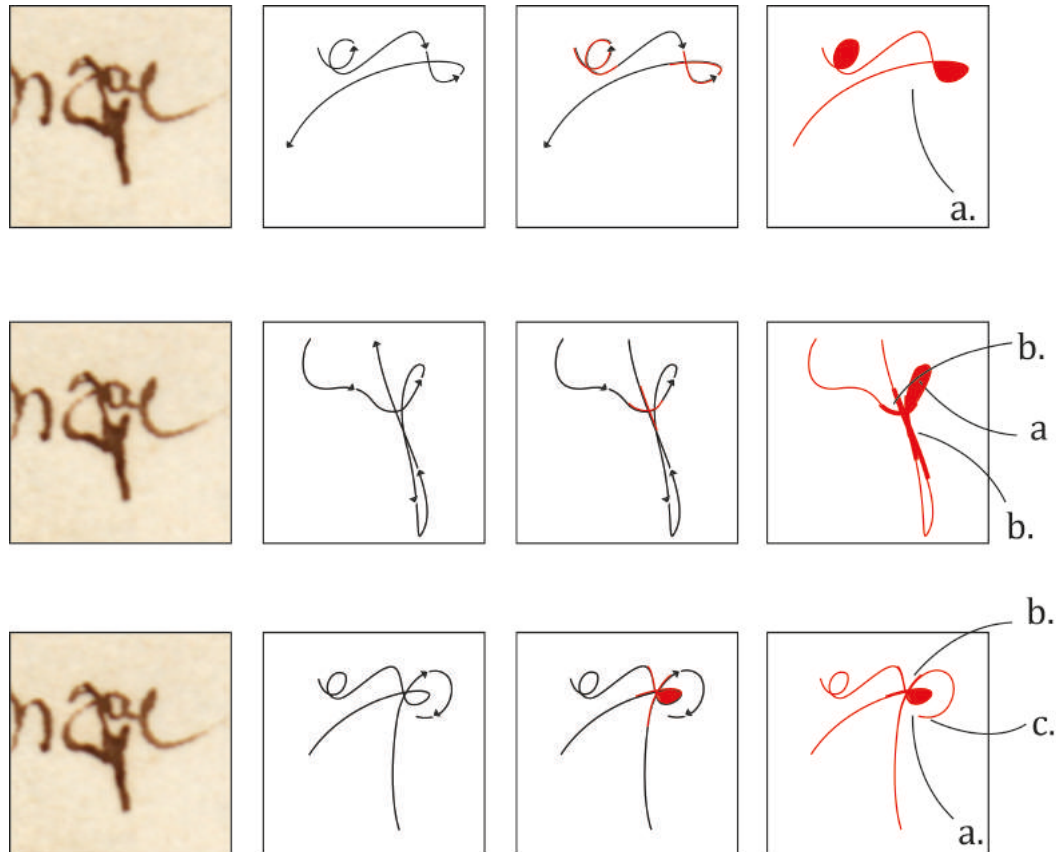


Figure 3.12 Pl. no. 05 : Inkblots identified in letter *a* (ae)

The advantage of knowing how to construct the letter takes one to the next stage of the visual analysis. For example, if we observe figure 3.16, we learn that the same letter is constructed with minute visual variations. Therefore, to understand this, the same letter was written by applying speed to the hand. This was conducted to understand the influence of the speed of writing that would result in the form of the same hand, and to write the same letter differently. This can be easily understood in figure 3.14, it shows how the start of the letter *a* (ae) changes its form. We were able to identify this visual feature *x* (start of the letter) of the letter *a* (ae) because of

two reasons. A). The knowledge on how the letter was written. B). The focus on the first visual feature (start of the letter) among the ten divisions.

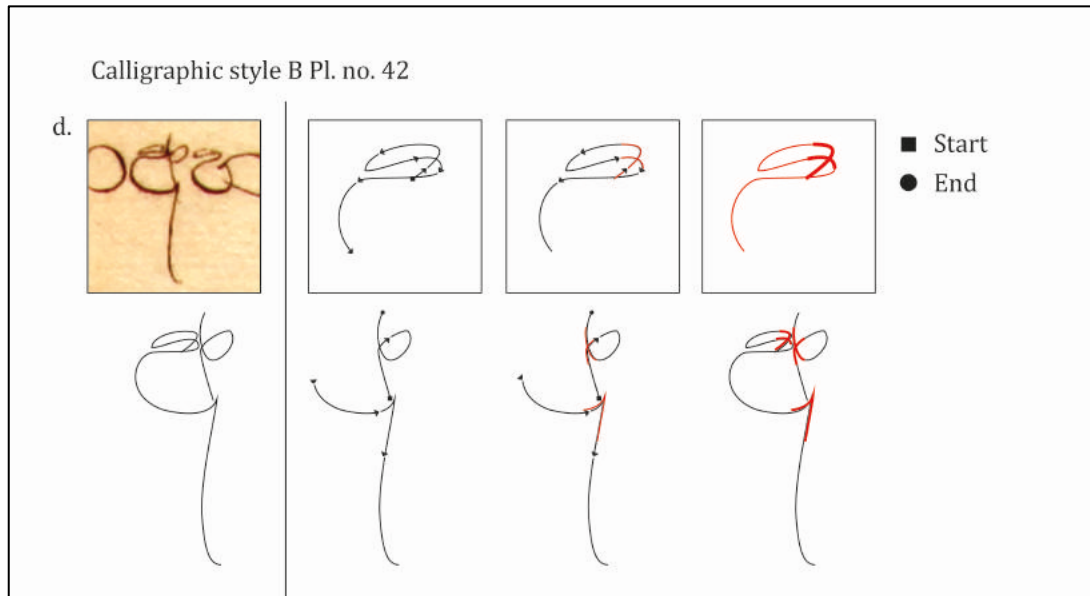


Figure 3.13 Pl. no. 42 Smooth flow of ink to identify the letter $a(\text{අ})$

Specified visual feature with the application of speed

The specified visual feature is the first category among the ten divisions given by Dissanayake. It takes the form of an eye and is a common visual feature among Sinhala letters. We now apply speed to the hand when constructing x . As a result, the visual feature changes to two diagonal strokes connected to each other.

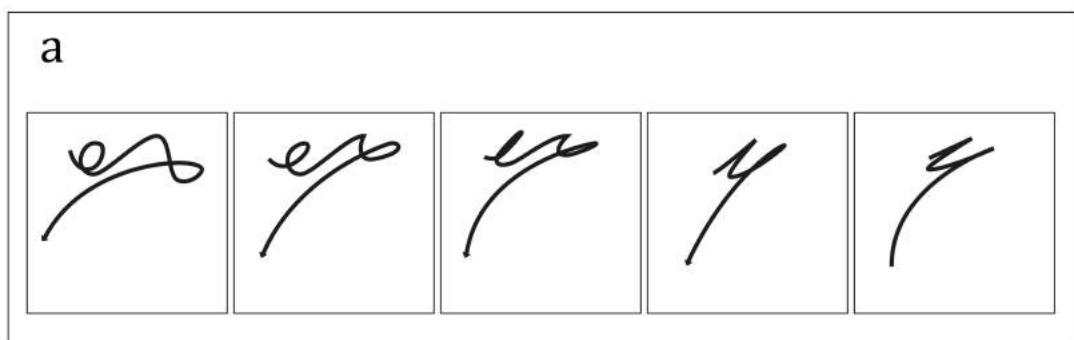


Figure 3.14 Visual feature x in pl. no. 11, Style A: the influence of the speed of writing

In the reconstruction process of the calligraphic style B, (pl. no. 42) we identify a different way of writing *x*. There again, when we apply speed (figure 3.15), we see the adjustment of pressure within the letter; it begins with less to produce a fine line and then, with the increase of pressure of the hand, a thick stroke is created. This continuing stroke concludes with minimal pressure indicating a fine descending stroke. The second stroke starts at the center of the letter and continues with a knot; yet due to the fine adjustment of pressure and the angle of the nib, we do not find an ink trap (figure 3.17 f.) but a loop like shape. By identifying the sudden change in the direction of the nib, one can observe a gradual thin to thick or thick to thin contrast in the stroke, which is defined as the ‘stress’ in typography. Therefore, by observing the stress of the letter, one can identify the direction and the lifts of the nib.

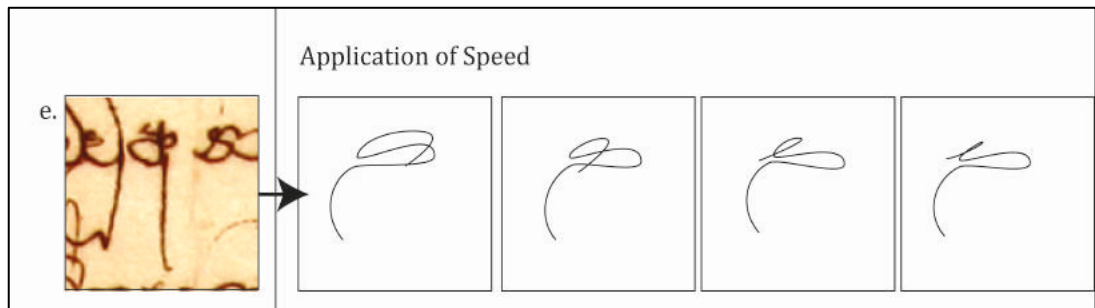


Figure 3.15 Visual feature *x* in pl. no. 42, Style B : the influence of the speed of writing

The idea of knowing how the letters were written, helped to apply speed to the hand. And concentrating on the visual feature *x*, helped to identify how one feature is composed differently. Figure 3.16 explains how the letter *a*(æ) is written with minute visual variations.

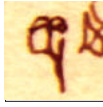
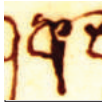
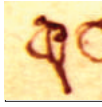
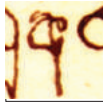

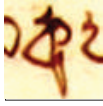




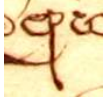
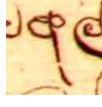
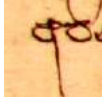
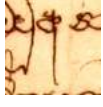
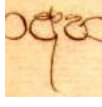
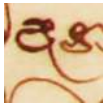
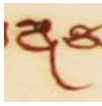



Calligraphic Style A		Selected Letterforms				
a අ	pl.no.05					
	pl.no.11					
Calligraphic Style B						
a අ	pl.no.42					
	pl.no.48					

Figure 3.16 minute visual variations of the letter *a*(අ)

We conclude this visual survey by observing the specific visual features with Schade's typeface. This typeface is documented in a *plakkaaten* dated 1737 April 05th.

3.2.4 Calligraphic style A and B verses Schade typeface

The focus of this thesis is not on the resemblance of Schade's typeface with other handwritten styles of the same era; but, on the importance of visual features of Sinhala letters. Therefore, this survey is limited to focusing only on one visual feature (*x*) and on one letter within two calligraphic styles.

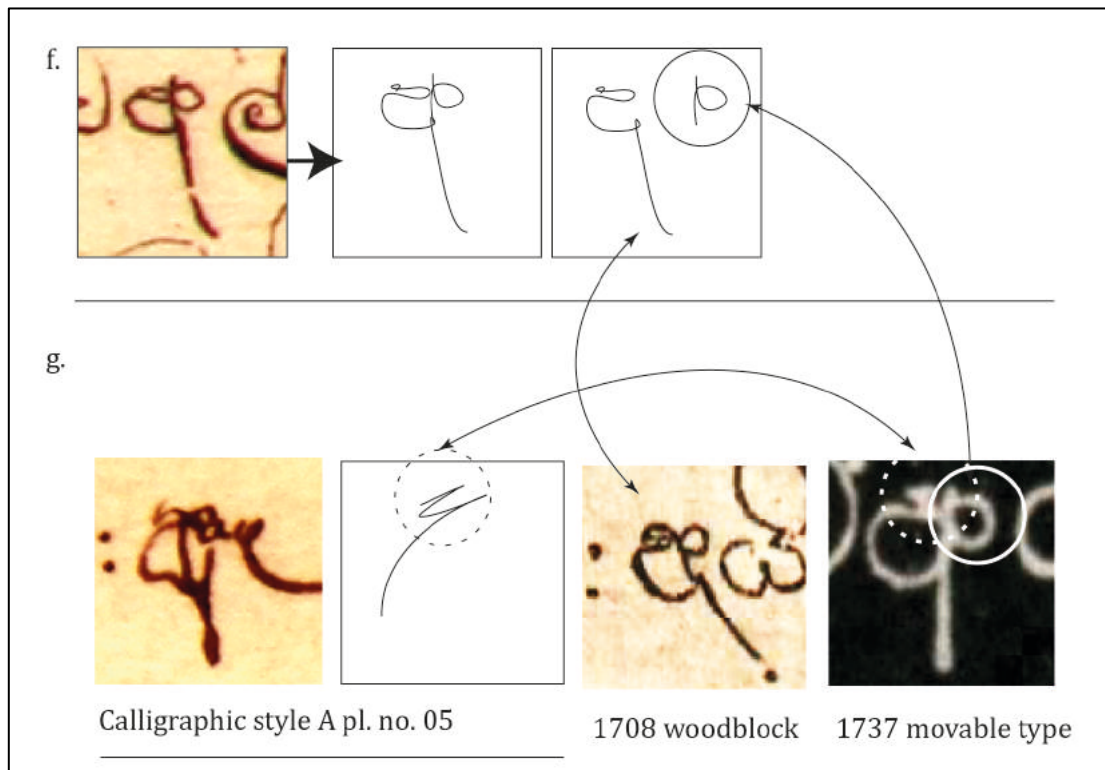


Figure 3.17 Influence of Handwritten Letters with the First Typeface

The *x* of calligraphic style A resembles Schade's *x*. This was identified by learning how the letter was reconstructed, and by applying speed to the hand. As a result, we see the outcome of two different calligraphic styles construct the visual feature *x* in two different ways. The end stroke of the letter *a*(අ) in calligraphic style B, resembles Schade's *a*(අ). This can be considered as a direct copy (imitation) of what Schade saw in the letter. Other features that make the letter *a*(අ) cannot be discussed as Dissanayake's work is limited to the starts and the ends of Sinhala letterform. At the end of this visual survey, we identify that certain calligraphic styles during the same era had influenced Schade's typeface. But we are unable to pinpoint the specific calligraphic style due to the limited scope of this study. Nevertheless the survey contributed to the overall study by indicating the limitations of the existing literature on Sinhala letterforms and warrants the need to capture anatomic features of the Sinhala letterform.

In reference to the visual survey, the following observations on the Sinhala letterform and the existing literature are listed below.

Limitations in existing visual features - The knowledge on the visual features of each Sinhala letter is limited to the start and the end strokes. This can be explained as a disadvantage to identify the overall structure of each Sinhala letter relevant to Sinhala typography. The proposed letter divisions by Dissanayake were based on how the letter is written. Therefore, we find an absence in literature that discusses on Sinhala type or typefaces.

Need to identify the distinct feature of each letter -The survey analyzed one selected letter *a*(අ). It explained to us the visual variation of one single letter that needed to be studied. Therefore, to understand anatomical features of Sinhala letterforms, it is important to know the distinct nature of each Sinhala letter.

Existence of terminology on visual features - The start and the end strokes of the Sinhala letter, explained by the expert, are justified visually and numerically with no terminology. This explains the existing literature on the visual features of the Sinhala letterform has no vocabulary to define them.

Influence of letter form in typeface -The analysis of the early calligraphic styles communicated how the letters were written. Thus, it resulted in the expression of the overall Sinhala letterform. This analysis and documentation of early letterforms conveyed meaning to the form of the overall structure of the letter, and its stylistic approach that can influence current typefaces. Therefore, it is important to look at historical letterforms/typefaces to learn for the future.

3.3 Historical outline on the Documentation of Sinhala Type

The earlier section discussed the introduction of the printing press to Sri Lanka and the importance of knowing early Sinhala letterforms, and how they had inspired and transformed into a typeface. Therefore, to learn more on early typefaces, this section presents a historical outline as background on the development of Sinhala typefaces.

It reviews the growth of the printing press and the technological changes the type goes through to capture the current status of Sinhala type. This is then summarized into three phases on the availability of archival material and accessible fonts to continue this research.

3.3.1 Sinhala Typefaces with the Growth of the Printing Press

The following section discusses the development of the Sinhala type with the growth of the printing press. Since there is no direct literature on Sinhala type, this is an investigation on the social and political features that impacted the early printing press. It explains the importance of Sinhala type and the establishment of printing presses and its silent growth. It speaks of the developing number of typefaces, but with several fallbacks. Yet, to know the early typefaces, we observe archival prints as they are the only witness for evidence of Sinhala typefaces.

Dutch Period (1656 – 1796)

The first Sinhala printed document, records the first Sinhala typeface. As discussed in the first part of this section, it was printed under Dutch Administration. The first printed *plakkaaten* (1737, April) comprises two sizes of type. The large size is 36 point (pt) and the body size is 18pt. A sample text is indicated in figure 3.11. The first locally printed Sinhala book: *Singaleesch Gebede Boek* (1737, May) is compiled with one size of type (36pt), and it contains Sinhala numerals. The author calculated the point size of these typefaces by measuring the height of the pure consonant *dha*(ඳ) with the use of a pica ruler, as it touches the two extreme points of the composing lines. Kularatne documents 63 books/booklets to have been printed during the Dutch period in addition to the *plakkaaten*. The most comprehensive list of publications (books and pamphlets) completed during this period was by Graham Shaw. They were printed in Sinhala, Tamil, Portuguese and Dutch with the use of three scripts: Roman, Sinhala, and Tamil type (2006:29-30).

The designer of the first Sinhala typeface is considered as Gabriel Schade. At the beginning of this chapter, we learnt that his death prevented him from having a look at the first print. Therefore, by observing the print, it can be presumed that he

cast two sets of matrices before 1737; and any other cast of type would be of someone else. Records indicate Johann Bernhardt Arnhardt and Pieter Bruwaart were the printers and Hans Barents, Johann Fredrick

Christop Dornheim were foremen of the printing press after Schade till 1790. The publications of this period were confined to the state and the church, and most of these are now considered as archival material. Since there is no literature on the number of Sinhala typefaces completed during this period, the existing typefaces can be observed in publications of this period.

British Period (1796 - 1948)

The British arrived in Colombo Fort on the 15th of February 1796. With their arrival, the administration of the maritime province under the Dutch control, and the press, was taken over by the British. As an outcome, the commercial and political servants of the Dutch administration were given the option to continue their work. Therefore, it is assumed that the workers and the print material would have had little interruption during this transition (Kannangara cited in Kularatne 2006:32).

For nearly two years, the British East India Company at Madras administered Ceylon till the arrival of the first Governor, Federick North. As a result the press was called the 'Government Press'. After the arrival of the British, the most significant publication completed by the printing press was 'the Ceylon Gazette' and it was printed in English. This was done six years after the arrival of the British and was printed by the Head Printer: Frans de Bruin. Another remarkable impact during North's period was the grant of freedom to worship, which was restricted during the Dutch Administration. This benefited the Buddhists, the Roman Catholics and even the Dutch clergy to continue their missionary work in Ceylon. But the most outstanding act was the invitation to missionaries. The missionary enterprise in the island centered around three activities: setting up of churches, establishment of schools and the activity of printing. "Almost all the missionary groups in Ceylon wanted to set up their own printing establishment soon after their arrival"

(Kularatne 2006: 61). The following table shows the arrival of the missionaries and the establishment of their presses, based on Kularatne.

Name of Mission	Arrival	Est. of Press	Location of the Press
Baptist	1812	1841	Kandy
Wesleyan Methodists	1814	1815	Colombo
American Missionary	1816	1834	Manipay, Jaffna
Church Missionaries (Anglicans)	1818	1823	Kotte
		1826	Nallur, Jaffna
The Colombo Catholic Press		1843	Colombo
<u>Societies</u>	1812	1814	Colombo
The Ceylon Auxiliary Bible Society			
The Jaffna Religious Tract Society		1823-1867	Most printing was done at the Church Missionary press, Nallur
The Colombo Auxiliary Religious Tract Society		1825-1849	
Cotta Auxiliary Religious Tract Society		1833-1862	
The Kandy Religious Tract Society		1847-1849	
The Sinhalese Religious Tract Society		1849-1859	
Ceylon Christian Vernacular Education and Religious Tract Society		1859-1868	
The Society for Promoting Christian Knowledge		1816	

Table 3.2: List of the establishment of Missionary Presses

The arrival of the missionaries contributed immensely to the development of the press. It was with the help of the missionaries and their societies that the British got assistance to recover the abandoned status of the Government Press. Bruin who printed the Government Gazette had been a habitual drinker, which brought disorder

in the press till 1814. (Kularatne 2006: 37). Under the next governor, Brownrigg, an invitation was sent in 1815 to W.M. Harvard to reorganize the printing press. The Head Printer, Nicholas Bergman at the time, carried out his duties under Harvard's instructions. The position of the 'Head Printer', which started with G. Schade continued till 1833, and this position was usually held by the senior most type compositor. Thereafter, the post of 'Superintendent' becomes the controlling body of the press, while mostly individuals who did not know the subject of printing held this position till 1849. Annexure 3.2 provides the names of the relevant persons, positions and their period of duty. However, it was during Harvard's supervision, that several comments were made on the status of the type being broken and impossibility to print. He states:

“Whole fount of type were rendered unserviceable, by large mass of broken matter cast among them; and the materials which were in use were so intermixed to render correctness, (to say nothing of neatness) utterly impossible” (cited in Kularatne 2006:35).

The Ceylon Auxiliary Bible Society, on the other hand did the printing and publishing of Christian literature after the advent of the British. They themselves had their own printing press to accomplish their objectives; and the objective of this society was to print the Bible or parts of the Bible in local languages. At this time, there were no copies of the Bible in Sinhala or in Tamil in the island. Therefore, the first Chaplain and Superintendent of Schools in Colombo: T.J Twisleton, makes an agreement with the Calcutta Auxiliary Bible Society(CABS) for five thousand copies of the New Testament in Sinhala (Kularatne 2006: 62). As a result of this request, the Calcutta Society presented two thousand copies, which was printed at the Serampore printing press. The 1st report of the CABS, mentions that the Secretary of the Calcutta Auxiliary bought the types from Serampore to be sent to Colombo and that they arrived on the 15th March 1813 (Kularatne 2006: 64). This explains that the typeface that printed the New Testaments of Serampore to have the first typeface during the British period. A sample text is found below Figure 3.18. And, that the CABS printing press (1814) to be the second printing office since the establishment of the Government Press. But it was short lived due to the poor health of the superintendent

of the press, and was removed to the Wesleyan Mission House in Pettah in 1816 (Kularatne 2006: 68).

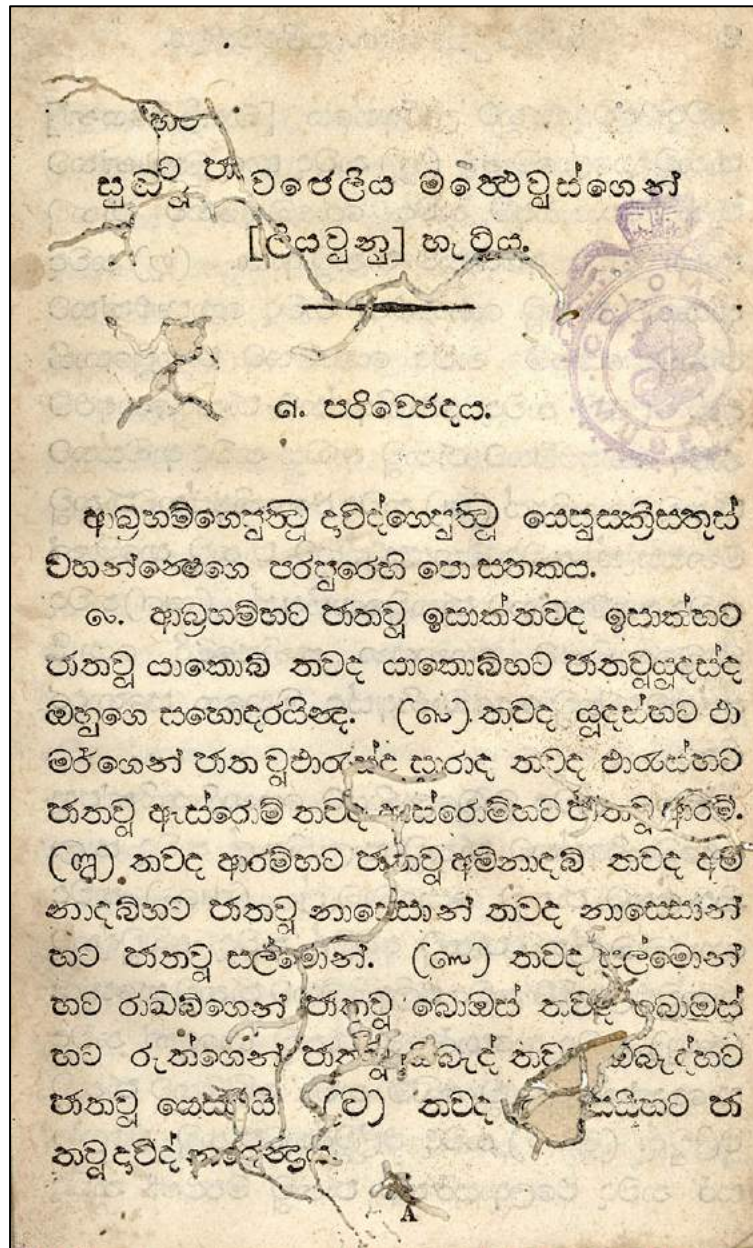


Figure 3.18 : Sample page of the Serampore Bible

Nevertheless, The involvement of Harvard at the Government Press was also evident at the same time. Harvard himself was a Wesleyan Missionary, who had learnt type foundry work at the Fry and Co. in London (Kularatne 2006: 69). In 1818, Harvard speaks of proceeding and completing work on the “Serampore fount of types,

in order to begin the Cingalese New Testament in the octavo size” (Kularatne 2006: 86). This comment of Harvard explains that another set of Sinhala type, smaller in size, similar to the Serampore type is been cast by him. The task of making a type means the process of punch cutting and casting of metal. Kularatne assumes the help of clever native punch cutters and presumes them to be silversmiths, because they were traditionally trained in tooling intricate engravings, who were at Harvard’s disposal (Kularatne 2006: 86).

Expansion of Missionaries

The arrival of the missionaries contributed immensely towards the growth of the printing press, most importantly the development of typefaces. At the inception of most missionary presses, we learn the need for type. The adaptation of printing created a need for type and as a result, a shortage of type was faced. The Church Missionary Society press, which was established in 1823, requested for the Serampore type to start their press work (Kularatne 2006: 106) and by 1825, due to the lack of Sinhala type they continued printing with two founts of Sinhala (Kularatne 2006: 108). Up until 1834, the shortage was not met as records indicate that they requested for matrices for new Sinhala type from Madras. It was evident that type foundry work was limited to the Government Press and the Wesleyans Missionary press because of the availability of matrices and material.

The names of natives or the contributors, who assisted the creating of Sinhala type are rarely documented. But what is known is the continuous assistance by the natives towards this process. The assistance provided by the natives is said to have been ‘in-proper’, as Harvard and Clough stated ‘the execution not being so boastful, due to the in-proper attention by the workmen’. Yet, this could be because of the lack of exposure to such machinery. Nevertheless, the interest in publications by the Sinhala and Tamil natives was high. Therefore, the need for publications increased, with a handful of capable people working at the presses. Even with such shortcomings the growth of publications in most Missionary presses and the Government Press increased with time. This growth can be documented by the

number of publications catalogued as archival material both locally and internationally.

Buddhist revival (1860's)

It was a time where print material on Christianity was growing rapidly within the island. In 1868, there was an instance when the Wesleyans Missionary Press, printed more books than the Government Press. Christian publication grew immensely. Among the most controversial Christian publications in Sinhala was written by D.J. Gogerly, titled *Kristiyani Pragnyapthiya* (The Evidence and Doctrines of the Christian Religion) in 1848; and reprinted in 1853 and 1857 (Kularatne 2006: 99). And as a result, Buddhist monks came out in the open and protested at several places in the country – Baddegama (1865), Varagoda (1865), Udanvita (1866), Gampola (1871) and Panadura (1873).

With the initiation of Buddhist monks, Bulatgama Sumanatissa *thera* and Hikkaduve Sumangala *thera*, and with the financial assistance by King Mongkul of Siam and a wealthy local (Kandyen) chief, a new printing press was established in 1862. The press was known as the 'Lankopakara Press' and was known as the first Buddhist Press. The first report of the Lankopakara Press states that the matrices, punches and the cases for type were made locally and by 1865 more than 40,000 pamphlets and tracts were issued by this press (Kularatne 2006: 159). The next press was established by Mohottivatte Gunanada *thera*, who was in the forefront of most public debates, and supported by *Sarvajana Sasanabhivarddhidayke Samagama* (Society for the Propagation of Buddhism) the second press was established. The Church Mission Press (CMP), Kotte, initially used the press that was bought for the establishment of the second Buddhist press. A Sinhala workman at the CMP had purchased the press in 1855. Even though records state that the establishment of the *Lankopakara Press* was in 1862, it is believed to have printed the first Sinhala newspaper: *Lankalokaya* in 1860. This can be justified, as records say that the press was bought in 1855. By 1883 The Buddhist Theosophical Society established another press called the *Bauddha Mudra Yantranalaya* and within a course of ten years, over 80,000

publications (Pamphlets and tracts) were printed. A newspaper for the Buddhists – *Sarasavi Sandarasa*, was also printed at this press.

Yet, The biggest influence from the natives towards the printing establishments was the purchase of this 1855 printing press. Since the Buddhist revival was a conspiracy that was building up against the colonizers, no records are left on type related matter. In 1870, the report of the Government Printer states that an attempt was made to steal types from the Government Press. The records state that it was by two workmen (a peon and a punkah puller), and that they had with them type weight of 60lb; the receiver (not mentioned) was waiting to receive the removed type on a bullock hackery, (Kularatne 2006: 41). This conveys the shortage of type within the country and the existence of indigenous type foundries by 1870.

The search towards the existing typefaces of this period is left for further study. But, this background knowledge conveys the limitation in literature on early Sinhala typefaces. Since this study is not focused on the documentation, but on typefaces of this era, we take this knowledge to observe (the original sources) of the prints; and to consider the printed typeface as specimens in chapter five.

3.3.2 Sinhala Type Within the Newspaper Industry and Technological Development

The earlier section discussed the growth of typefaces since the inception of the printing press; it spoke about the limitations in literature, and that it is a challenge to document all typefaces. Therefore, to understand and access available typefaces, a systematic structure is important. The search looks at the newspaper industry because of its systematic documentation that can be chronologically observed. Since the inception of the first Sinhala newspaper, all registered newspapers (np) are catalogued and archived at the Dept. of National Archives, Colombo. The archived np's are accessible for research purposes and contain a variety of typefaces. Thus, typefaces used for the body of the text are reviewed. Since the chapter speaks of the background of the typefaces, this section discusses the chronological development of type-composing techniques within the context of Sri Lanka.

Movable type composing (From 1737)

This is a technique where the relief of a single block of metal presses onto a surface. Each of these blocks of type is cast to create a body of type. Schade initiated this process by hand-cutting the punches and casting the first Sinhala type in 1737. Since then, up until 1980's, this form of relief printing was common in Sri Lanka. Movable type does not limit the Sinhala letter to sixty characters. At the time Schade was cutting punches, there had been a common practice of the use of conjunct consonants. As a result, Schade's and the Serampore typeface contained a large number of conjunct consonants, cast as individual characters.

All of the characters in movable type were usually stored in type cases. They are termed as upper case (උඩ තට්ටුව) and lower case (හත තට්ටුව). Each case is made of individual compartments to store each character. Silva states that there are usually two cases to store Sinhala characters figure 3.19 but, an exception of four cases was evident at the Government Press and it is illustrated in figure 3.20. The above-mentioned compartment in a type case demonstrates the number of Sinhala glyphs (characters) used for letterpress printing and, the most frequently used Sinhala characters are based on the space allocated in the compartments.

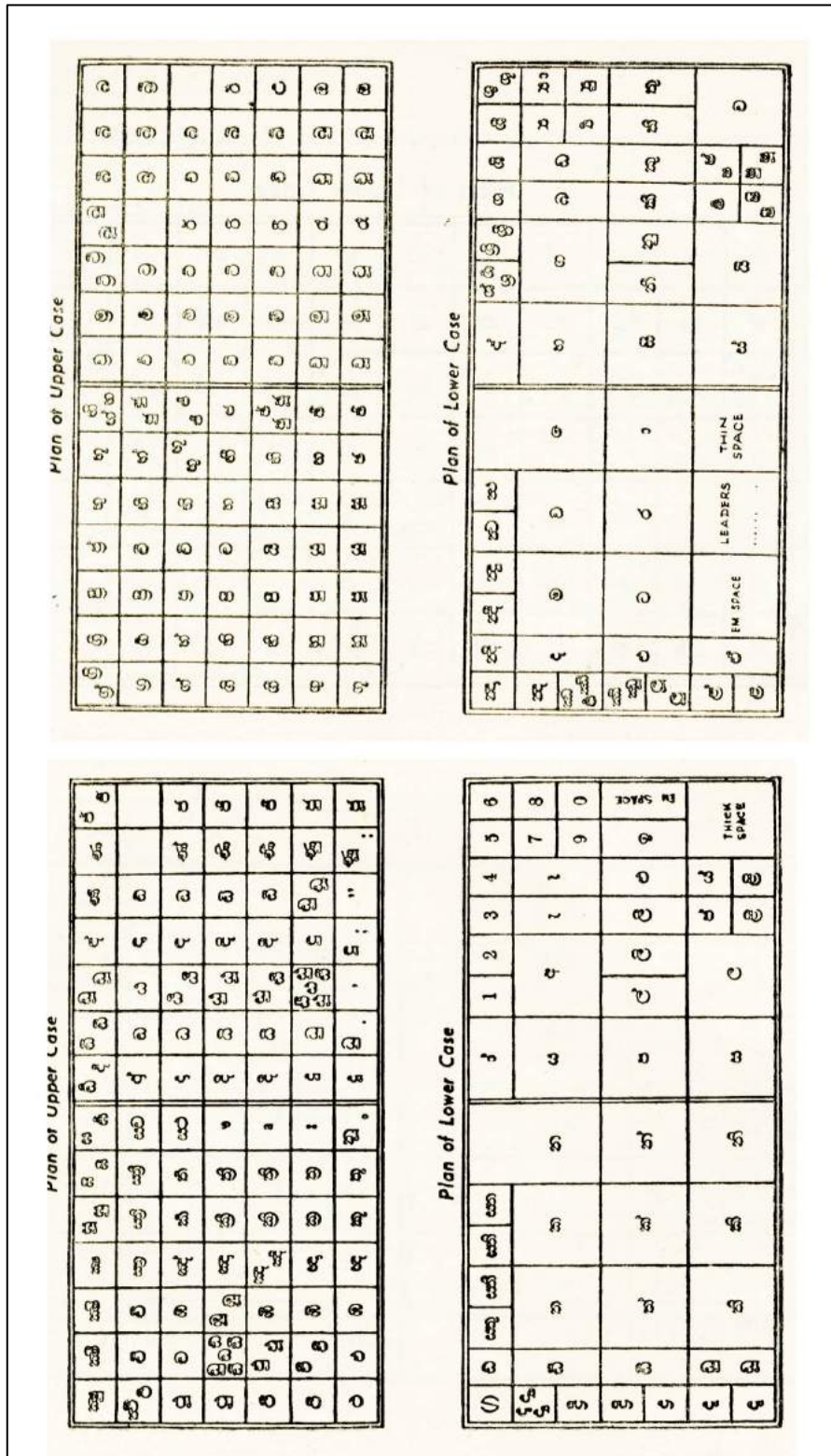


Figure 3.20 Government Press :Storing of Sinhala Characters in Cases
 Source: Silva K. A. S., (1973)

Characters and type foundries: Among the silent trail of native type designers, records of N.J. Cooray stand out. A catalogue published by N.J. Cooray type foundry in 1962, declares that the foundry was established on 1892 and that the motivation was given by Mulleriyawe Gunaratane *thera*. Wilson states that 'Cooray had raised Standards of Sinhalese hand-cut types' (Rafael 2012: 37). Cooray's catalogue documents several sizes and styles of Sinhala type (Figure 3.21). This included Sinhala regular, italics, bold and display typefaces. The sizes are defined by names, which were common to that era. Cooray's catalogue contained Bourgeois type, Small pica Modern types, Small pica italic type, Small pica Antique types, Two line Brevier small pica size. We identify the use of the term 'white' letters to define 'regular' type as an exception in the catalogue.

Similar practice is seen in the catalogue of Chithra type foundry; established in 1965. It uses the same term 'white' to define regular type sizes. The founder of Chithra is third generation N.J. Cooray; the great grandson, who ironically holds the same initials to his name. whereas, the name of the Type Foundry 'Chithra' conveys 'Chintha', who is the daughter of N.J. Cooray Jr. Another commonality between the two catalogues is the term 'mono' to describe a set of typefaces. Both, catalogues contain a variety of type sizes and weights as Mono typefaces. Therefore, to find out, if both carry the same typeface or holds the same name for two typefaces, a visual study needs to be conducted. Another query is also to find out if these typefaces are the same typefaces of the Monotype Corporation. Nevertheless, the work of Monotype and Linotype are discussed in the following section.

සීමාසහිත ඇන්. ජේ. කුරේ සහ පුත්‍රයෝ.
දෙමටගොඩ පෙදෙස, කොළඹ.

සිංහල අකුරු වගී

සෙමිල්පසිකා කළු අකුරු Small Pica Antique Types

2/50 සීමාසහිත ඇන්. ජේ. කුරේ සහ පුත්‍රයින්ගේ සිංහල, ඉංග්‍රීසි, දෙමළ අකුරු සහ අනිකුත් මුද්‍රණ උපකරණ.

පොයින්ට් 14 සිංහල අකුරු 14 Point Types

2/50 සීමාසහිත ඇන්. ජේ. කුරේ සහ පුත්‍රයින්ගේ සිංහල, ඉංග්‍රීසි, දෙමළ අකුරු සහ අනිකුත් මුද්‍රණ උපකරණ.

දිලසින් බ්‍රිවියර් අකුරු Two Line Brevier Types

2/50 සීමාසහිත ඇන්. ජේ. කුරේ සහ පුත්‍රයින්ගේ සිංහල, ඉංග්‍රීසි, දෙමළ අකුරු සහ අනිකුත් මුද්‍රණ උපකරණ.

පොයින්ට් 22 සිංහල අකුරු 22 Point Types

2/25 සීමාසහිත ඇන්. ජේ. කුරේ සහ පුත්‍රයින්ගේ මුද්‍රණ අකුරු

1/10 සවසනික අකුරු

1/15 සිරියා අකුරු

N. J. COORAY & SONS LTD.

Dematagoda Place,

(Phone 95123)

COLOMBO 9.

Figure 3.21: Sample of N.J. Cooray Type Foundry' Catalog

On a personal interview with the daughter of N.J.Cooray Jr. we learnt that Cooray traveled to Japan to learn the craft and trade of type with the hope of expanding the foundry work. On his return, he had purchased machinery. Three Kaiko machines to cast type, a shadowgraph machine (Model 6, Nippon Kogaku K.K. Japan) to trace and draw letters, and a machine that works is a pantograph but a Japanese model called 'Tsugami'. The Tsugami machine helped to trace the Sinhala letters and outputs metrics on the required sizes. He had used a stencil made of aluminium to trace the letter. Therefore, for each letter, an individual stencil was cut. For letters that have similar visual features, he had used the same stencil with multiple visual features inserted into it (Figure 3.22). Therefore, most stencils do not carry readable letterforms because of the insertion of vowel signs. As for the designer, a few years later, after his return he passed away leaving the knowledge to his widow and the two year old daughter Chinthra (Personal interview 2014). An industry that would have developed with the developing technologies ends, due to its confined knowledge of the designer. Pioneering type foundry N.J.Cooray, together with the leading type foundries of the early 1950's: Chithra and M. N. Shanthi and Company continued casting type for letterpress printing. And to date, Chithra is the only type founder still in existence.



Figure 3.22: Stencils of Chithra used for the Shadowgraph machine

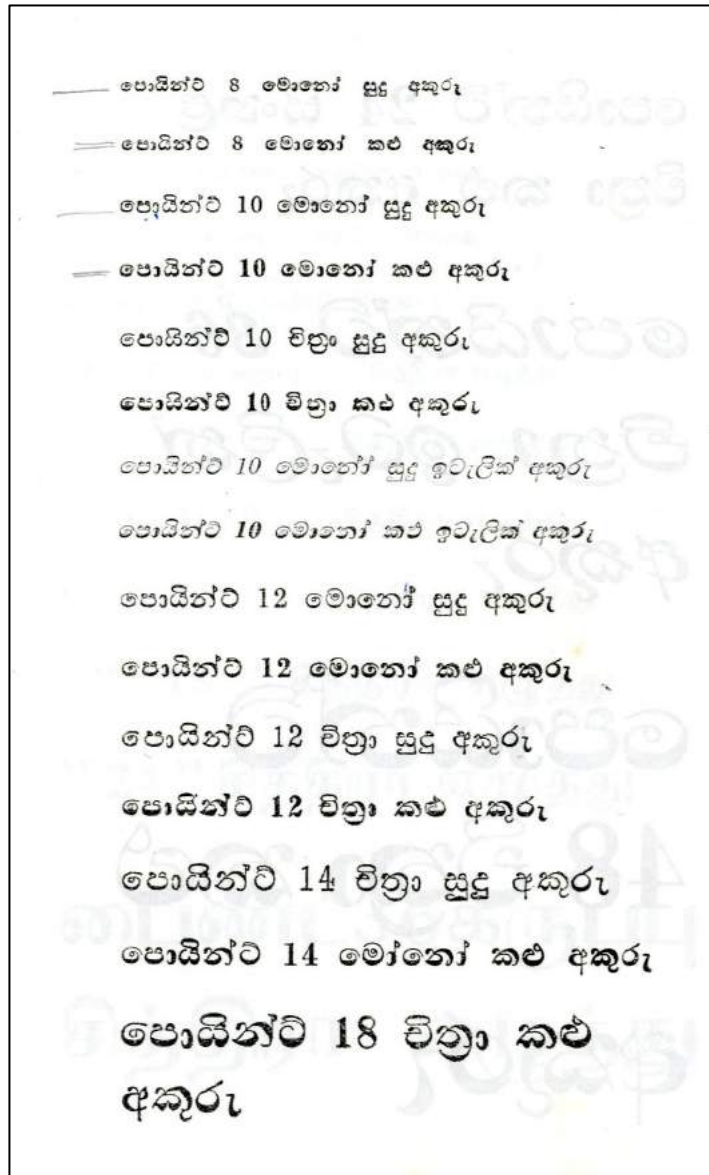


Figure 3.23: Sample of Chithra Type Founders' Catalog

Other than the metal type, the uses of woodblock letters were evident in newspapers. From the first Sinhala newspaper, the use of woodblock is used for newspaper titles. The variety of newspaper titles range from the simplest decorative letterform to intricate titles (figure 3.23). In other areas we find woodblock printing is for the headlines in newspapers (usually with the body copy). They are carved as large as 200pt-240pt. Such prints are seen prior to the country's Independence from the British, as an expression of thought; in newspapers on social and political matters. Starting with the Nationalist movements and Marxist movements followed by new

political parties and governing parties continued the use of large headlines carved out of woodblock in newspapers. The large letters are individually carved as blocks, while some headlines are completely carved as blocks.



Figure 3.24 Samples of Wood Block Newspaper Titles



Figure 3.25 Samples of Wood Block Newspaper Headlines

Hot-metal Type casting (1900's)

A similar concept of a relief is used in hot metal type composting. What differs is the mechanized casting process invented by two companies – Linotype and Monotype. The Linotype casting machine, heats metal and produced lines as slugs, as a result an entire line of body is cast at the speed of a typing keyboard. Whereas Monotype the casting machine casts single characters to create a justified line of body. Both machines have keyboards; therefore the widely used 600 letter alphabet got narrowed down. Wilson states that a group of scholars from the Government Training College for Teachers conducted a research, the focus of which was to minimize the amount of characters needed for ordinary composing and to keep the traditional use of Sinhala script. Monotype specimen 557 series show a total character count of 351 (Figure 3.25), whereas Wickrama states that the Monotype keyboard holds 328 keys and the Monotype typeset consisted of 367 compartments (Wickrama 1997:53).

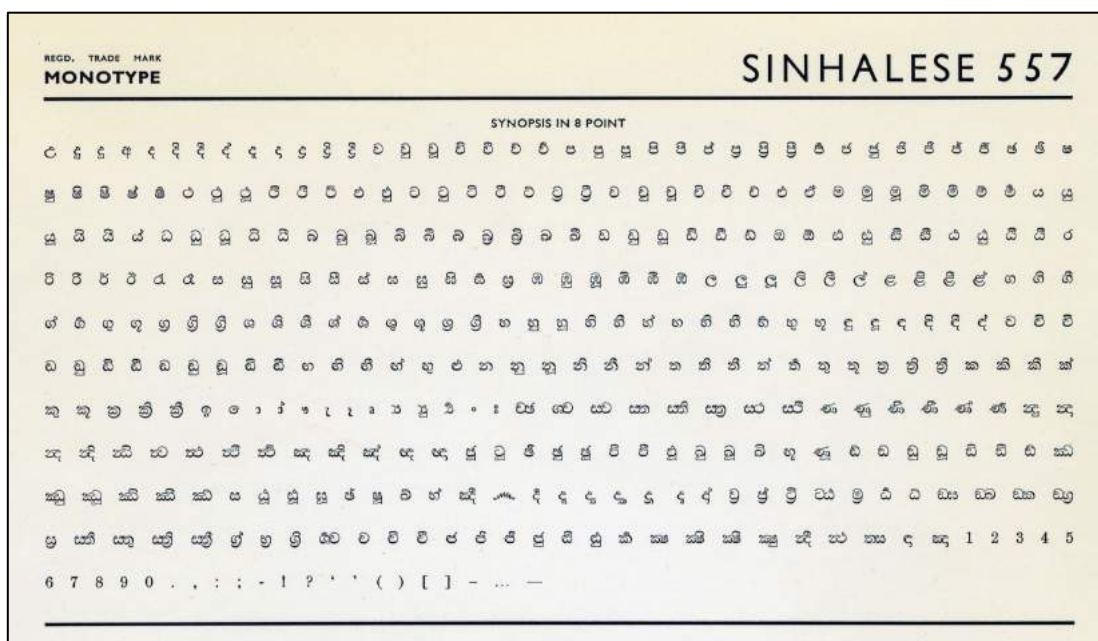


Figure 3.26 Sample of Monotype specimen 557

Source: Saraiva R. (2012)

Linotype Corporation started the process of designing type in 1886. Records indicate that a Linotype machine was in the hands of the Ceylon Times Press by 1915,

probably to cast Latin type. The earliest records of Linotype Sinhala letters were found at the Government Press by 1940 (Rafael 2012: 53). Linotype Sinhala dated 1950, is now kept in the *Mergenthaler* Font Library in Boston, USA. It has a range of 2 type sizes (8pt, 12pt) and two styles of Light and bold. These typefaces were produced in USA. The uses of Linotype typefaces are evident within the newspaper industry and publications printed at the Government Press due to the availability of machinery. Monotype Sinhala typefaces, on the other hand, have recorded several type sizes; as italics; and as bold faces. The Specimen of Sinhalese series 557 convey four type sizes 8, 10, 12, 14pt. After the completion of the above series, another series 657 (Sinhala Bold) was completed in 1957(Rafael 2012: 45). Series 698 and 699 was released in 1967, but aimed at Monophoto machine. The following section discusses the next stage in Sinhala type composing.

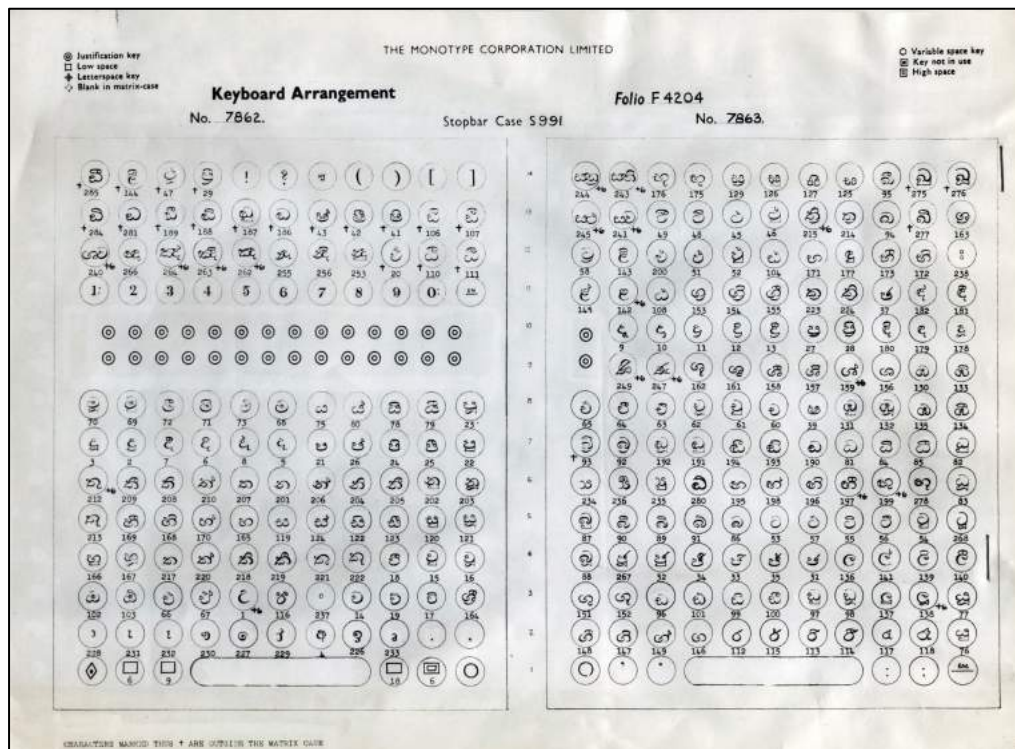


Figure 3.27 Sample of Monotype Keyboard Layout

Source: Saraiva R. (2012)

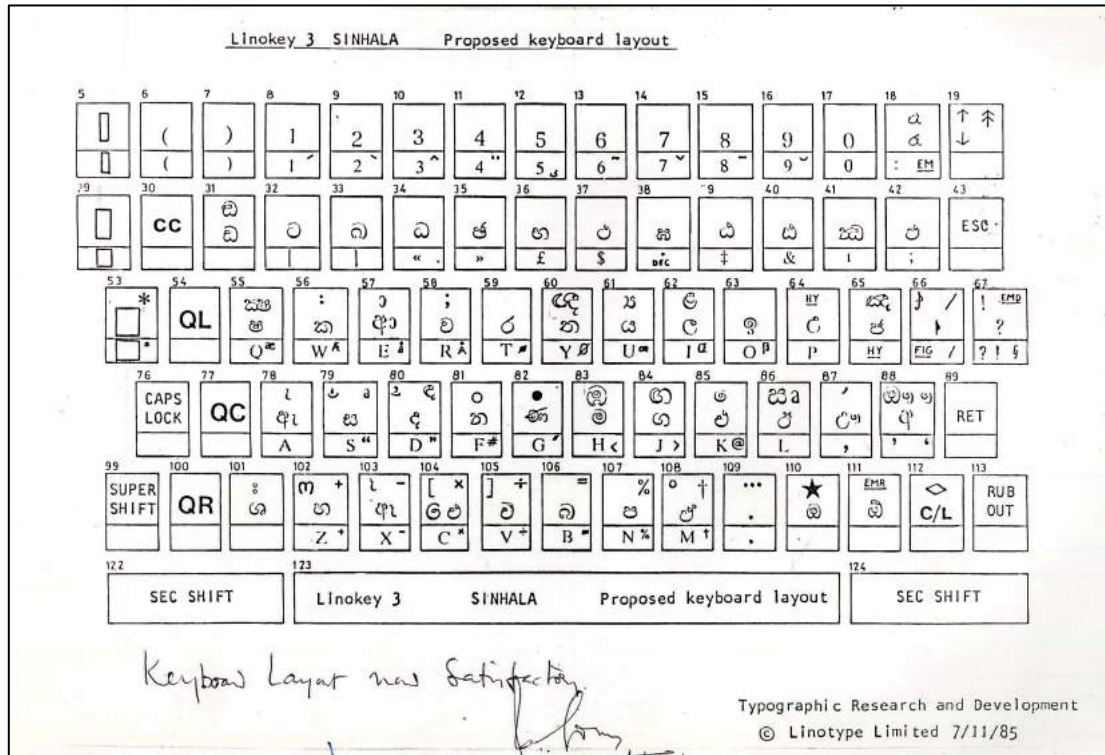


Figure 3.28 Sample of Linotype Keyboard Layout

Source: Saraiva R. (2012)

Photo-type Composing (1970's)

Typesetting started to change with the introduction of new technology. Monotype Corporation, being a market leader, changed its hot metal composing to photo-type composing with the introduction of the Monophoto machine. Wickrama records the photo-type composing to have been adopted around the 1970's to Sri Lanka (Wickrama 49). A proposal to reduce the number of characters was again needed with the adaptation of this new technology. Therefore, Wickrama, who was the General Manager of the State Printing Corporation in the 1970's, proposed six guidelines to compose the Sinhala letters. The proposal indicated a reduction of 328 keys to 70 (Figure 3.27) and gave provision to accommodate three different Sinhala weights (regular, bold, italic) along with Latin. Nevertheless, it was not a success (Wickrama 1997: 49-53). The Monophoto machine was released with an original Sinhala character set, by 1973. And the Monotype series 698 and 699 was released in 1967 for this machine (Rafael 2012: 45). Meanwhile, Linotype revised the 1950 hotmetal typeface to suite the Linotron 202 photosetter and CRTronic photosetter.

The typeface was in use by 1985, at Wijeya Offset, Lake House Printers. The Linotron 202 had a phonetic keying system.

EN	1	2	3	4	5	6	7	8	9	0	EM
240	241	242	243	244	245	246	247	248	249	250	251
252	253	254	255	256	257	258	259	260	261	262	263
264	265	266	267	268	269	270	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286	287
288	289	290	291	292	293	294	295	296	297	298	299
300	301	302	303	304	305	306	307	308	309	310	311
312	313	314	315	316	317	318	319	320	321	322	323
324	325	326	327	328	329	330	331	332	333	334	335
336	337	338	339	340	341	342	343	344	345	346	347
348	349	350	351	352	353	354	355	356	357	358	359
360	361	362	363	364	365	366	367	368	369	370	371
372	373	374	375	376	377	378	379	380	381	382	383
384	385	386	387	388	389	390	391	392	393	394	395
396	397	398	399	400	401	402	403	404	405	406	407
408	409	410	411	412	413	414	415	416	417	418	419
420	421	422	423	424	425	426	427	428	429	430	431
432	433	434	435	436	437	438	439	440	441	442	443
444	445	446	447	448	449	450	451	452	453	454	455
456	457	458	459	460	461	462	463	464	465	466	467
468	469	470	471	472	473	474	475	476	477	478	479
480	481	482	483	484	485	486	487	488	489	490	491
492	493	494	495	496	497	498	499	500	501	502	503
504	505	506	507	508	509	510	511	512	513	514	515
516	517	518	519	520	521	522	523	524	525	526	527
528	529	530	531	532	533	534	535	536	537	538	539
540	541	542	543	544	545	546	547	548	549	550	551
552	553	554	555	556	557	558	559	560	561	562	563
564	565	566	567	568	569	570	571	572	573	574	575
576	577	578	579	580	581	582	583	584	585	586	587
588	589	590	591	592	593	594	595	596	597	598	599
600	601	602	603	604	605	606	607	608	609	610	611
612	613	614	615	616	617	618	619	620	621	622	623
624	625	626	627	628	629	630	631	632	633	634	635
636	637	638	639	640	641	642	643	644	645	646	647
648	649	650	651	652	653	654	655	656	657	658	659
660	661	662	663	664	665	666	667	668	669	670	671
672	673	674	675	676	677	678	679	680	681	682	683
684	685	686	687	688	689	690	691	692	693	694	695
696	697	698	699	700	701	702	703	704	705	706	707
708	709	710	711	712	713	714	715	716	717	718	719
720	721	722	723	724	725	726	727	728	729	730	731
732	733	734	735	736	737	738	739	740	741	742	743
744	745	746	747	748	749	750	751	752	753	754	755
756	757	758	759	760	761	762	763	764	765	766	767
768	769	770	771	772	773	774	775	776	777	778	779
780	781	782	783	784	785	786	787	788	789	790	791
792	793	794	795	796	797	798	799	800	801	802	803
804	805	806	807	808	809	810	811	812	813	814	815
816	817	818	819	820	821	822	823	824	825	826	827
828	829	830	831	832	833	834	835	836	837	838	839
840	841	842	843	844	845	846	847	848	849	850	851
852	853	854	855	856	857	858	859	860	861	862	863
864	865	866	867	868	869	870	871	872	873	874	875
876	877	878	879	880	881	882	883	884	885	886	887
888	889	890	891	892	893	894	895	896	897	898	899
900	901	902	903	904	905	906	907	908	909	910	911
912	913	914	915	916	917	918	919	920	921	922	923
924	925	926	927	928	929	930	931	932	933	934	935
936	937	938	939	940	941	942	943	944	945	946	947
948	949	950	951	952	953	954	955	956	957	958	959
960	961	962	963	964	965	966	967	968	969	970	971
972	973	974	975	976	977	978	979	980	981	982	983
984	985	986	987	988	989	990	991	992	993	994	995
996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007

Figure 3.29 : Proposed Simplified Monophoto Keyboard

Source: Wickrema, Keino, (1997)

Another development was evident with the introduction of the letter transferring technique. According to Gorden, who had been in the print industry of the time and who had attended the orientation ceremony, that technique was introduced first by Oriental Signs Company in 1973. The brand name of this Company was Alfaca, and it had introduced two Sinhala typefaces; one was a mono liner and the other was a modulated. These two typefaces are believed to have been designed by a person named Wijeyaratne (Personal interview 2013). The other company that introduced this technique was Letraset Company in 1984. This company too, had introduced two typefaces and two different type sizes; both typefaces were designed by Gunasiri Kolambage. The Letraset sheet comprised black and white letters; mono liner or modulated. The mono liner typeface was titled as Prassana.

Digital Type Composing (1980's and beyond)

The next stage of the Sinhala type was the adaptation of computer technology. Wickrama states the first Sinhala word processor was developed by a team of programmers at the Institute of Fundamental Studies in Kandy, and the first Sinhala package 'Vadan Taru' was developed by the Institute of Computer Technology at the University of Ceylon, Colombo (Wickrama 57). Both of the above had errors that made the implications of Sinhala type hard. Meanwhile, the Apple Computers established itself as the standard machine for typesetting and Desktop publishing. Packages such as Font manager were used for typesetting and Wickrama mentions fonts such as *Anuradha*, *Araliya*, *Manel*, *Nelum* and *Ridma* were the popular ones among the Mac users. In Parallel, IBM machines adopted Truetype fonts, and fonts such as *Kandy*, *Lankanatha*, *Lankathilaka*, *Dinamina*, *Thibus* and *Dasuni* became popular among the IBM users.

As a result of this, a demand for Sinhala type was evident and, therefore, fonts used during this stage were copies of another. There exists no copyright law or intellectual property laws that seemed to be applicable to this area. This resulted in a large use of fonts available but held the same visual character. The need to 'design a typeface' was against the norm. Therefore, if we observe visual features of letterforms in typefaces within these fonts, we see similar visual features. Microsoft added the Monotype Sinhala series to the Windows in 2003. Microsoft held the rights to the font and renamed it as '*Iskoola pota*'. The digitalizing of typefaces was done by Monotype Corporation. Rafael compares *Iskoola pota* with Monotypeseries 557 and states a noticeable thickening of strokes that was accommodated for legibility purpose. (Rafael 2012: 51). Similarly, Linotype converts the earlier typeface to postscript format and changes the name to *Araliya*. Ross mentions minor adjustments made to the outline. Among contemporary fonts for the web, we have: Malithi Web, LKLUG, Bhashitha and Dinamina. Rafael analyses the digital files of these fonts and compares them and reveals two almost identical designs: Dinamina and Bashitha. He says, Bhashitha is a corrected version of Dinamina, and Dinamina is a derivation of a previous typeface. Such visual studies

explain the current status of type design in Sri Lanka and that it lacks originality (Rafael 2012: 61).

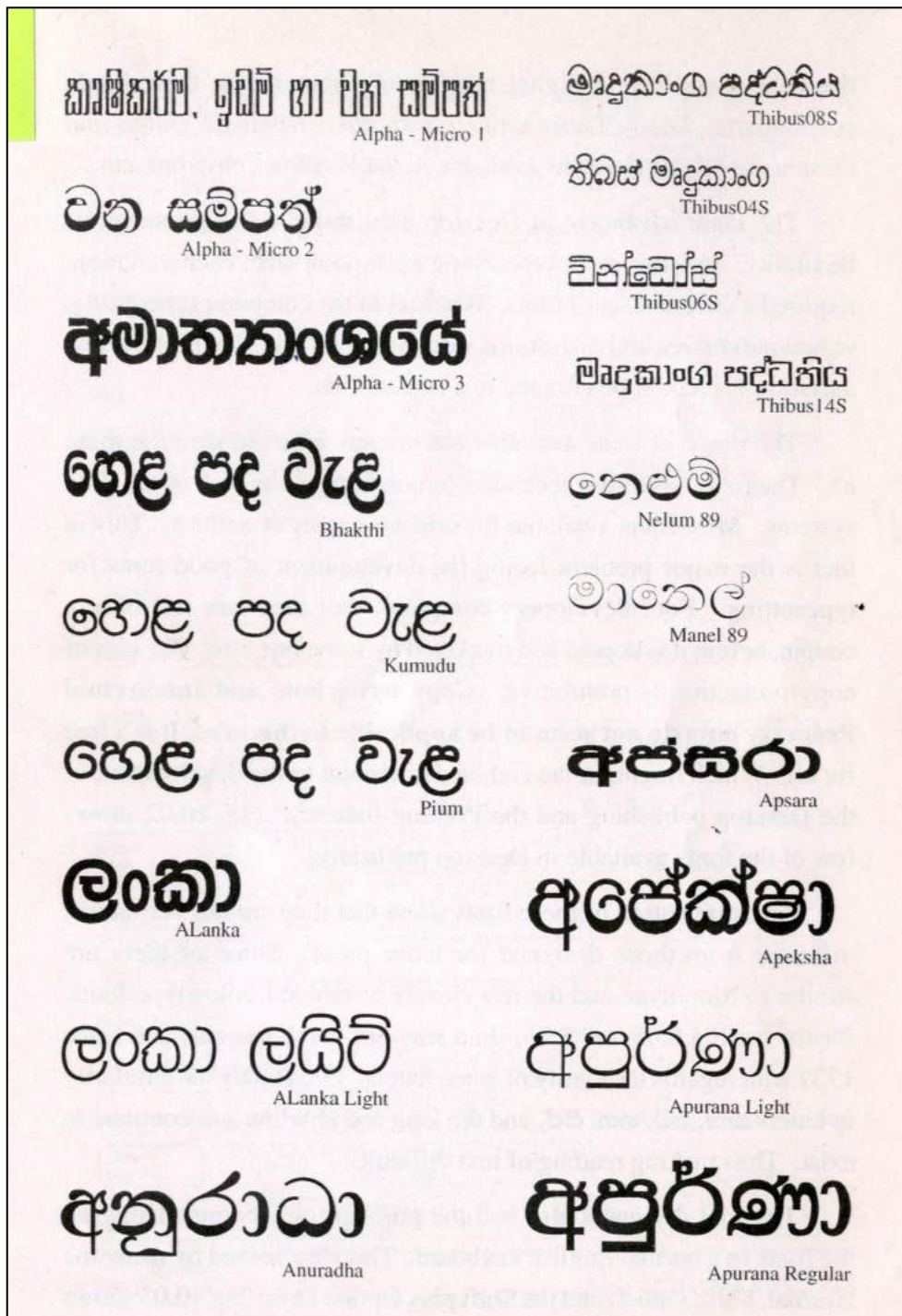


Figure 3.30 : Digital fonts as illustrated by Wickrama

Source: Wickrema, Keino, (1997)

With the boost of Sinhala typefaces required for digital typesetting, type designers are rarely identified. Yet among the contributors are Gunasiri Kolambage for *Divaina*, Thibus, Micro Image Corporation, Modular Infortec for *Sri Lipi*, Pushpananda Ekenayake of Font Master, Sammit Technologies, Anuradha Ratnaweera and Harshular de Silva of *LKLUG*, Linotype for *Iskoola poota*, Sarasavi by Harsha Wijewardena, Premasiri for the ICTA *Bashitha*, Muthu Nathimaran for Mac *Sangama*, Apex font, Monotype for *Noto Sans* etc.

By 1997, Sri Lanka presented a proposal for the Sinhala character code at the Unicode working group in competition with the British, Irish and American proposals. The Sri Lankan characters were included in Unicode version 3.0 (Dias 2005). The encoding operation was conducted by the Council for Information Technology (CINTEC) and by the University of Colombo, School of Computing (UCSC), and it took seven years for the implementation of Sinhala Unicode. And the Sri Lanka Standard Institute (SLSI) standardized this input method in 2004 (Dias 2010). During the 2000's the Information and Communication Technology Agency of Sri Lanka (ICTA) in partnership with the University of Colombo UCSC had conducted a training programme that aimed at providing knowledge and expertise on how to develop standard based fonts (Dias 2005). Such attempts by National Institutes indicate the need and the importance of such work towards type design.

At the conclusion of this literature survey on the historical outline of the development of Sinhala typefaces, the following points were noted.

Lack of Meta-data of typefaces – with the growth of the printing press in the island, we recognized the growth of typefaces. Most typefaces that were created were to overcome technological challenges and as a result most typefaces lack meta-data such as the designer of the face, name of the typeface, name of type foundry and date created.

Designing of Existing Sinhala typefaces – Type foundries of the letterpress era designed typefaces as originals and they are believed to have been self-taught. These

typefaces were unique by itself but, they were family oriented businesses, therefore with time type designing knowledge remained within the family. It was also evident that the letterpress typefaces were copied during the digital era to overcome the fast moving technological changes, and as a result creating of typefaces during this era is not design oriented.

Documentation of the chronological development of Sinhala typefaces –The literature on the development of typefaces are in rudiments, as they are discussed within the context of the printing and publishing. Therefore, in this literature survey on the historical outline, we were able to discuss the chronological journey of the Sinhala typefaces. This helped to structure the list of type composing technologies used within a chronological timeline, together with the sources they were printed/ published on, and where they are archived.

3.4 Summary and Conclusion of the Chapter

As part of the background study this chapter documented the initiation of the first Sinhala type that resulted in the start of the Sinhala printing press in the 18th century. It spoke about the political challenges the designer goes through, the importance of type, and the impact it had to start the printing press. The second part of this chapter was a visual study on the hand written styles of the early 18th century and the influence it had towards the first typeface. This was conducted to review the background of the Sinhala letter and how it had transformed to a type. But when conducting the visual study, we realized the need and the knowledge on the overall structure of the Sinhala letterform. It was identified that the existing literature that contributed to the Sinhala letter, was based on the handwritten Sinhala letter and, there were limits to certain strokes of the letter. Therefore, to discuss visual features of type, we needed to know anatomical features of Sinhala. Also, we learnt that each letter is unique. Therefore, the search on the anatomical features of Sinhala should be an analysis on each Sinhala letter and that it cannot be generalized. At the end of the visual survey, several aspects relevant to this thesis were discussed. It spoke about the lack of literature on the structure of the Sinhala letter and that the existing knowledge is biased to Sinhala handwriting and not to Sinhala typography. Thus, it

explains the significance and the importance of the research; and how it contributes to current knowledge.

With this thought, we discussed the chronological development of the Sinhala type based on technological adaptations. We started the third part of this chapter with a discussion on the growth of the Sinhala printing press and the missionary contribution. It was then followed by the Buddhist revival and together we discussed the growing need for type, within a socio-political viewpoint. As a result of this development, we identified the lack of documentation of the early typefaces and the meta-data. We proposed to observe early publications; analyze the prints; and to consider the type as specimens; to document the typefaces. This type of documentation helps to prepare samples of typefaces that would benefit the latter part (Chapter five) of the thesis.

The background study on the typeface summarizes with a brief discussion on the technological changes the Sinhala type goes through. We observed the development of movable type and its character set based on the type-cases. It discussed the terminology used to describe Sinhala typefaces and its sizes in early catalogues and, reviewed a few early Sinhala type foundries and how they had influenced the other composing technologies. With the introduction of hot metal type composing, the number of characters needed for Sinhala was reduced to accommodate the number of keys in the keyboard. Proposals were brought to reduce the character count further with the introduction of photo-type composing technology but it was not successful.

The boost in the number of Sinhala typefaces was evident with digital type composing. But most typefaces were copies of another and lacked originality. We learn several reasons for it: the demand for Sinhala type within the new technological changes was so much, so the experts copied existing Sinhala typefaces. Another aspect was the non-existence of copyright or intellectual property laws applicable to type designs. The type design process was confined and abrupt. This resulted in the lack of documenting the knowledge on Sinhala typography. The lack of terminology

to describe letterform, or as a matter of fact the understanding of the Sinhala letterform is nearly absent. To bridge this existing gap – the absence of knowledge to constitute the anatomy of Sinhala, next chapter captures what anatomical features are, in relation to other typographic practices. And as an outcome, anatomical features relevant to the Sinhala letter are suggested.

THE ANATOMY: STUDY ON SINHALA LETTERFORM

In this chapter, a short literature survey on what constitutes the anatomy is discussed. It is explained by understanding the practices and implementing of the anatomical features of other scripts of the world. Next, a visual survey was conducted to capture anatomical features of the Sinhala letter through a pilot visual analysis. We review the results and identify limitations in the method to capture the anatomical features for Sinhala. Therefore, the third section proposes a new method to capture visual properties of each Sinhala letter, and through this method certain anatomical features that are relevant to Sinhala anatomy is discussed. This chapter concludes by identifying the distinct nature of each Sinhala letter and the need for a common vocabulary to define the visual properties.

4.1 Anatomy of Other Scripts

A comprehensive amount of research and a fairly standardized vocabulary is evident on the Latin script due to its historical involvement with typographers, publishers, printers and type designers. As discussed in the previous two chapters, theory and literature on the anatomy of the Sinhala letters, in comparison with Latin, is rare. Nevertheless, by observing the practices of the anatomy of Latin and other scripts helps to define the contributing factors that build the anatomy of a specified script.

The concept of the anatomy is derived from the Latin script due to its long print traditions. As a result, the amount of literature based on the anatomy is extensive. Mclean states that it is essential to study the character of each letter because it has its own essential nature (1980:51). Carter *et al* speak of this as the distinguishing characteristics of letters and that each letter is distinct, even though it works together harmoniously (2007:74). The vertical stroke of the letter *a* and the letter *d* are similar but what make each letter distinct is the way in which it appears. The intermediate forms (figure 1.1) between *a* and *d* are easily deciphered by the reader. In most cases, especially in Latin script, such distinctions are identified. Tracy defines the *bowl* as “the curve part of the letters B, P, R, b, p, q and a”, and *Swash*, as the fancy alternatives in the italics of some book types such as Garamond and Caslon (2003:13). The first example clarifies the knowledge, and practices on the structure

of the letter (atomic properties) while the second speaks of features common within (a) typefaces (composite features). Dalvi explains the atomic features as 'stroke primitives', since the strokes can be considered as a combination of strokes that make the letterform and, composite features to be the visual properties of a typeface (Dalvi 2014). To understand the anatomy of Sinhala, the main element– the letterform must be understood. Nevertheless, the anatomy does not complete itself without the other elements. Dalvi includes all of these elements together and outlines it as 'the system' in his definition of the anatomy, "the anatomy of a letter can perhaps be defined as a system which depicts the structural makeup of a letter, describing key parts within the letter for a given typeface" (Dalvi 2009: 30). Carter *et al*, termed it as 'factors', and he specified them to be nomenclature and measurements that express the nature of the letterforms (Carter *et al* 2007:29).

Therefore, other than the letterform, such factors are discussed within the anatomy of other scripts. Each of these factors is discussed below, in comparison with Latin, Devanagari, Tamil, Bengali and Arabic script.

4.1.1 Reference lines

Terms such as structural grid lines, guide-lines are used to describe these imaginary lines that are drawn to portray the height of letterforms. They are drawn to describe certain parameters of the letter. The reference lines act as a ratio, a scale to define the height of the letter and proportion of the letter, specific to a script. Latin documents four reference lines: Cap line, Mean line, Base line and Beard line (Carter *et al* 2007). Whereas Zoghbi suggested five lines for Arabic: Base line, Loop-height, Tooth-height, Ascender height and Descender height (figure 4.1), and also proposed eleven lines for Arabic in comparison with the Latin, in his most recent article (2015). Chandra *et al* speak of six lines for Bengali: Topmost Line/Ascender line, *Shiro-rekha*/Headline, Initial line/ Shoulder line/ Upper mean line, Extreme bottom line/Descender line (Chandra *et al* 2015). And Devanagari describes six lines (Dalvi 2010: 63). Therefore, it is clear that the reference lines are relevant to the script.

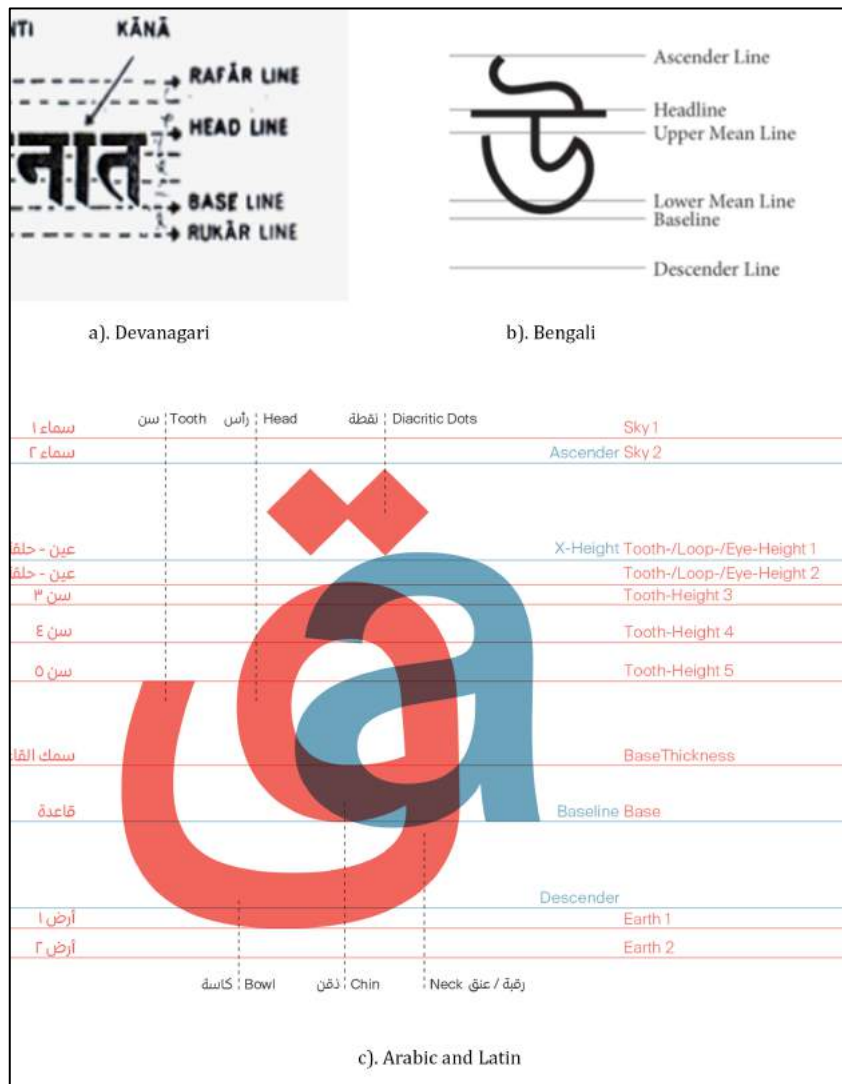


Figure 4.1: Reference lines of Devanagari, Bengali, Arabic

Source a).: Naik, Bapurao S., (1971)

Source b).: Chandra S., Bokil P., Kumar D. U., (2015)

Source c).: Zoghbi P., (2015)

4.1.2 X-Height (base character height)

In most literature on the anatomy of the Latin letter, the x-height is discussed and it is also closely knit with reference lines (Lupton 2010: 37, Coles 2012:11, Craig 2006:13). X-height is considered as the base character for Latin, therefore, the reference lines work as the boundaries of the x-height. In Latin the lowercase x is placed on the baseline and the top of the x touches the mean line, and this space between these two lines, or the size of the lower case x is described as the x-height.

Based on the same concept, Kumar proposes the Tamil base character to be *pa* and explains the *pa* to be the only character in the Tamil script that touches the main reference lines (Kumar 2010). And, Bengali too does not consider the x-height, because Chandra *et al* state that there is no reference of a *x*- in the Bengali script (Chandra *et al* 2015). Abulhab, explains the importance of the x-height in Arabic; he explains that designing a typeface on a fixed x-height is more beneficial than without (Abulhab 2008). Nevertheless, Devanagari does not sit on a base line, but hangs from the *Shiro-rekha*, therefore, Dalvi explains the ratio of the Devanagari according to three proportions based on the *kana*-height. He explains: the ratio of the height of the *Shiro-rekha* to the vertical height of the base character of Devanagari (*kana*-height), the ratio of the height of upper *matra* height to that of the base character to the lower *matra* height, the ratio of the height of complex upper *matra* height to that of the base character to the lower conjunct *matra* height (Dalvi 2010).

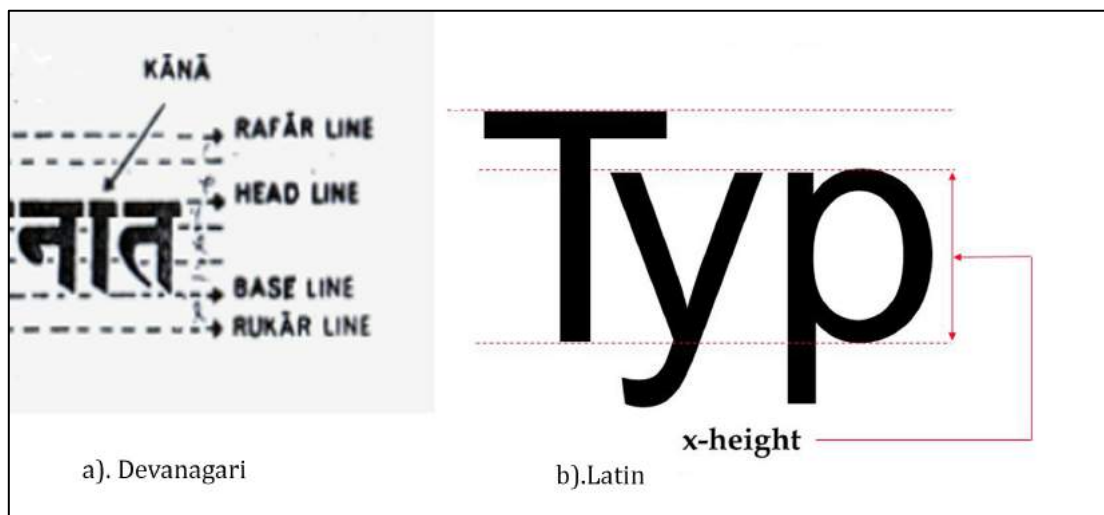


Figure 4.2: Base character proportions of Latin

4.1.3 Terminology

Another aspect that is discussed within the anatomy is the vocabulary; the terminology used to describe the visual properties of letters/ typefaces. Tracy states that ‘the terms used in the practice of type design are ‘illogical’ (Tracy 2003), while Cheng mentions that there is no official nomenclature for the unique structural features of type (Cheng 2006). Amado speaks of multiple use of terms based on his work on ‘multilingual typeface anatomy terminology’; he documents terms across

five languages (English, Portuguese, Spanish, French and German) that use the Latin script and speaks of how a single visual property can have multiple terms and opens up discussions in different local, linguistic, historical, artistic and technological contexts (2012). Nevertheless, in Latin typographic practice, the visual properties of the letters are defined with a term. Most terms are derived based on the resemblance to the human or animal anatomy. Terms such as eye, shoulder, chin, leg, tail are common in Latin (Ambross *et al* 2006:61, Coles 2012:11, Craig 2006:13).

Bengali uses a few borrowed terms from Latin and Devanagari, and also includes terms that describe the plant anatomy (Chandra *et al* 2015). Whereas, Tamil use terms, such as window, gateway, and human anatomy (Kumar 2010). Devanagari and Arabic uses terms from the human anatomy. Meanwhile, a common set of terms are used in certain Indic scripts due to the intersectional stroke variation of these scripts, therefore, terms such as knot, loops are evident with Devanagari, Tamil, and Bengali etc.

The terminology used to describe visual properties of typefaces, are expressions of the shape it communicates. The shape is usually biased towards the tool it was written with. For example the term *swash* resembles the splash feel that originates from the ink when a quill is used. Usually such features are evident at the end or start of strokes (terminals). Nevertheless, to describe the visual features of the Sinhala letterforms and typefaces, the search towards the anatomy needs to be established.

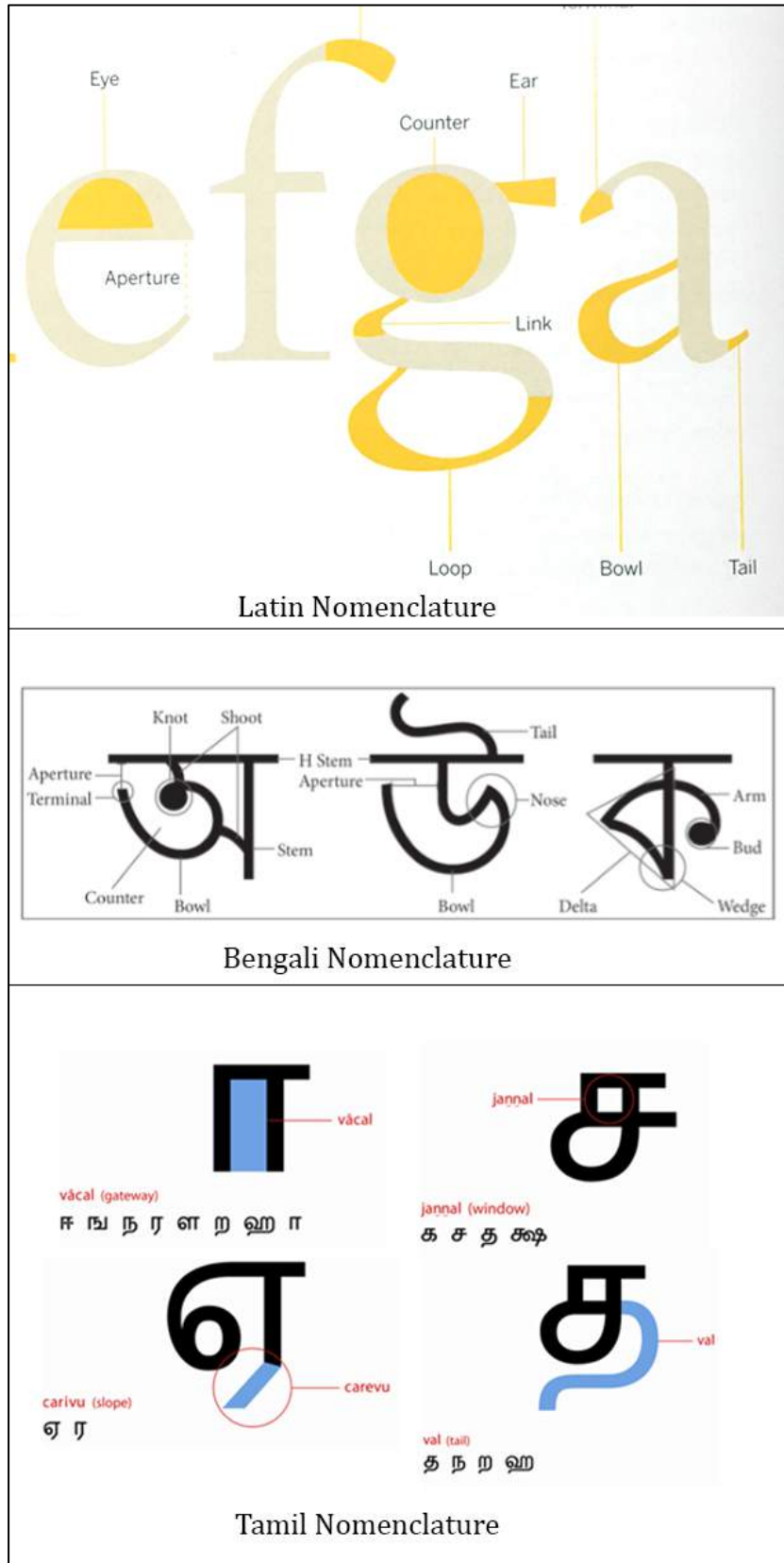


Figure 4.3: Selected terminology in Latin Script, Bengali script, Tamil

The following section explains the existing knowledge on the anatomical features relevant to Sinhala and a pilot experiment to understand the visual structure of the Sinhala letterform based on a visual analysis.

4.2 Reference Lines and Circular Grid in Sinhala

When constructing the Sinhala letter, the use of four reference lines can be considered as the most common, even though there were proposals and ideas of five and six guidelines for the construction of Sinhala. This is discussed in detail below.

4.2.1 Five Reference Lines

Under the direction of The National Education Commission (NEC) in 2005, *A Guide to Write Sinhala Letters (Sinhala Akuru liveema sandaha margopadesha)* was published. It was published on a research, to improve handwriting to schoolchildren and as a guide to teachers on how to teach children to write Sinhala.

It proposed five lines to construct the Sinhala letter. The five lines are not of the same distance due to the main part of the Sinhala letter being found between lines 3 and 4, and more space is provided within that space. If the space between lines 2 and 3 are considered as a measure, the main part of the letter (found between lines 3-4) is given three times of that measured space. The spaces of the top and the bottom lines have twice the size of the measured space. The top and the bottom lines are practiced to place the medial vowel signs, ascender and descender strokes. A systematic division of space is further explained in the following figure 4.4.

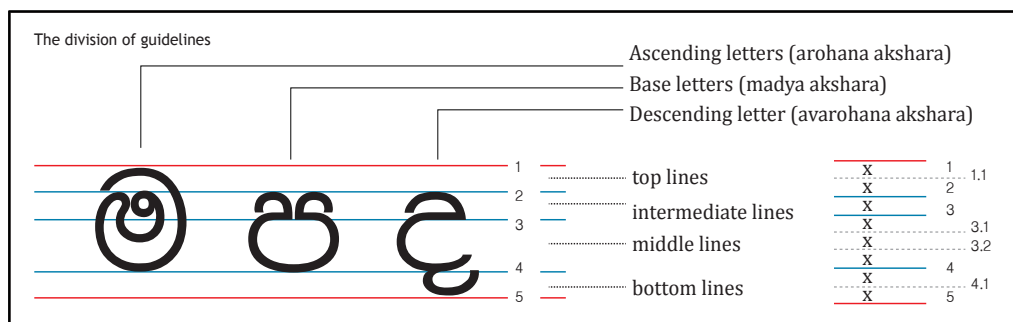


Figure 4.4: The five guidelines of the NIE publication

These lines are only numbered from 1 to 5 in the 2005 publication. Yet, we find Dissanayake describing these lines in a separate publication. He names the four

spaces as: top lines / line (*udu pela*), intermediate lines / line (*athuru pela*), middle lines /line (*mada pela*) and bottom lines/line (*yati pela*). Thereafter, he groups the Sinhala letter as base letters (*madyaakshara*), ascending letters (*arohanaakshara*) and descending letter (*avarohanaakshara*) (Dissanayake 2006:358-9). The learning on the five reference lines is further discussed in the analysis of the study (In the 3rd part of this chapter).

4.2.2 Six Reference Lines

Wickrema, who was the General Manager of the State Printing Corporation, presented a proposal in 1997. He proposed to reduce the number of Sinhala letters to accommodate the photo-type composing technique. The changing over from hot-metal type composing to photo-type composing in 1971 had an issue to accommodate 328 characters into the Monophoto mark II matrix. As a result, the six reference lines were introduced to compose the Sinhala letters (Wickrema 1997:51).

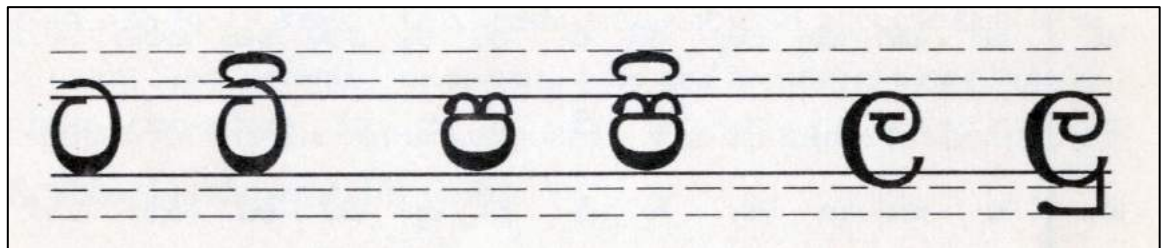


Figure 4.5: The six reference lines by Wickrama

Source: Wickrema, Keino, (1997)

The six reference lines are not of equal proportions, but as in the five reference lines a large space was provided for the base height of the letter. Wickrema used the term x-height to describe this space, even though Sinhala does not have an *x*. The lines immediately after the x-height on the top and the bottom are the lines used to place the ascender and descender Sinhala letters. The extreme lines at the top and the bottom are used to place the vowel signs. The proposed six reference lines reduced the number of keys from 328 to 79 keys in the Monotype keyboard, and accommodated space for three different Sinhala fonts as well (normal, bold and the italics). The six reference lines helped to achieve technological goals but failed at the aesthetic, as a result the Ceylon Poets Association's opposition to the proposal. Yet,

we find a few printed work completed with Wickrama's characters (Wickrema 1997:51).

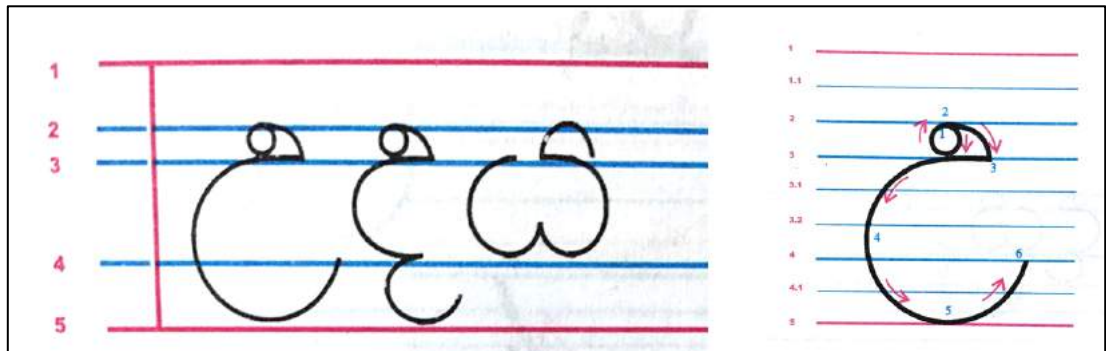


Figure 4.6: Sample of the five reference lines in current primers

4.2.3 Four Reference Lines

The National Institute of Education (NIE) compiles the syllabuses of primary education in Sri Lanka. They put out handbooks on the school syllabuses. The grade one and two syllabus include the practice of writing. But none of the handbooks (from grade one to five) provided by the NIE discuss the use of reference lines except a base line. Yet, Sinhala primers and writing books are complied with doubled rules (with four reference lines) The four lines are printed with two blue lines to construct the base of the letter and two red lines on the extreme top and bottom to indicate the extreme parameters of the letter. (Figure 4.7)

There is no official document on the use of the four reference lines, even though it is the most commonly practiced reference line system. Wickrema too, in his proposal of six lines, demonstrates the common practice of the four reference lines (Wickrema 1997:51).

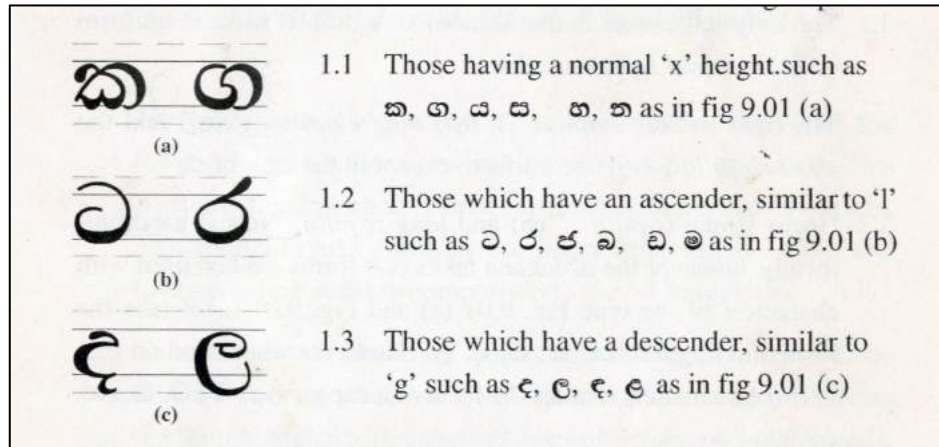


Figure 4.7: The four reference lines illustrated by Wickrama

Source: Wickrema, Keino, (1997)

4.2.4 Circular Grid in Sinhala

The work of Kanter: *Hastha Lekanaya* (Kanter 1961:4) discussed the written letter within a circular grid and divided the Sinhala letter into four structural systems, according to the number and the direction of the circles as: 1. One circle 2. Two circles horizontally placed, 3. Four circles with three horizontally and two vertically placed (third circle is part of both directions) 4. Two circles vertically placed (Figure 4.8). The publication is not on the subject of typography but on how to compose public documents through a systematic way. But such literature explains the need and the limitations in knowledge on the analysis of Sinhala letterform.

To study the letter to build the anatomy, Ross and Mohanty confirms that the anatomy formulates the structure of letterform, and it assists type designers to design typefaces from a conception to its final letterform (cited in Chandra *et al* :2015:238). The structure of the letter can be formulated by grouping similar visual features within letters. The uppercase and lowercase Latin, is a result of this visual grouping (Pohlen 2010:95). Similar grouping is implemented in identifying Bengali (Chandra *et al* 2015:), Tamil Script (Kumar 2010: 109-116), Devanagari (Dalvi 2010: 63) and Arabic. Therefore, to understand the structural formation of the Sinhala letter, a similar visual grouping was done in the following section.

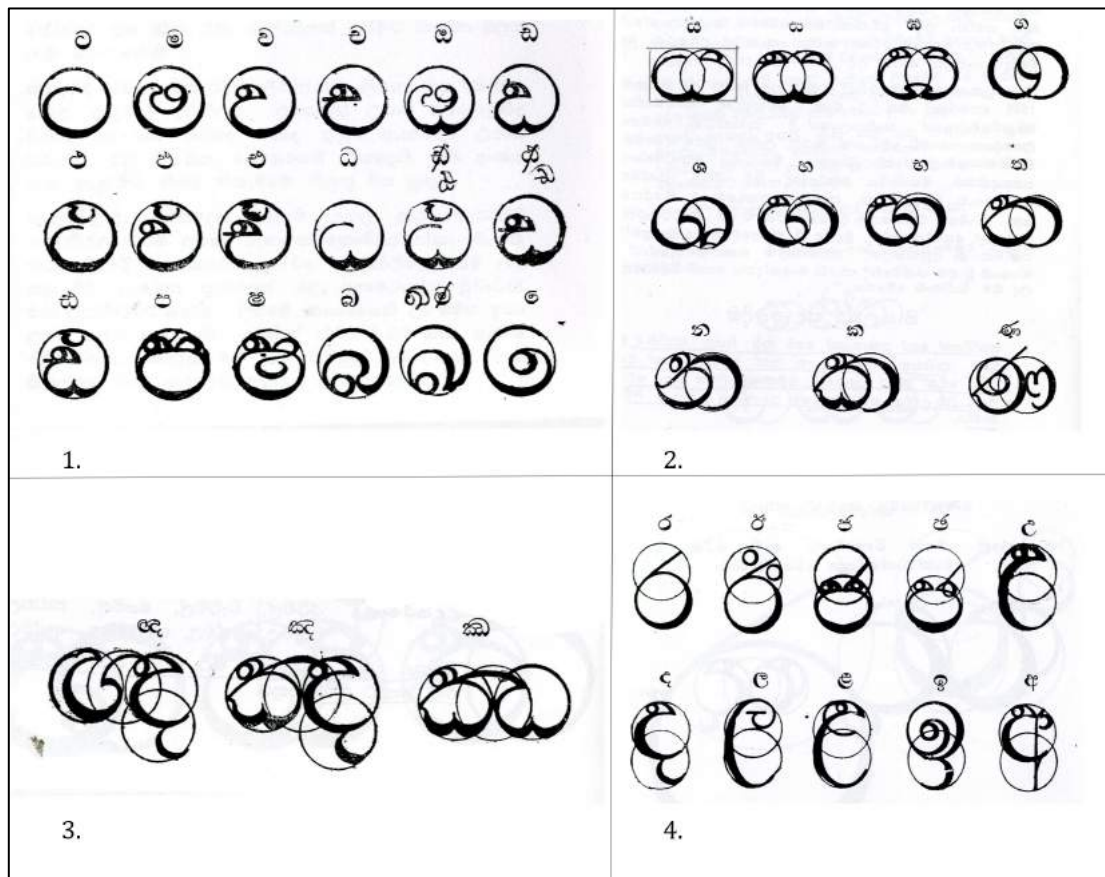


Figure 4.8: Circular grid, proposed by Kanter's :HasthaLekanaya

Source: Kanter O., (1961)

4.3 Pilot Visual Analysis of the Sinhala Letterforms

This was conducted on the search towards the structural formation of the Sinhala letter. The survey was conducted by observing all sixty-letters of the current Sinhala alphabet. The typeface of the NEC 2006 publication was considered as the ideal Sinhala letter structure for this pilot visual analysis.

At first glance, certain visual elements were evident and they are:

- Most Sinhala letters are cursive (constructed as a circle or part of a circle)
- The letters can be categorized as ascenders, descenders and base letters
- Certain letters are wide and narrow; they are either vertical or horizontal
- The letters have a range of stroke variations with open and closed counters

Based on the above points relevant to the letter's visual appearance, the Sinhala letters were grouped and tabled accordingly. The table further discusses how certain letters are two storeyed, open or range from narrow to wide. All of these were analyzed based upon the letters vertical or horizontal composition.

Construction	Horizontal	Vertical
Two-storied	<p>ඩො න ග ජි ඟ</p> <p>කඩ ණ න න ඟ</p> <p>ය ශ පි හ ඟ</p>	<p>ඉ කු ද ද</p>
Open	<p>ඟ</p>	
Wide	<p>කඩ කු ණ</p>	<p>ඔ බ බ ධ ධ</p> <p>ඔ ඔ ට බ ධ</p>
Medium Wide	<p>ඩො ධී ක ග ජි</p> <p>ඟ න න ඟ ය</p> <p>ශ පි හ ඟ</p>	<p>ඵ ම ඵ ඵ ඵ</p> <p>ට ට ඈ ඉ</p>
None	<p>—</p>	<p>රී ර ද ද</p>

Table 4.1 : Visual similarities on the structural formation of Sinhala letter


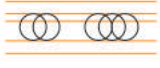



Base Shape						
Category 01		ඹ ජ ජ ළ ප ළ	ර ඊ			
Category 02		ග ශ න ශ හ හ	ස ෆ සෘ ය	ක න න	ඝ	ණ
Category 03		ච් ච ට ධ ච් ච් ච් ච් ධ ච් ච්	ඹ ම ඹ	බ බ	ච	
Category 04		අ ඉ ද ද	උ ඌ ඌ			
Category 05		කඩ කෑ				

Table 4.2: The circular nature of the Sinhala letters as: ascender, descender and base characters

Another table was compiled based on the visual observation of the circular nature of the Sinhala letters as: ascender, descender and base characters. Table 4.2 considered the main shape of the Sinhala letter to be a circle, and based on this, the letter was analyzed further as:

- A complete circle
- Vertically circle
- Horizontally circle
- Complete circle with diagonal strokes

4.3.1 Summary of the Pilot Visual Analysis

As a result of this visual cluster analysis, the following points were noted down to achieve the knowledge on the Sinhala letterform. The points are as follows:

- An initial understanding of how the Sinhala letter visually appears based on its syntagmatic relationship.

- The letters needed to be further analyzed, as it did not define the minute stroke variations such as joinery and terminals
- The reference lines need to be defined when explaining the letter structure: its vertical and horizontal stroke divisions
- The absences of a base character the Sinhala anatomy.
- Repetition of letter under several visual categories.

To achieve a comprehensive outcome of these defining visual properties, the Sinhala letterform needed to be re-addressed. Therefore, the research spiral method used in management research was adopted. Using this method, the letters were analyzed and re-analyzed on different contexts to achieve the objective of the thesis. Yet, before the main survey, two key elements of the anatomy needed to be defined. The two key elements were; reference lines and the grid for Sinhala.

4.4 Main Research Method

The research method was strongly built on the reference lines and the grid to formalize the analysis process. Therefore, the reference lines and the grid needed to be established.

4.4.4 Reference lines for Sinhala

The findings of the existing literature on the reference lines reveal gaps in knowledge. Among them was the scarcity of terminology to describe the reference lines. The five reference lines were numbered in the NIE publication and Dissanayaka had only termed the spaces between the lines. Disanayake had termed the space between the top lines as *udupela*, in-between lines *asathurupela*, middle lines *madapela* and bottom lines *yatipela*. He had further grouped letters according to its construction on the five lines, as base letters (*madyaakshara*), ascending letters (*arohanaakshara*) and descending letter (*avarohanaakshara*)(Disanayake 2006:358-9).

The line one, is the top most line that all ascenders touch, while line five is the bottom most line where all descenders touch. All base letters (*madyaakshara*) are placed on line four while all eyes of letters, are placed on line three. The line two is

part of the top lines (*Udupela*) and the in-between lines (*athurupela*). Taking the five reference lines and Dissanayake's proposal into consideration, five terms were proposed in this section to define the five lines (*pela, s.pela = rekha*). Line one, to be the ascending line (*arohana rekha*), line two, in-between line (*athuru rekha*), line three, the eye line (*akshi rekha*), line four as base line (*madya rekha*) and line five as the descending line (*avarohana rekha*).

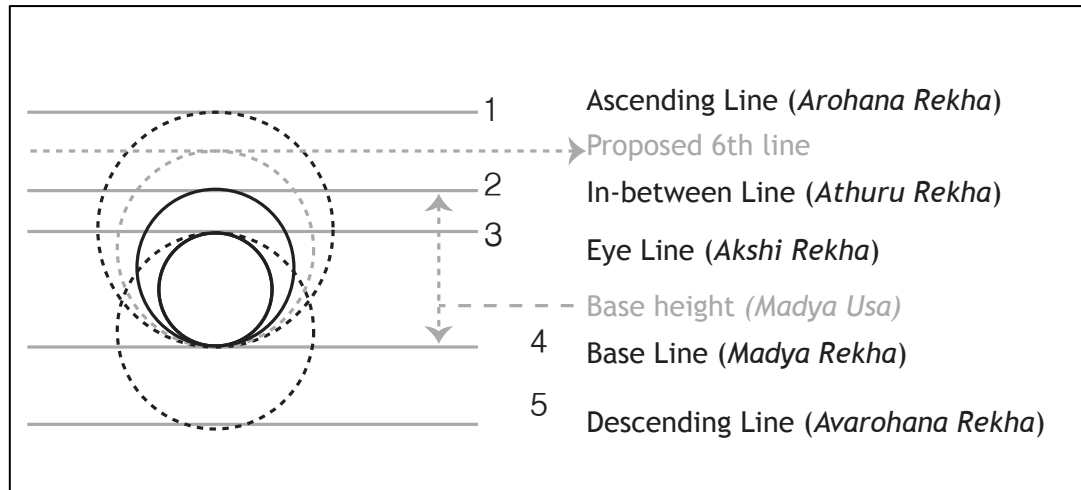


Figure 4.9: Terming of the five guidelines for typographic purpose.

For the analysis of this study, the above-mentioned terms will be used to explain the variables.

4.4.5 Grid for Sinhala Letters

For the purpose of analyzing the Sinhala letterforms, the research took the closest geometric shape: the circle, to create a grid for the Sinhala Letter. The selection of the shape was based on the earlier (pilot) visual analysis. The Circle was considered as the base shape of each letter because all letters can be derived from this shape. Therefore, with the use of multiple circles the proposed grid for Sinhala was constructed. The circles were constructed on the five reference lines. The eye and the base stroke were taken as the key features and the base height due to the amount of space provided in the previous study of reference lines. It was evident that all existing reference lines (four reference lines, five reference lines, six reference lines) had provided more space for these two features.

The circle characterizes the base shape (between line 3-4), another larger circle composed on the base circle between line 2-4 indicated the space provided for the eye of the letter. The space determined by these two circles denoted the proposed base character height for Sinhala. Taking these two circles, the parameters of the ascender and the descender strokes were defined. The third circle drawn on top of the two circles that touch the ascender stroke indicated the parameter of the ascending letters. And, the fourth circle that touches the top of the base circle and the descender line, defined the parameter of the descending letters. (Figure 4.10)

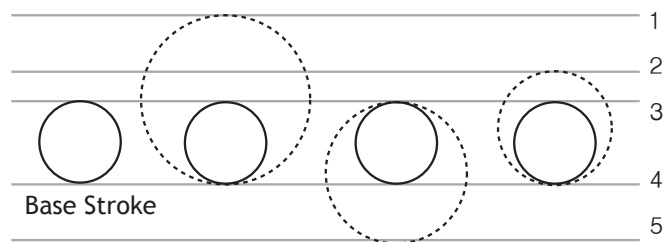


Figure 4.10 : Circular grid in relation to the base shape

It is also important to note that the ascender and the descender circles are not of the same diameter, as the ascender circle included the space for the eye of the letter. However, if a circle is constructed between lines 1-4 with the same diameter as in the descender circle space, this circle can then be proposed as the 5th circle. And the reference line that touches this circle between line 1-2 would be the 6th line. This line can be used to indicate the parameters of the ascender vowel signs.

Since this study only included Sinhala letters and not the vowel combinations, the search limited itself to five reference lines. With this knowledge a new method was adopted to identify the visual properties of the Sinhala letter.

4.4.3 Research Spiral Method

The current study focused on the 'letters'; as vowels and consonants (Table 2.6), it recognized the need to identify the distinct visual properties (DVP) of each letter.

The methodology was designed through an action research spiral with the clear purpose of identifying the DVP of the Sinhala letter (Figure 4.11). The selected

typeface for the analysis was from The National Education Commission (NEC) publication (2005), as it was the only official recent publication on the formation of the Sinhala letter and its proportions. Diagnosing, planning, taking action and evaluating within three contexts before the final analysis iterated the analysis. The first context was the reference lines, the second was the reconstruction of each letter, and the third was the grid.

The action research is a strategy used mostly by management research, but the author adopted the sequence of the research spiral on the basis of finding '*research in action rather than research about action*' (Coghlan *et al*, cited in Sauners *et al* 2009: 147). Here, the *research* was defined as identifying the distinct feature of each Sinhala letter (Sinhala letterform) and *in action* was referred to as the contexts that influences the research, in this case the letterform. Thereby the spiral commenced with a specified context and a clear purpose (Robson cited in Sauners *et al* 2009: 147) to identify the distinct properties of each Sinhala letter. The selected variables are examined through a repetitive spiral by diagnosing, planning, taking action and evaluating within two contexts before the final analysis (Figure 4.11).

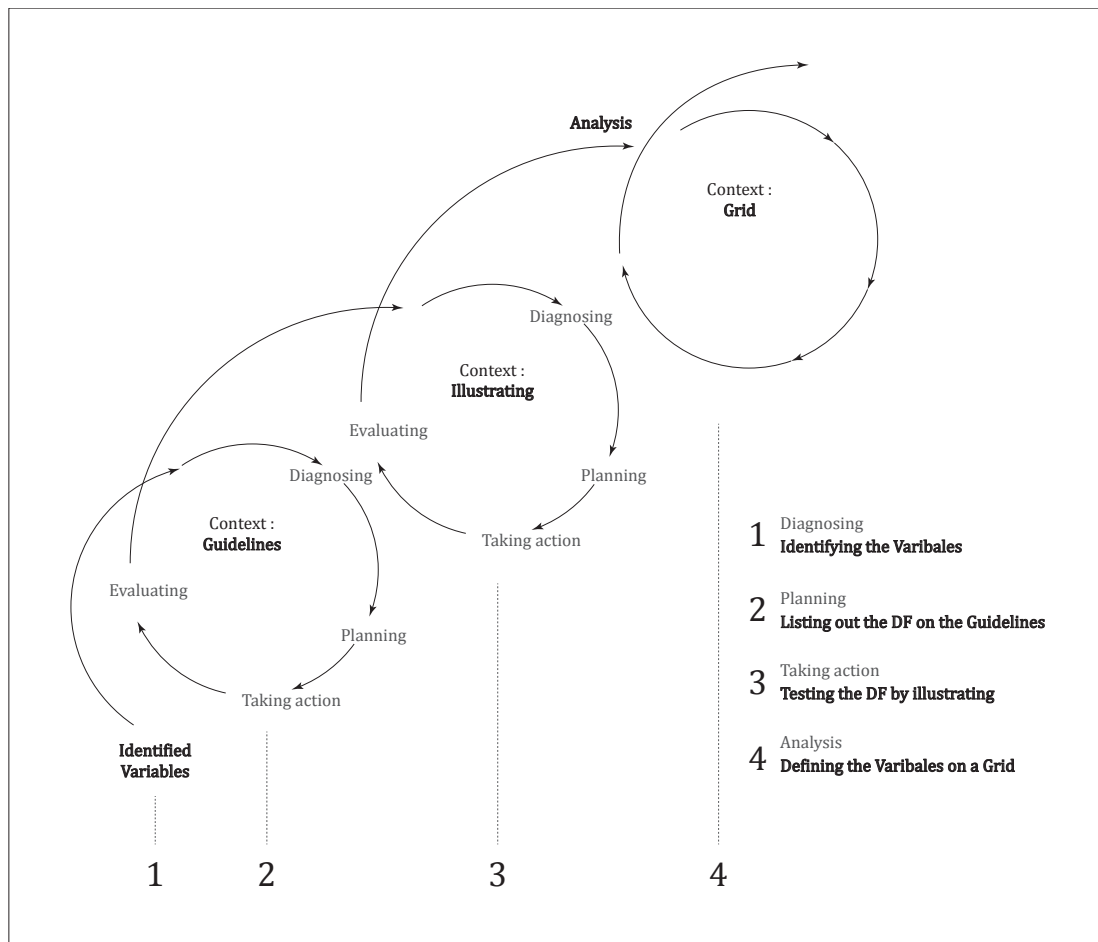


Figure 4.11: Designed methodology: Research spiral

The first spiral discussed the initial listing of the DVP of the letter by placing them on the five reference lines. The second spiral debates within three stages: illustrating, visually grouping and reconstructing each variable to understand each visual property. As a result the number of visual properties in the first and the second spirals was reduced and stored as data for the final visual analysis (Discussed in section 4.5, 4.6, 4.7).

A). Selection of Variables

All letters comprised vowels and consonants making a total number of sixty variables. This number was dropped to forty-eight by deselecting variables that have vowel signs attached, due to its repetitive nature. The selected and deselected variables for the overall analysis of the DVP is found in table 4.3.

random names and tabled in the first column in annexure 4.2 to identify the number of visual features common to the Sinhala letter.

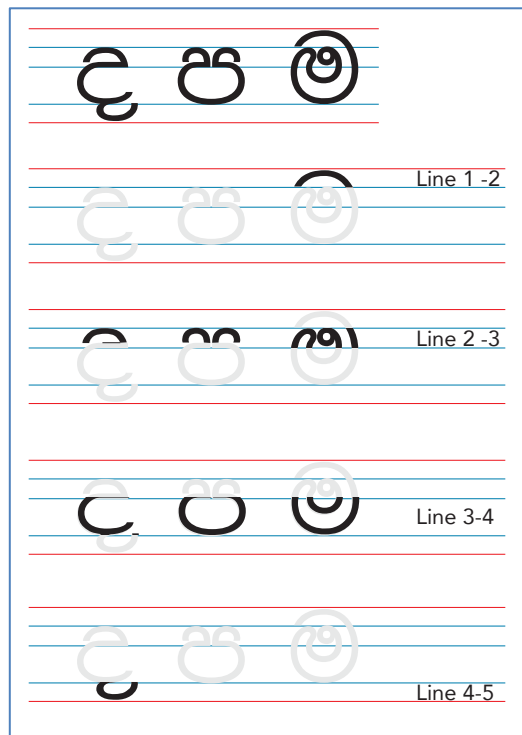


Figure 4.12 : visual observation of each letter, line by line

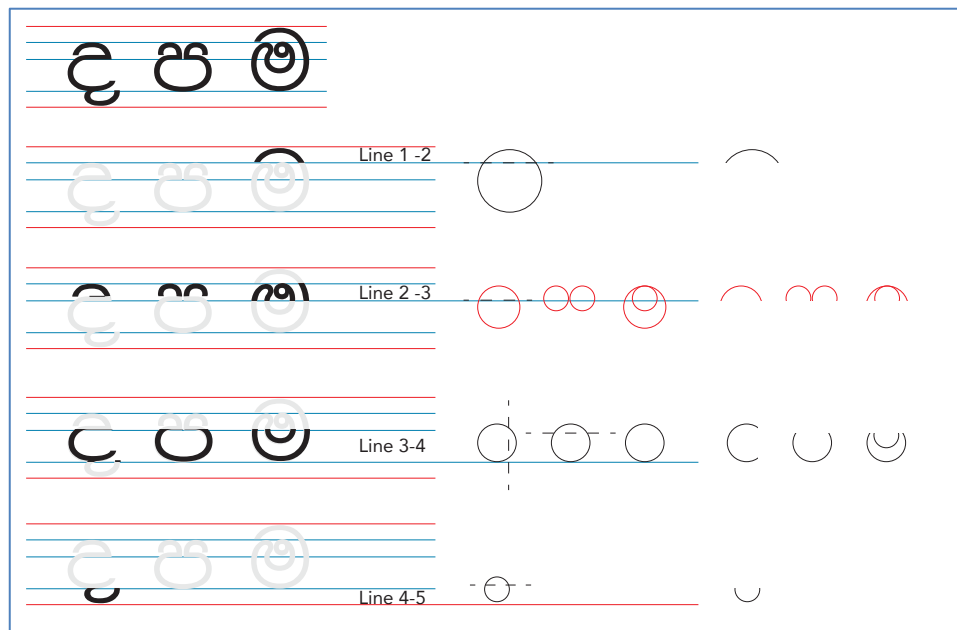


Figure 4.13 : Observing the visual form in relation to a circle

The summary of the discussion within the first spiral is as follows:

Circular (Geometric) shape in variables

Parameters of the stroke needed to be addressed, for example: Is the stroke part of a circle, if so could it be half or a quarter of it? Naming the strokes according to geometric terms such as full circle, elevated circle, curve, diagonal, horizontal and vertical was needed to define and understand the parameters, behavior, and the construction of the strokes.

Start and end of the stroke in variables

Start and end of the stroke needed to be identified, as certain strokes were part of other features. Therefore, the joinery and intersections were closely observed. For example, is the stroke part of another stroke, where does it start and end? To prevent repetition and miscommunication, additional terms such as continuous, joint, intersection were added in the list to indicate that the mentioned stroke is part of another stroke.

Random set of Visual properties

Noticing certain visual properties helped to identify common properties within the variables. Questions such as: Is the stroke a part of another feature? What are the other features that influence the stroke? Were answered by describing them with specific names as the eye, base stroke, loop, knot etc.

By understanding the geometric nature of the stroke, its start, end point and certain visual properties helped to identify the need to observe the variables again. This was because repetitions of visual properties within a single variable were found. Nevertheless, all visual properties that were observed were documented in column one of annexure 4.3 . Therefore, the number of features common to Sinhala at this stage was 57. The second revision discussed within this stage (spiral one) focused on repeated visual features. Therefore, among the 57 visual properties, all visual properties that were termed such ascend of ..., start of..., cont... etc. were omitted, and this brought the list to 29 DVP. It is documented in the second column of

Annexure 4.3 . It was proposed as the 'Initial DVP list' and the count of properties was dropped to 29.

Summary and Finding of the Spiral: ONE in the Context of Reference Lines

- Diagnosis : Each variable is unique and consists of different visual properties
- Planned : To observe them line by line within the four spaces
- Taken action : Document the process and make an initial list of DVP
- Evaluated: Initial DF list was compiled, however repetition of visual properties were identified. It was then narrowed down. Yet, the following objectives needed to be addressed.
 - What are the distinct visual properties of the Sinhala letter?
 - What are the reasons for the repetition of visual properties?

C). Action Research Spiral : TWO

The second spiral discusses the action taken towards answering the above objectives in the context of visual construction. Here, the objective of the overall study was to revisit the reasons for the repetition of the listed (Initial DVP list) visual properties.

The variables were moved away from the reference lines and treated as a unique shape. It was constructed by tracing the typeface of the NIE publication under each feature, identified in the previous spiral. Each variable was traced as a dotted line and the feature highlighted with a complete stroke to emphasise the visual properties among all variables (4.14). As a result, all properties were individually and visually documented (Annexure 4.3) with a complete list of all the variables. During this documentation process, we learnt the following points:

The definition of the start and the end of the stroke to define visual properties.

When constructing the variables we learnt the lack of knowledge on the starts and ends of the strokes. Eg: where is the start of the ascending stroke? An ascending stroke comprises with several formations such as the ascending stroke of the *ta* (⊙), *da* (⊗), *ba* (⊘) are different from each other, brings the question – which part of the

stroke can we indicate as the start and the end of the ascending stroke. Therefore, it is important to define them accordingly. (Figure: 4.14

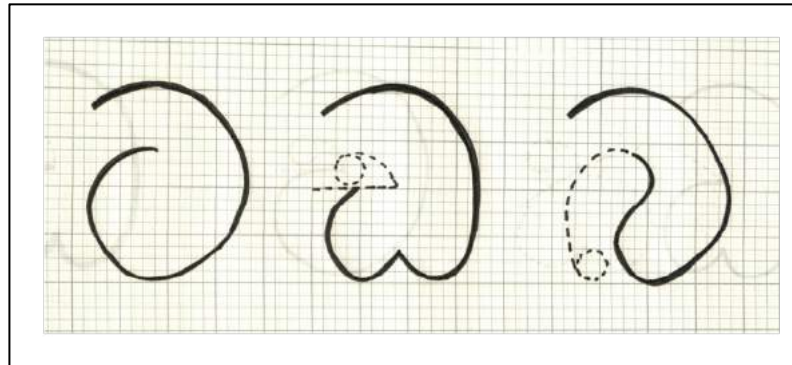


Figure 4.14: Different variations of the ascending stroke

The definition of the stroke behavior to define visual properties.

Another aspect was to identify the behavior of the stroke, to define each feature, to reduce the number of repetitions. Eg: Is the diagonal stroke of the variable *jah* defined as a knot or an eye? The formation of the diagonal stroke in the letter *jah* could be defined as a knot or an eye, therefore, one must know the distinct qualities of the eye and the knot to reduce repetition.

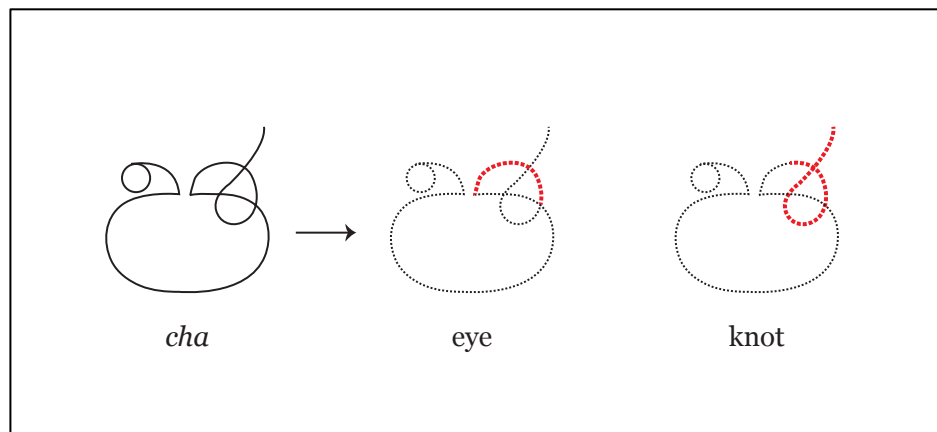


Figure 4.15: Repetition of features on the variable *cha*- eye and knot.

The traced variables were digitally drawn and grouped according to the common features (Annexure 4.4) to provide a clear view on the number of visual properties and the number of variables that have the listed visual properties (Annexure 4.3). As a result we observed a repetition of visual properties and

variables. This was because the identified visual properties were defined by indicating the parameters or the behavior of the stroke. To start the definition we looked at two distinct visual properties that had the most number of variables; the eye and the base stroke.

To find the answer to the objectives of the study, the eye and the base stroke were reconstructed to indicate the parameters of the strokes. To do this, both visual properties were visually examined and grouped.

D). Composition of the Eye and the Base Stroke

There are five variations of the eye listed at this stage (figure 4.18), all of which needs to be analyzed and defined. Therefore, we look at the variations of the eye found between line 2-3 and 3-4, while the base stroke is defined between line 3-4 or 2-4. This visual study helped to understand that the eye is always part of a variable either joint to a base stroke, ascender stroke and descender stroke.

The next largest amount of variables is found under the base stroke feature. Here, we found the base stroke as a continuing stroke to form ascenders and descenders. Therefore the author limits the base stroke to variables that are constructed between line 3-4, even though all variables are constructed within this space. As a proposal, we considered the ideal height of the Sinhala letter to be between line 2-4 which accommodated the eye height and the base shape height. For example the letter pa represents the ideal height – which includes the eye and the base shape height. (Figure 4.16). By distinguishing the line spaces reduced repetition and comprehension the eye and the strokes as separate features.

The link between the base stroke to other strokes was defined with a geometric form: circle, to explain the base stroke. For example the circle that is constructed between line 3 and 4 is considered as the base stroke (even though there are base strokes constructed between line 2-4). When a larger circle is drawn touching the bottom of the base circle and the ascender line, it becomes an ascending stroke, while if it touches the top of the base circle and the descender line it becomes

a descending stroke. When a circle is drawn in between line 1 and 3 we find line 2 to indicate the parameter of the eye.

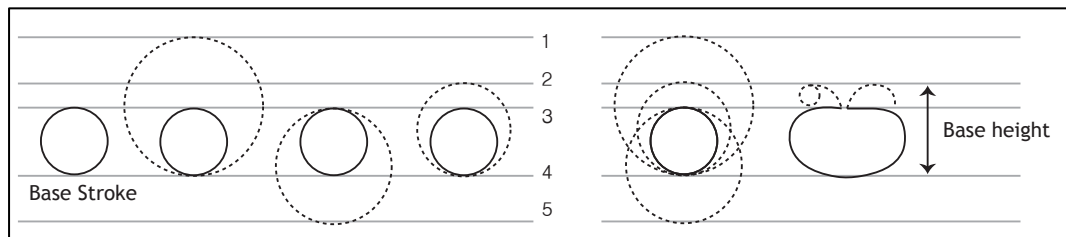


Figure 4.16: Initial grid: Ascender and Descender Stroke in relation to the Base Stroke.

The visual construction of each variable and defining of the eye and the base stroke helped to reduce the distinguished features to 20. The five features that explained the eye was narrowed to one distinct visual property, while the definition of the base stroke divided into ascender stroke and descender stroke, which was illustrated through a grid to place variables for, further analysis.

Summary and Finding of the Spiral : TWO in the Context of Visual Construction

- **Diagnosis** : The strokes that construct the variables are found repeated in several features and are variable.
- **Planned** : To observe them, by visually reconstructing the variables to understand the parameters of each feature in the list.
- **Taken action** : Document the process and refine the initial list of DVP - documented in spiral one.
- **Evaluated** : Initial DF list was refined and a grid was introduced to place the variables for further analysis.

Through the action research spiral we found that the identified variables were first evaluated to recognize the DVP in the context of the five reference lines. The knowledge gained was then transferred to another context by visually constructing the variables. The spiral continued further under different contexts, but for purpose of analysis the spiral recesses here. The findings of both spirals, conclude on the

importance of defining the stroke behavior and its parameters. As a result a grid constructed on the 5 reference lines was proposed for further analysis.

4.5 Analysis of the Distinct Visual Properties

To conclude on the identified DVP that made up the anatomy of the Sinhala letter, the author analyses the 20 DVP list. The analysis was divided into three stages:

- 1) The eye and the main strokes: base, ascender, and descender stroke.
- 2) The other distinguished features.
- 3) Letter joinery and terminals.

The eye and the main strokes: base, ascender, and descender stroke

We started the analysis with the learning on the reference lines and the proposed grid to distinguish the uniqueness of each visual property. The eye properties and the three main strokes: the base, ascender and descender are discussed and analyzed first, followed by the sub-properties that contribute to the DVP list of the Sinhala letter.

4.5.1 Composition of The Eye

In literature the term eye is rarely used except in Sinhala primers and in teaching students on how to write. Eye is a key feature as most letters are constructed initially in this circular shape. It is also believed that when the letters were constructed on ola leaf manuscripts, the scribe initiated the construction of the letter by scribbling several circular strokes on top of each other, to break the uneven and vertical surface of the leaf. Later, this practice resulted to be a DVP for most Sinhala letters. Yet, the research does not include the significance of this feature as the initial portion of the Sinhala letter due to its various visual interpretations. But it is interpreted according to its current visual appearance that resembles a human eye.

In the case of Devanagari, a similar feature is defined as a loop “in which the stroke of a letter (touches) or overlaps over another stroke, but does not cross over; usually to create small counter spaces”. The limitation of this definition is further stated as the stroke completes itself to form a hook (Dalvi 2010:178), and proves that

the larger stroke completes itself into a smaller counter space. Meanwhile, the Tamil script resembles the Sinhala letter with the stroke of the small counter space extending itself to a larger curve stroke and defined as the eye (Kumar 2010: 110). The visual representation of the pupil or the eyeball is interpreted in the Tamil script, and the eye is considered a complete circle.

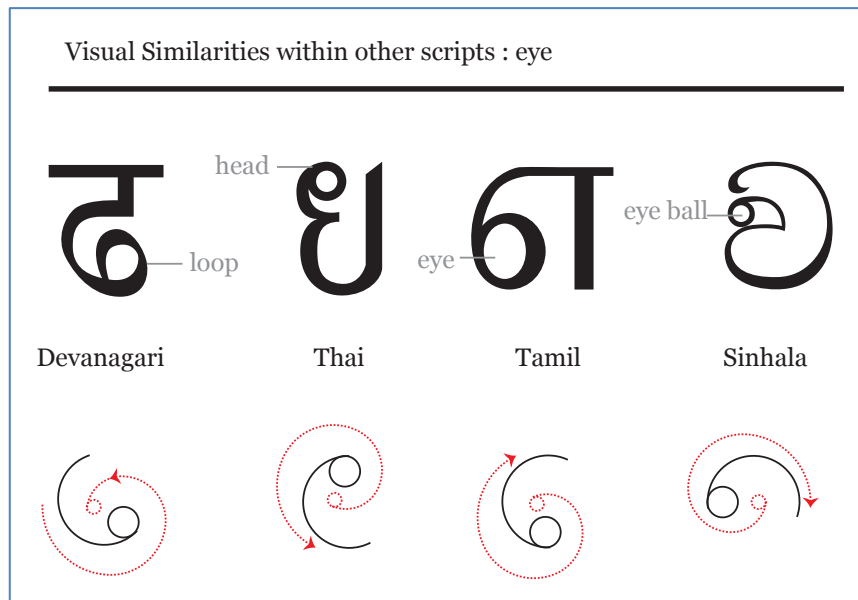


Figure 4.17: Visual Similarities in selected scripts

Where as in the Sinhala script, the author proposes the full circle to represent the pupil or the eye ball, and the extended stroke that takes a crescent shape; the eyelid. So, in the absence of the full circle it becomes a closed eye. When the crescent shape is completed with a horizontal stroke it takes the appearance of an eyelash. There are few letters that are constructed with both eyes, either one opened and one closed or both opened, while a few have a knot that projects out of the full circle making a tearing appearance. The properties of the eye are found in figure4.18.

The proposed terms for the identified eye properties are used for identification purpose, as the objective of this section is not to term the features but to learn its forms. For the purpose of this research the eye is *defined as the way in which a curve stroke completes itself to create a small counter space but extends outward to form a semi- spiral parallel to the horizontal plane*. There are thirty-seven

out of 48 variables constructed with this feature, but with miniature details each letter distinguishes itself. To understand the minute variations the eye is grouped into three (figure 4.18).

1. The eye constructed with and without the small counter space and has the crescent shape.
2. The eye with continuous strokes on either side.
3. The eye constructed without the crescent shape and only the small counter space.

Except for four characters, all of the eyes are composed on the eye-line (eye property 06). The eye is further analyzed according to how it is structured and placed on the variables; with or without it horizontally flipped, and its vertical division into two symmetric halves placed on either side or one side. Nevertheless, the eye could be found duplicated to create a combination of the above characteristics. The third grouping of the eye, however, works as a separate unit due its construction being found in two spaces; lines between 2-3 and 3-4. The visual grouping is found in Figure 15, giving us a clear understanding on fifteen variations of the eye within all the variables.

Meanwhile, certain properties that brought confusion in the research spiral due to the lack of knowledge in the stroke behavior were noted, and brought forward as sub-properties of the eye. The three sub-properties are closely related to the eye, because it continues the stroke of the eye to form another feature. Therefore, they are noted and discussed separately as they are identified as DVP within the list (Annexure 4.3).

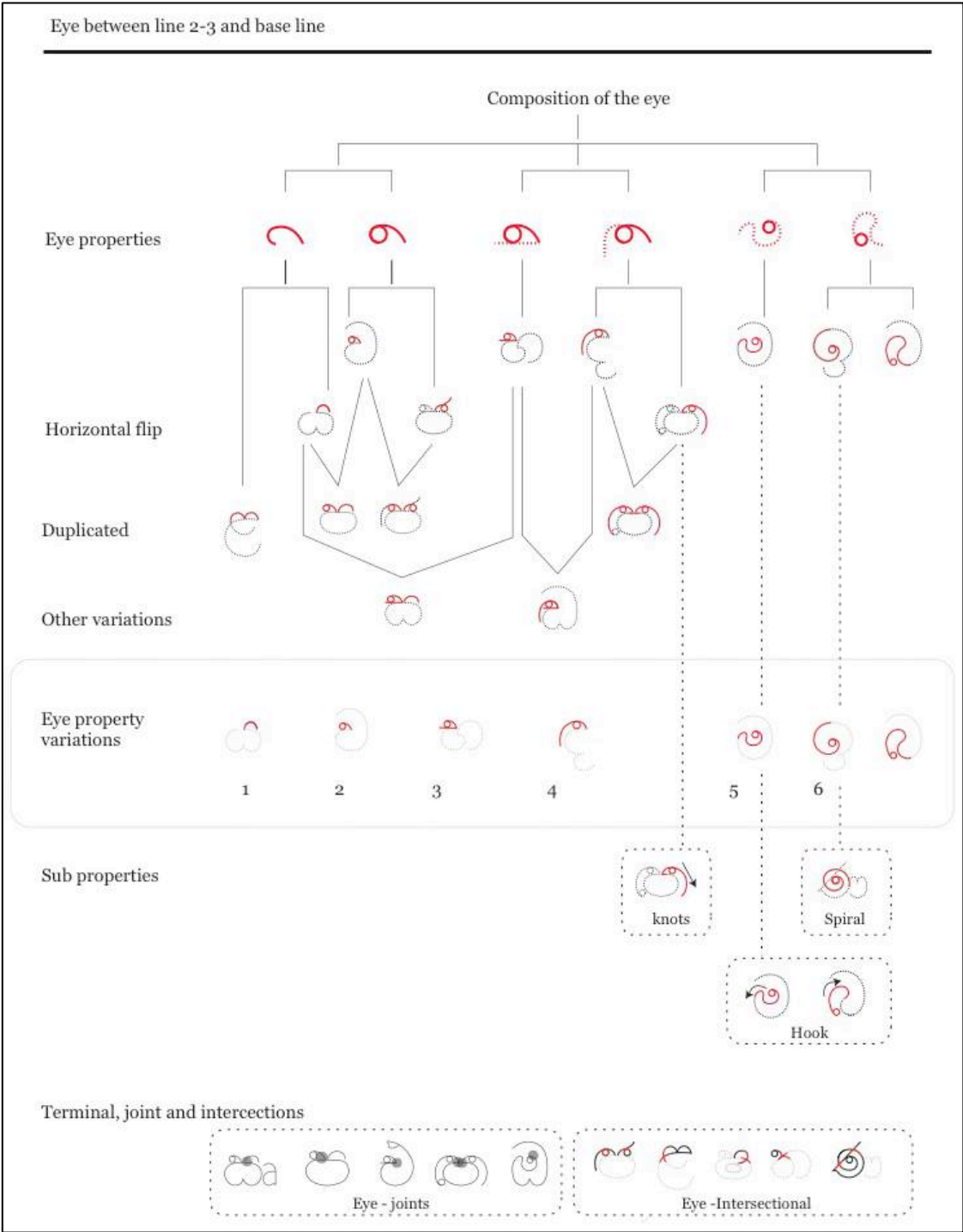


Figure 4.18: Distinguished feature EYE : Visual representation of its divisions and subdivisions

4.5.2 Composition of the Base Stroke

All variables that are constructed between line 2 and 4 are considered as base stroke characters. The variables with an eye attached and ascends at the ascending line or descends at the descending line are not discussed within this group.

Other than the full circular stroke, the base stroke has another form: the eye-like stroke, but constructed three times larger than the eye. It can be defined as a stroke that *completes itself to create a small counter space, but extends outward to form a spiral parallel to the base line creating an overlap*. The two forms can be explained according to the form of *pa*(☉); *an enclosed full circular white space*, and the second as the form that represents the letter *tha*(☉); *a stroke which overlaps another by creating an enclosed full circle and continues to form another curvature*. All of which are analyzed within twenty-eight variables. (Figure 4.19)

When the circular form is duplicated it creates two visual formations making the width of the variable larger *a*(☉), *ga*(☉) while the combination of both base shapes creates another variation with a much larger width *ka*(☉). Taking all of this into consideration, we note five variations of base stroke properties.

The analysis of the base stroke is further analyzed according to the placement of the eye. The base shape, which is considered as the circle/s constructed between lines 3-4, are vertically divided into two symmetric halves to elaborate on this.

- Variables with two eyes and placed on **top** of the letter.
- Variable that are composed with one eye and placed on one **side**.
- Variables that are **attached** to the base stroke because of its continuing nature to create a loop, knot or a shoulder.

Thereafter the sub-properties noted in the base stroke are discussed separately as unique properties in the following section.

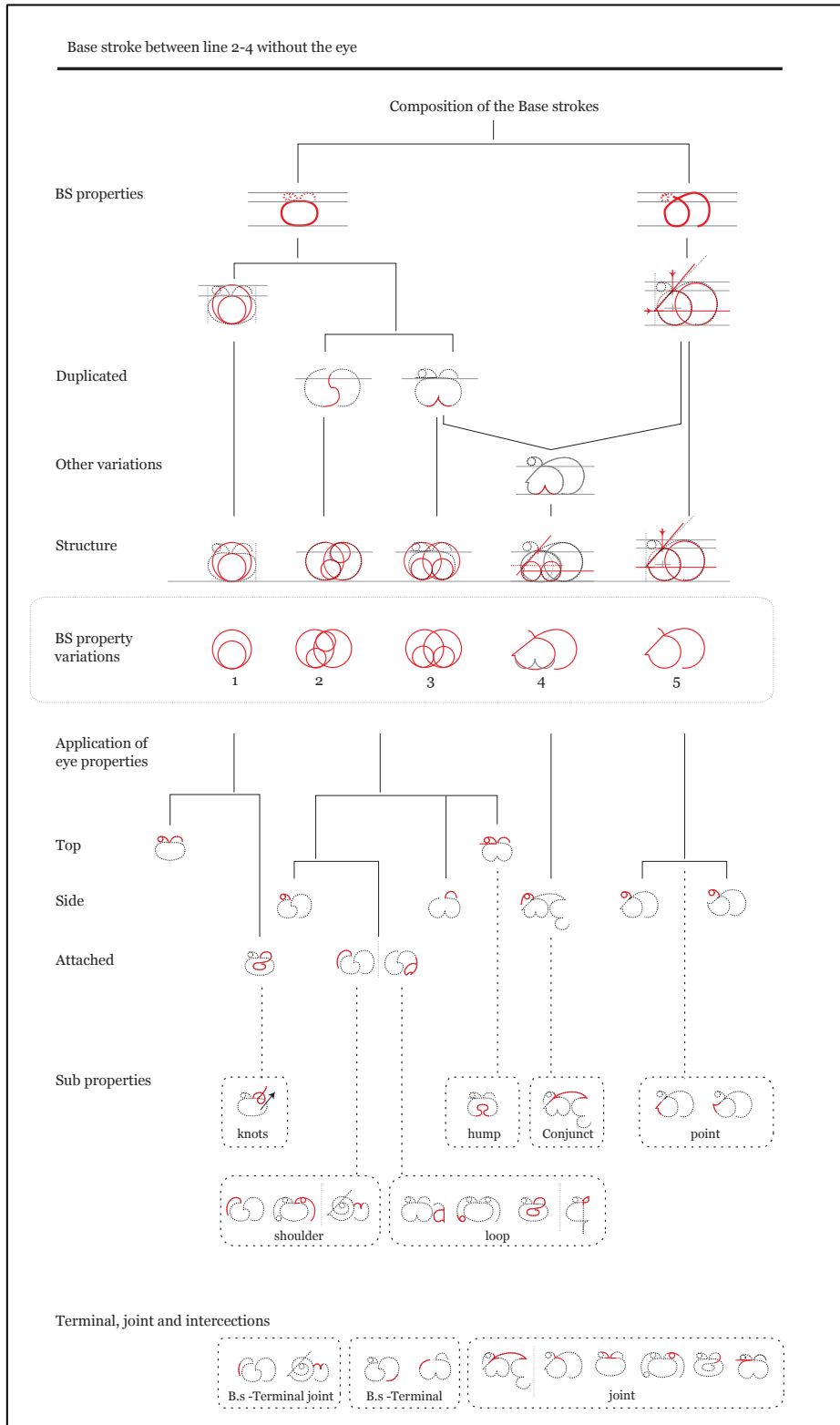


Figure 4.19: Distinguished feature base stroke - Visual representation of its divisions and subdivision

4.5.3 Composition of the Ascending Stroke

All strokes that extend towards the ascender line are considered as the ascending variables. There are three visual forms representing this, with two taking the shape of a half circle while the other as a diagonal stroke that joins a full circle. When these three visual forms are placed on the grid for analysis purposes we find five base stroke properties that influence the ascending stroke. These five variations are further studied according to the overall structure into six variations, as ascender properties.

With that understanding, we can define the parameters of the ascender stroke 01 as; *the curve stroke that starts at the eye line to create a semi-circle towards the base line and extends to form another semi-circle towards the ascending line.* While the ascender stroke 02: *the diagonal stroke that starts at the eye line and extends towards the ascending line.* At the points where the stroke touches the eye line, base line and the ascending line, certain features vary and distinguish each variable. The primary variations of ascending variables are illustrated in Figure 4.20, in the section that denotes (application). The structural formations of the primary variables are analyzed further by placing them on the proposed grid to explain the ascender property variations.

Each of the ascender property variations is discussed according to the placement of the eye. The eye between lines 2-3 and 3-4 have the most number of variables compared to the variables composed without an eye. This gives us an overall view on the formation of all ascending strokes and its sub-properties.

4.5.4 Composition of the Descending Stroke

All strokes that extend towards the descender line are considered as the descending variables. There are two visual forms representing this, with both taking semi-circular strokes with one touching the descender line and the other the base line. The one that touches the base stroke forms another semi-circular stroke by joining a smaller semi-circle that touches the descender line.

With that understanding, we can define the parameters of the descender stroke as; *the curve stroke that starts at the eye line to create a semi-circle or two semi-circles at the base line and extends to form another semi-circle towards the descending line.* At the points where the stroke touches the eye line, base line and the ascending line, certain features vary and distinguish each variable. The primary variations of descending variables are illustrated in Figure 4.21, in the section that denotes application. The structural formations of the primary variations are analyzed further by placing them on the proposed grid to explain the descender property variations.

Each of the descender property variations is discussed according to the placement of the eye. Here too, we find the eye between lines 2-3 and 3-4 and variables composed without an eye. All of which are illustrated and explained in Figure 18. The identified sub-properties within the descenders are noted and discussed in the following section.

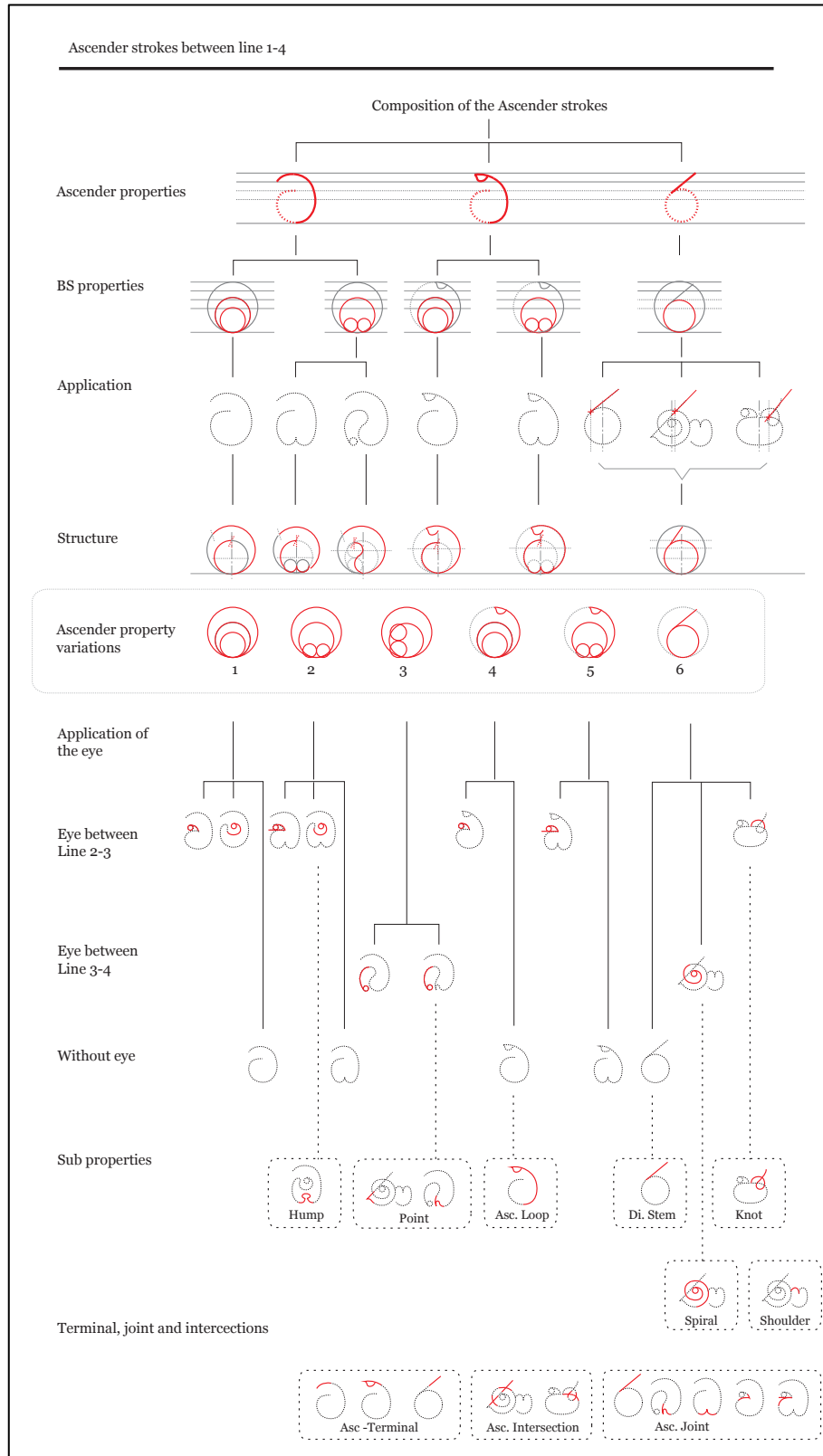


Figure 4.20: Distinguished feature ascender stroke - Visual representation of its divisions and sub-divisions

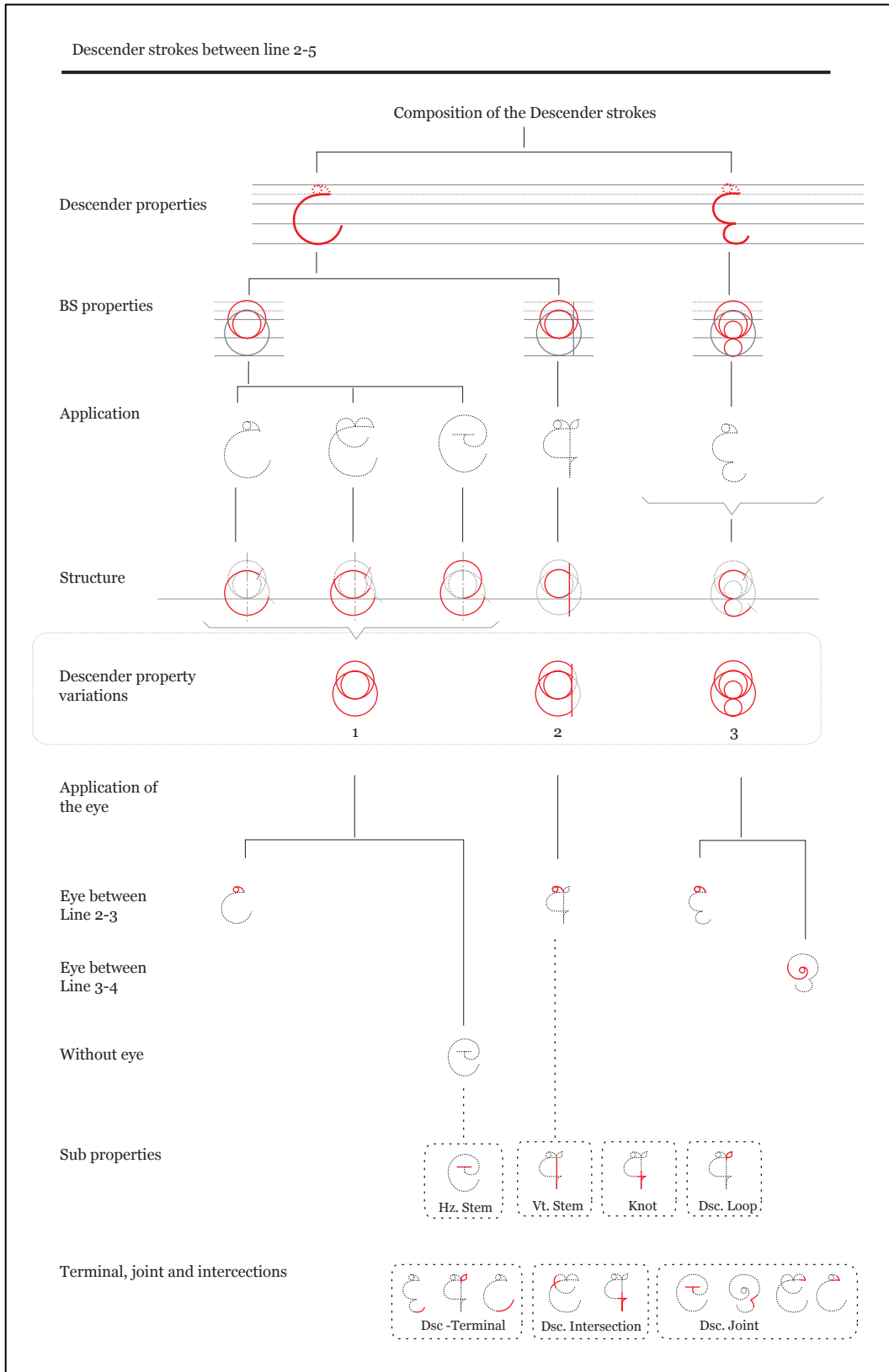


Figure 4.21: Distinguished feature descender stroke - Visual representation of its divisions and sub-divisions

4.6 Other distinguished features

All of the sub-properties listed out under the main three strokes and the eye are analyzed here to explain the distinct nature of each property. The term sub-property will not be used to explain them, as they are unique by nature, yet is part of the three main strokes and the eye. The terms used to describe these features were initially used by the author in the listing process (Annexure 4.3), and continues here with literature findings for purpose of identification, as this study's objective is to find the DVP. The terming will be left for further studies (Chapter 05).

4.6.1 Knot

The knot is a term taken from the Devanagari anatomy and defined as the treatment of the strokes which overlap each other, and cross over each other (Dalvi 2010: 183). In the Sinhala script the knot is linked to the eye as in some case the knot is the eye. The eye terminates in three different directions and groups the knot into 3 visual interpretations.

When the termination is directed down, it becomes a shoulder, when directed diagonally it becomes a stem. The third is variation when directed horizontally. Nevertheless the variable *jha*(ඃ) is composed of two variations of the knot with one pointing down and the other diagonally, while the horizontally composed knot is only found in the variable *a*(ආ).

All knots linked with the eye are constructed in and around the eye line and the horizontal knot stands on the base line. The list of all the knots and the visual deviation is explained in the following figure 4.22.

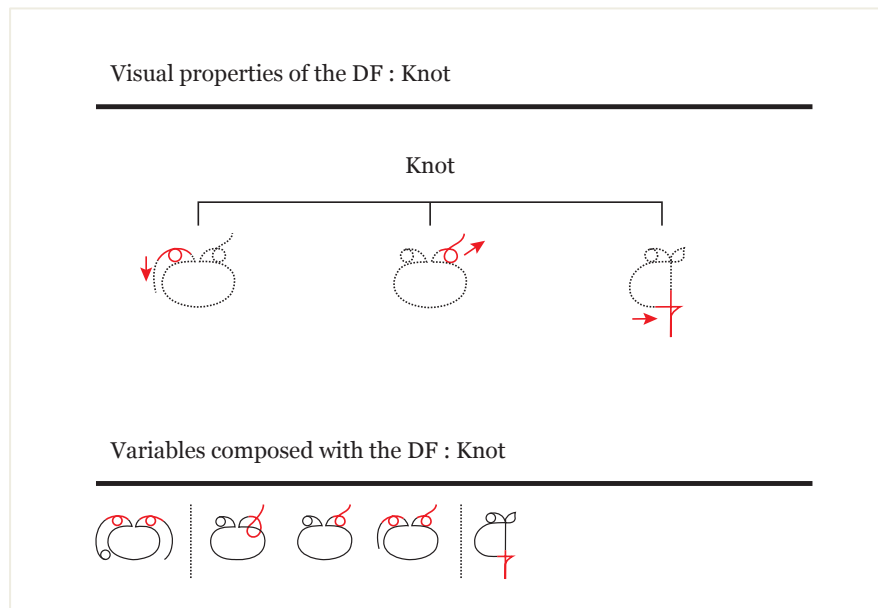


Figure 4.22: Distinct Visual Property: Knot

4.6.2 Hook/ Link

This feature is usually found as a part of the eye that signifies the eyeball. The term hook is used to explain this because of its visual appearance on how the eyeball is hooked to the ascender stroke. The hook can be described as an intermediating stroke that joins the eyeball to the relevant ascender stroke; therefore it appears as a part of the corresponding ascender stroke.

Ambross *et al* (2006:57) uses the term link to describe the stroke that connects the bowl and the loop of the lowercase Roman lowercase g. Taking the basis of linking two features, the author uses the term to explain the link between the eyeball and the ascender stroke. Therefore, when defining it, we describe it *as a stroke that hooks/ links the eye to the preceding stroke*.

Since the eyeball is constructed on the eye-line or between the base and the eye-line we find the composition of this feature within the range. The construction of the hook/ link is clockwise, but stresses vertically or horizontally. If this clockwise stroke continues, it creates a semi- spiral, which is discussed under another feature: Spiral.

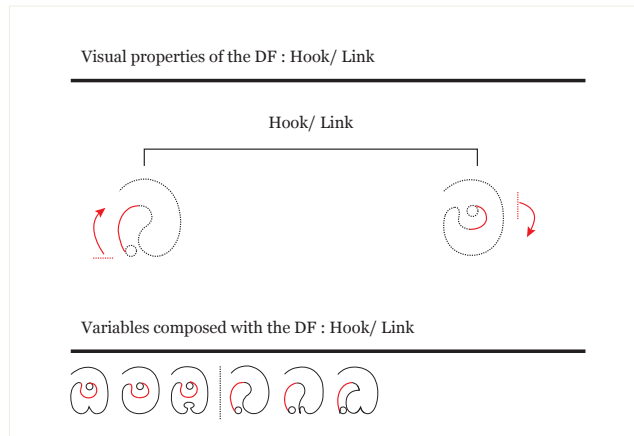


Figure 4.23: Distinct Visual Property: Hook/ Link

4.6.3 Nose/point

The term nose was used in a primer to describe the nose of the fox (*nariya*) in the letter na (न). This term was used at the initial listing in the Annexure 4.3. However it can be looked at as a point where two strokes meet. It is further defined as the *behavior of two strokes from different directions meet parallel to the baseline*. The nose can be found with two variations according to the direction of its point, either directed up or down.

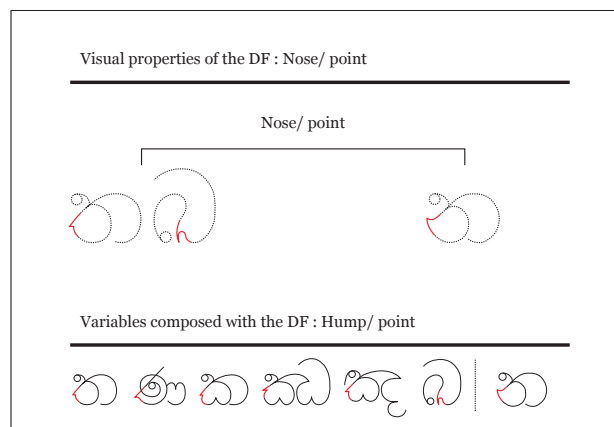


Figure 4.24: Distinct Visual Property: Nose/ Point

4.6.4 Hump

This feature is limited to two variables *gha* (घ) and *bha* (भ). The formation of this feature is usually found in the base stroke constructed with two circles parallel to the baseline. At the intersection of the two circles we find a curve to curve joint in some

variables, yet this feature is composed when this curve-to-curve joint is split and joined with a horizontal stroke parallel to the base line, that resembles a hump.

In the letter *gha* (ඝ) the hump joins two symmetric halves while in the variable *bha* (ඞ) it is an asymmetric joint with a base stroke and an ascending stroke, making the feature a part of the base and ascending strokes of these two variables. The scale of the feature varies according to its symmetric and asymmetric composition. This is defined as *the horizontal stroke that joins two halves circles parallel to the base line*.

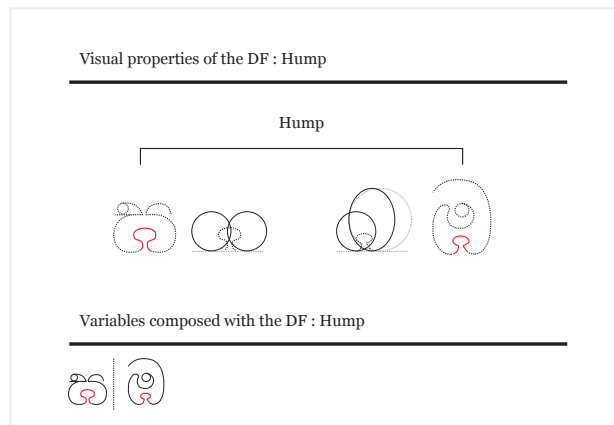


Figure 4.25: Distinct Visual Property: Hump

4.6.5 Stem

Since most Sinhala letters are circular, a straight-line gets a significant level of attention. Therefore, when observing the variables we find three forms of straight-lines, constructed; either vertically, horizontally or diagonally. The horizontal construction is found in another feature; the eye, which is not discussed here. Therefore, the stem is only found in ascending and descending variables. The ascending stem is always a diagonal stroke that terminates at the ascending line, while the other part joins to a base height full circle or an eye or point.

This feature found in descending variables are composed vertically and horizontally, and limits to two variables *a* (අ) and *la* (ල). The vertical line joins to a loop at the top end while the bottom joins to a knot. The horizontal stroke is attached to a descending stroke.

In the Roman alphabet, the stem represents the main stroke of the letter, as in the Roman capital T, H etc., while in Devanagari we see the use of the terms trunk and vertical stem to express the letter's vertical stroke that holds up the trunk of the letter. As for the Sinhala letter we can define it as *the stroke constructed straight either vertically, horizontally or diagonally*.

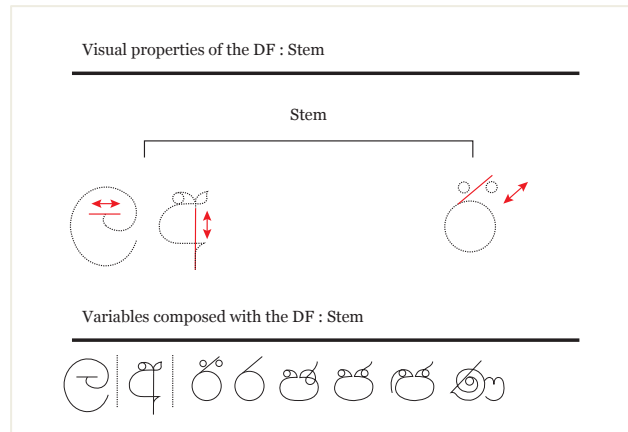


Figure 4.26: Distinct Visual Property: Stem

4.6.6 Spiral

This is an elaborated feature constructed on the base height. It becomes a part of the eyeball as it joins the eyeball as a cursive stroke and rotates clockwise to form a spiral. The termination of the spiral happens parallel to the baseline. In the case of the ascending variable it joins to be part of the nose/point and in the descending variable it joins another curve stroke. This can be defined as *the stroke that joins the eyeball at the base height to create a clockwise spiral*.

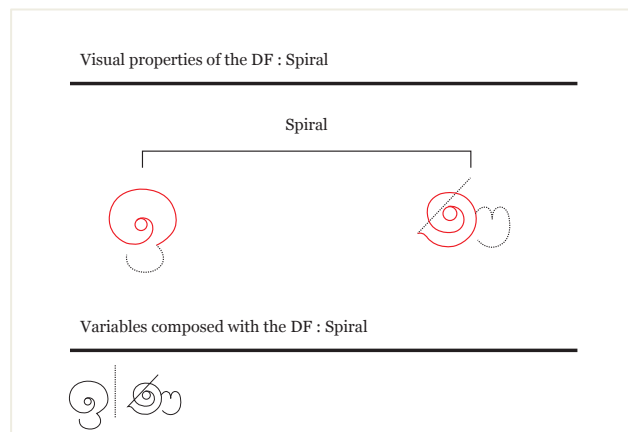


Figure 4.27: Distinct Visual Property: Spiral

4.6.7 Shoulder

This feature is usually found between line 3-4 and 2-3. It takes three visual forms on the basis of its connection to adjacent strokes.

The shoulder is a term borrowed from the Latin anatomy as a curve stroke projecting from a stem (main stroke of the Latin letter). Even though the shoulder identified here does not project out from a stem, it does project out of the base stroke and eye (which can be considered as the main stroke of the Sinhala letter). The relationship of the shoulder could be grouped according to:

- The way it joins the base stroke or the eye,
- The way the stroke joins at the mid range of the base stroke to look like it is adjacent to the other part of the letter.

We can define this feature as *a curve stroke that is composed parallel to the base stroke either as a joint or an adjacent stroke.*

The shoulder becomes part of three more features: the eye, knot, loop. Since the eye is composed with a knot, it terminates parallel to the base shape, even though it may be part of an ascending or a descending variable. Another variation is that the shoulder sometimes terminates into a loop.

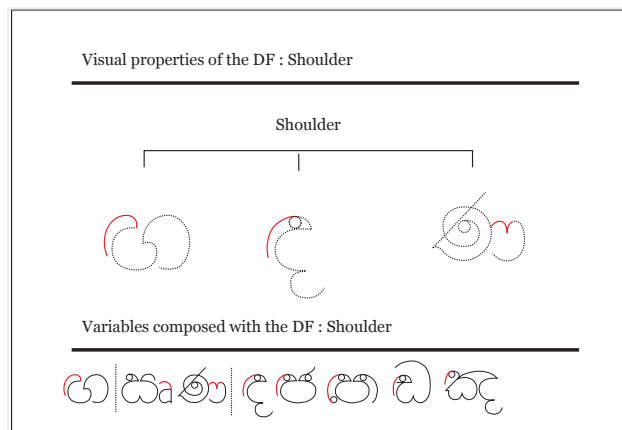


Figure 4.28: Distinct Visual Property: Shoulder

4.6.8 Loop

The loop works more like a terminating feature. We have three divisions according to its location; between line 1-2, 2-3 and 3-4. The loops found between line 1-2 are common within the ascending variables, as the stroke that touches the ascender line

changes direction to create a loop. Meanwhile, the loop on the vertical stem is an exceptional feature seen on the letter *a* (අ) found between line 2-3.

The most elaborate compositions of the loop are found between line 3-4 as there are four variables that are composed with a loop. In the vowels *a* (අ) and *l* (ල) it is found at the terminating point of a shoulder. In the letter *sha* (ඡ) the loop is unique by itself as it terminates inside a closed counter. To define this feature we look at Dalvi's description on *the way a stroke changes direction and overlap each other without crossing over*. (Dalvi 2010: 179).

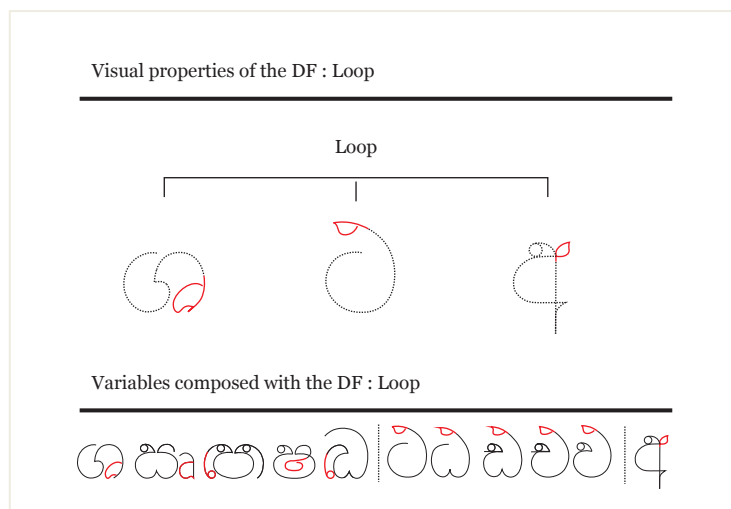


Figure 4.29: Distinct Visual Property: Loop

By analyzing the sub-properties, it was evident that most of it becomes a part of another feature with a minute variation of the stroke. Nevertheless, by defining the features helped to understand its distinct features within the Sinhala letter.

4.7 Letter joinery and terminals

An important element in the construction of the letter is the joinery and the terminals as they are visual properties that make the variable complete. Therefore, this section analyses the joinery that links strokes, intersect with each other, and how they terminate. The complete list of all variables that include eye joint, curve to curve joints, right angular joints, intersections and terminals are found in table 03.

4.7.1 Eye joints

The six variations of the eye properties joins the preceding strokes according to four ways:

- 1). The way in which the outward semi-spiral (that touches the eye line) joints the base, ascender, descender strokes.
- 2). The way in which the horizontal strokes joint the base and the ascending strokes.
- 3). The way in which the overlapping stroke of the eye joints the shoulder or creates a knot.
- 4). The way in which the eyeball joins the hook.

We define it as *the way in which the eye joins the preceding strokes*.

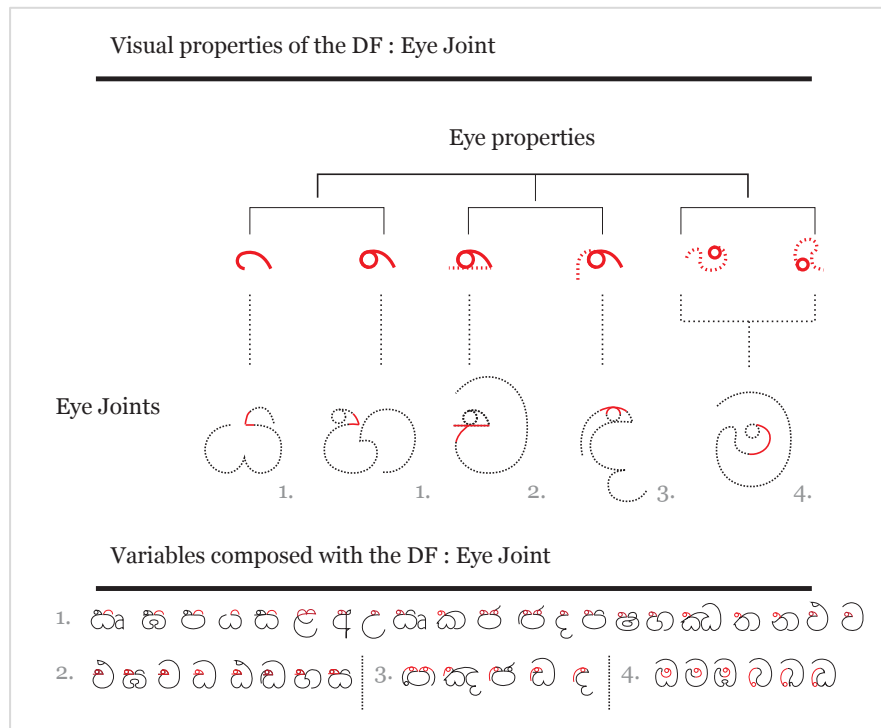


Figure 4.30: Distinct Visual Property: Eye Joints

4.7.2 Curve to curve joint and right angular joint

If we consider the base stroke to be a complete circle, this joint can be defined as *the way in which two circular shapes join*. The joinery can be divided into three visual divisions on the way the two circles collide; vertically, horizontally and diagonally.

Whereas the right angular joint is defined as *the way in which two right angular strokes joins two letters*. It takes the form of a ligature due to the combination of two letters, since we do not have ligatures in Sinhala we refrain from using this term.

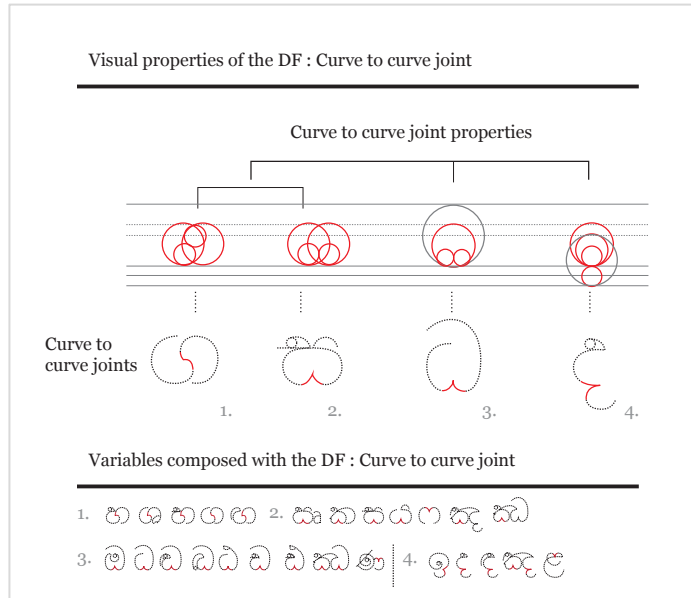


Figure 4.31: Distinct Visual Property: Curve to curve joint

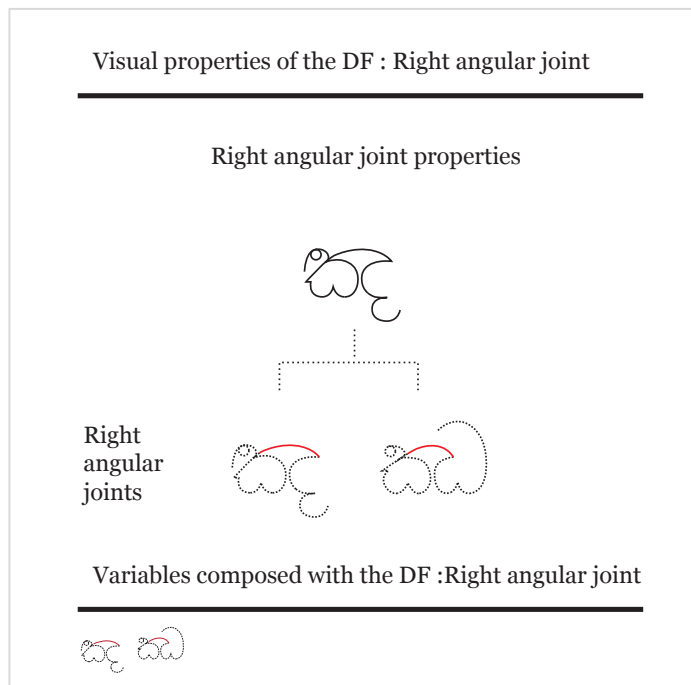


Figure 4.32: Distinct Visual Property: Right angular joint

4.7.3 Curve to stem joint

This visual appearance of this joint can be divided according to the way a curve stroke joins a stem and an angular stroke. The two descenders *a* (æ) and *la* (œ) are composed completely different compared to most letters, as the vertical stem of the *a* joins a knot at the bottom end and a loop at the top, while the horizontal stem of the *la* joins the descending stroke by making $\frac{3}{4}$ of a circle. The diagonal stems are all ascenders that join a full circle or an eye. Therefore, this can be defined, as *the way the stem joins to a curve stroke*.

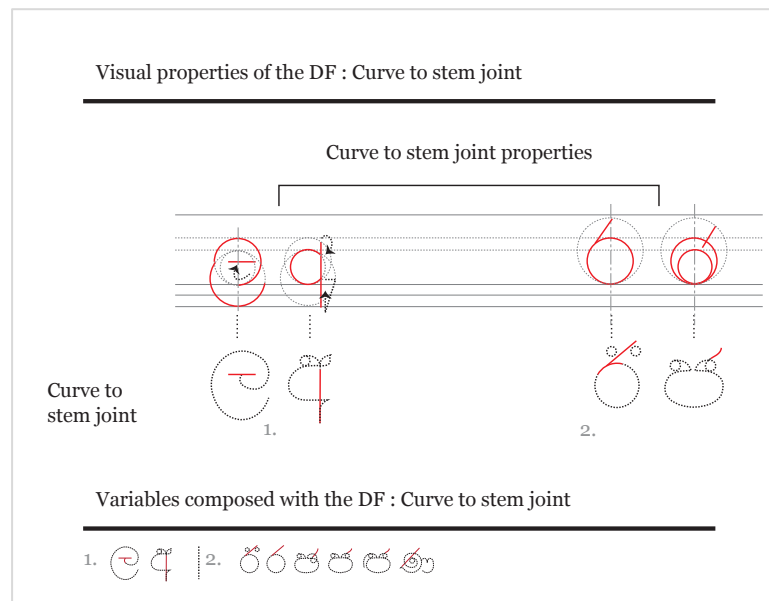


Figure 4.33: Distinct Visual Property: Curve to stem joint

4.7.4 Curve angular stroke joint

This joint is found in variables with the distinguished feature nose/point. This can be defined as the *connecting point where a curve stroke joins an angular stroke parallel to the base line*. In selected variables we find a horizontal line at this connecting point.

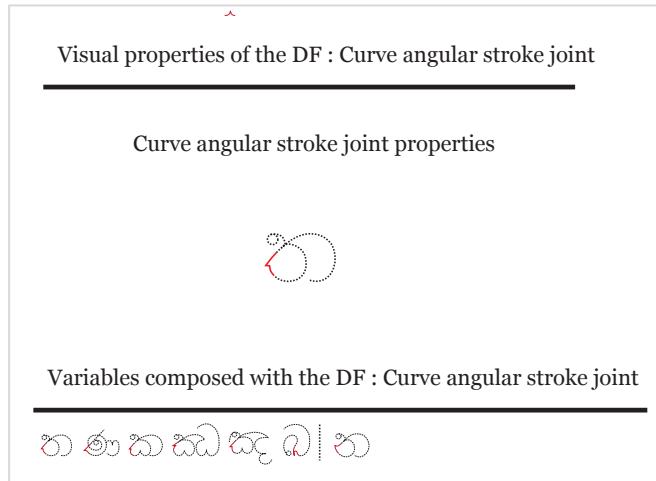


Figure 4.34: Distinct Visual Property: Curve angular stroke joint

4.7.5 Intersections

The *overlapping of two strokes can be defined as an intersection*. In features: knot, spiral, eye, and the descender *la*(ළ), we locate intersections of strokes. In the case of a knot, the eye and the *tha* (ණ) shaped base stroke, an overlap of the same stroke is evident due to its knot like appearance. Another form of intersection is found in the cerebral *na*(ණ) and *la*(ළ) where the diagonal stroke overlaps a spiral, while in the *la*(ළ) we find the curve stroke joining the eyes by overlapping the descending stroke.

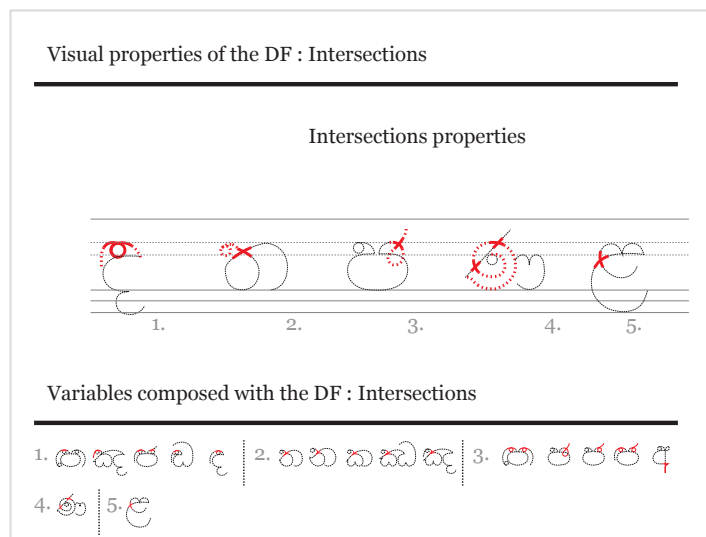


Figure 4.35: Distinct Visual Property: Intersections

4.7.6 Terminals

Most variables start with an eye and ends in various compositions. To understand the different terminals, we look at all variables and its ascending, descending, base stroke and the eye features. All variables that terminate at the eye line connect to a closed eye (without the small counter space). There are two forms of base shape letters, ones that start with eye and the other that starts at the eye line with a curve stroke, nevertheless the second form terminates as a loop and a curvilinear stroke. The base shape loop is found inside or outside the letter with an intersection. The ascenders on the other hand takes three forms with one starting at the eye and terminates at ascending stroke, and another with a loop. The third form of ascending terminal is seen when a diagonal stroke joints a complete circle to create a diagonal terminal stroke. The descenders have the least amount of variables, but also have the most amounts of stroke variations. The descenders have three forms of terminals with one that starts with an eye and terminates at the descending line as a larger curve stroke, and the other as a curve to curve joint creating a smaller curve. The third form of the descending stroke is unique to one variable that is the letter *a* (අ), which joints to a knot and terminates with a loop.

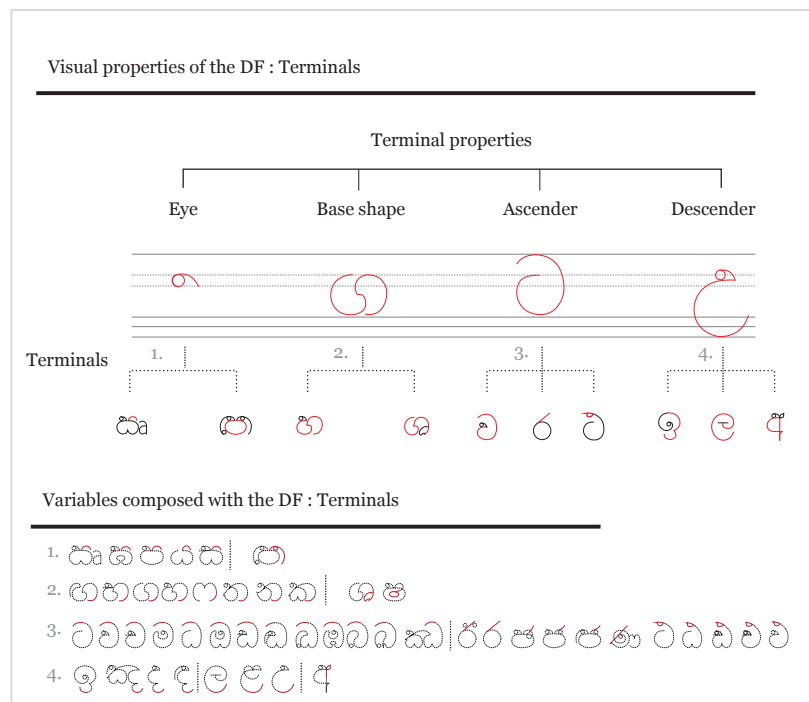


Figure 4.36: Distinct Visual Property: Terminals

During the analysis process, we learnt the parameters of the strokes by placing the variables on the five reference lines and a grid to an easy the visual analysis process. Thereafter, the eye and the main strokes: base, ascender and descender strokes were observed and listed individually according to their visual properties. For example the eye and the main strokes are each considered as a DVP. Similarly the other DVP – knot, hook/link, nose/ point, hump, stem, spiral, shoulder, loop, intersections and terminals too were listed according to its definition in Annexure 4.5.

Observation and findings

On the search for the anatomy of the Sinhala letter and its DVP, the findings are noted below:

A list of distinct visual properties of the Sinhala letter

To establish the anatomy of the Sinhala letter we needed to identify the morphological parameters of the Sinhala letter, specific to vowels and consonants. This analysis filled the gap of the limited research on the Sinhala letter –features, stroke parameters and behaviors of the letter. As a result the DVP of each letter was identified and listed (Annexure 4.7).

Structural system for the Sinhala letter: Five reference lines and the grid

We find limited literature on the structural system of the Sinhala letter within the subject of Sinhala typography. Therefore, the systematic structural systems: reference lines, grid, applied in this study contribute to literature as a pioneer proposal to analyze the Sinhala letter.

The proposed grid could be used to analyze and understand the design of an existing typeface or it could be re-arranged to design a new typeface. The fallbacks of using this grid are that it does not discuss the important attributes of typography such as: optical adjustment proportions, design properties and the quality of letter legibility and readability. Still this proposed grid can be used to identify the relationship between the strokes, its parameters, and behavior within all variables.

The five reference lines are solely focused on the letter and not on the relationship between the letter and vowel signs; therefore, we are left with the need to discuss on the 6th line identified in this study as further study.

Naming and defining the distinct visual

The terms used to describe the identified properties in the initial DVP list become more elaborate with literature findings. Here the terms used by the author before and after indicate the progress of the findings. Since the objective of the study is only to identify the distinct visual properties of each letter, terming of the visual properties is left for further study (discussed in chapter 05). Nevertheless, we conclude with 19 distinguished features that include joints, intersections and terminals - that makes the Sinhala letter in Annexure 4.5 (with definitions of each).

Joinery, intersections and terminals is another important aspect on how the distinguished features - joint, intersect and terminates are identified and listed out in Annexure 4.5. As for further study this list would help learn about the tool and proportions of the letter within a range of typefaces, rather than the hand.

4.8 Summary and conclusion of the chapter

To constitute the anatomy of Sinhala, the chapter starts by discussing the anatomy of other scripts. This knowledge spoke of certain elements that are commonly discussed within the anatomy of type, yet specific to script. Each element was examined and literature was reviewed to understand the existing knowledge on Sinhala script that can be used to establish the anatomy. The second part of the chapter focused on a pilot visual survey on the Sinhala letterform. As a result, the earlier discussed anatomical features specified to Sinhala needed to be re-addressed and defined. The reviewed knowledge on the pilot experiment was used to build a new method at the third part of the chapter.

The research spiral method, used in management research was re-designed to suit the thesis research objective. It was initiated, first by identifying the variables. Each variable in this case was the selected Sinhala letters, and they were examined

across three different contexts. The survey identified morphological features that are distinct to each Sinhala letter. As a result 59 (sub categorized into 19) visual properties distinct to the Sinhala letter were suggested. Each visual property was visually explained with tentative terminology.

The proposed terminology is addressed in the next chapter, and it is further discussed across selected typefaces within a chronological time line.

THE ANATOMY: STUDY ON SINHALA TYPEFACES

The background study in chapters two and three identified the existing literature on the Sinhala letterform to be biased to other subject areas and not to typography, and as a result, limitations in literature on the anatomy of the Sinhala was identified. In chapter three, the absence of knowledge in Sinhala typefaces was documented. Lack of research and observation on the morphological features of Sinhala typefaces needed to be addressed. Therefore, the previous chapter reviewed how other scripts had built their anatomy relevant to their script. It examined the need to incorporate certain elements to constitute the anatomy is relevant to the script, and homogeneous to the field of typography. With the knowledge of the elements of the anatomical features, a visual survey was conducted to identify the morphological features of the Sinhala letterform. It was concluded with a visual grouping of letters, that explained the distinct nature of each Sinhala letter, and with that, one of the main findings of the thesis was achieved.

This chapter is a continuation of the previous chapter, in an attempt to achieve the anatomical features of Sinhala letters, but specific to typefaces. The chapter is divided into three main sections. The first section brings forward the identified visual properties of each Sinhala letter and proposes a common vocabulary to define them. The proposed terms were tested with a set of experts and non-experts. The second section conducts a random visual survey on Sinhala typefaces from the inception of the printing press in Sri Lanka and to the present day. This was conducted to document a selection of Sinhala typefaces to facilitate the third part of the chapter. The third section discusses a random set of visual properties within a selected set of letters, to demonstrate the earlier findings on the letterform properties. This together with behavior on the visual features of typefaces presents the proposed anatomy of Sinhala.

5.1 Development of Nomenclature to Define Type

Use of a standardized set of terms to describe the morphological characteristics of letterforms or typefaces can be considered as the most important element in the anatomy of type. Since the letterforms' distinct visual properties were identified in the previous chapter, this section documents the survey conducted on the proposal of terminology to define the Sinhala letters' visual properties.

In chapter two, we learnt that the existing terminology used to describe the Sinhala anatomy was limited to Sinhala vowel signs and selected non-alphabetical signs. They had no unified terminology as a single sign was termed differently by different experts on the subject. Nevertheless, the derivation of the existing terminology was identified as an expression of a visual and sound. This knowledge was brought forward in this chapter to assist the analysis of the survey.

5.1.1 Survey Procedure on Terming Visual Properties

The survey was conducted in two stages. The first stage was conducted with the participation of ten non-experts. The second stage was with four experts on the field of Sinhala language. Both parties were given a survey form that was independently evaluated to propose the final set of terms to describe the anatomy of the Sinhala letter.

The survey form consisted of a table of three columns. The first two columns included the number of visual properties and the second included a blank space to be filled by experts and non-experts. The third column consists of visual property marked in red and groups of letters with similar visual properties. A sample is attached in annexure 5.1. The survey examined how various individual, both experts and non-experts, termed certain Sinhala letter properties. It explains the rationale and purpose of the terms proposed. Therefore, the objective of this survey was as follows:

- To understand how experts and non-experts term letter properties and the reasons behind it
- To understand, if the derivation of terminology is based on the expression of visual and sound (as in the existing terminology)

- To identify the best approach when proposing terminology for the anatomy of Sinhala letters

5.1.2 Suggested Terminology by Non-experts and Experts

The non-expert survey was conducted with ten individuals, between the ages of 16-25 with an interest in typography (but with no academic knowledge on typography). Each individual was given a survey form and was asked to fill the blank cell, with a proposed term. At the conclusion of the survey the participants were given an opportunity to ask questions on the survey. At the evaluation, we opened up for a round of questions to inquire on the concerns the non-experts had, and concluded with a discussion. As a result of this the following points were noted:

- The terming of visual properties was random and had no justified reason. The proposed terms were mere descriptors of visual expression according to the individual's preference. Nevertheless, most participants suggested terms that conveyed human body parts, a few suggested geometric shapes and parts of plants.
- Difficulty of terming certain visual properties was a common concern with the non-experts because of the similar visual properties. Therefore, they had used the same term to define other visual properties and this resulted in the repetition of terms.

The same survey form was given to the four experts on the field of Sinhala language. The individuals selected for this survey comprised academics in the field of Sinhala Language Studies, who had more than twenty years of research experience, and published more than ten academic publications on the field of Sinhala script. The survey was conducted as a group interview and their ideas were discussed openly. The following points were noted, before they proposed the final terms:

- To term the visual properties with Sanskrit terminology, due to its origin and practice

- To discuss suggestions on their ideas based on the visual appearance of the visual property. To select the most appropriate and to translate them into Sanskrit terms
- The decision to use human or animal anatomy to describe the visual properties
- A collective decision to take a common term for selected visual properties (that can be grouped in the survey form) and to use a term to mark the location of the visual property

Visual properties that were surveyed were described with tentative terms in the previous chapter. Therefore, the following discussion is on the suggestions made by experts on these tentative terms. But none of these terms were shared with experts till the end of the survey. The experts started the discussion with the eye of the letters, and they conveyed the term *iha* (meaning head) as a term commonly used in language studies. Nevertheless, due to the visual grouping of the current survey form, the experts considered the term 'eye' to describe all of these features. The eye was categorized into five fields: open eye, closed eye, eye with stem, eye with shoulder, and the eye (iris). The experts termed them as *akshi*-අක්ෂි meaning eye in Sanskrit as an overall term to define its visual expression. Each eye was termed separately thereafter: *Vivṛta*-විවෘත meaning open, *Sanvṛta*-සංවෘත meaning closed. The eye that has a horizontal stroke was emphasized by its horizontal stroke, that visually expressed a horn like shape. Therefore it was termed as *Śrngika akshi*-ශ්‍රංගික අක්ෂි, *Śrngika* meaning horn. The eye with shoulder was interpreted as a trunk of an elephant and was suggested as *Śunda*-ශුන්ද meaning trunk and the visual property was termed as *Śunda akshi*. The eye/s that takes a full circle was identified under two visual properties based on the location of the full circle. The one that is at the mid-range used the term *Madhya* (මධ්‍ය- mid) and one that is at the bottom was given the term *Patita*-පතීත meaning bottom. Yet, due to the circular nature and the location of this feature, the experts proposed a common term for both, *nābhi* meaning navel and suggested the term *Nābhiakshi* - නාභි අක්ෂි to define the eye with the shoulder.

Expert terminology in English	<i>Vivṛta akṣhi</i>	<i>Sanvṛta akṣhi</i>	<i>Śṛṅgika akṣhi</i>	<i>Śuṅḍa akṣhi</i>	<i>Nabi akṣhi</i>	<i>Patita akṣhi</i>
Expert terminology in Sinhala	විවෘත අක්ෂි	සංවෘත අක්ෂි	ශ්‍රිංගික අක්ෂි	ශුණ්ඩ අක්ෂි	නාබි අක්ෂි	පතිත අක්ෂි
Tentative terms in English (from previous chapter)	Open eye	Closed eye	Eye with horizontal stroke	Eye with shoulder	Iris	

Figure 5.1 Eye: Terminology by Experts

The base character letters were termed as *Skandha*-ස්කන්ධ to denote the meaning body in Sanskrit, as they are considered the body of the letter. The complete (full) body was termed as *Pūrṇa Skandha*-පූර්ණ ස්කන්ධ, *Pūrṇa* meaning – full. The frontward and backward body was termed as *Pūrva-apara skandha*-පූර්වඅපර ස්කන්ධ. *Pūrva* meaning frontward and *apara* meaning backward. Yet, due to the observation on the joint, of the frontward and backward half circles, the experts suggested the body to be defined by its hooked nature and suggested the term *alamba* -අලම්බ. The letters that have a body with a *Śula* (point)-ශූල was termed as *Śulita skandha*-ශූලිත ස්කන්ධ and the experts separate the body of the letter ‘na’ from this group as the letter ‘na’ (න) has a body that takes the shape of a horn (*Śṛṅgika*). Therefore, the term *Śṛṅgikakskandha*-ශ්‍රිංගිකස්කන්ධ was suggested. With that, letters that have a body with a broken nature was termed as *Baṅgika skandha*-බංගික ස්කන්ධ (Broken body). *Bhaṅga* means broken. The brokenness of the letter was captured by its joint as the body is broken into two half circles for example the letter ‘ka’ (ක). Among the base character, there is also another significant feature expressed as a pointed shape. Therefore, an overall term was suggested by the experts to define characters that share this point within the body as *ශූලිතස්කන්ධ* (Body with point).

Expert terminology in English	<i>Pūrṇa Skandha</i>	<i>Pūrva-apara S.</i>	<i>Baṅga Skanada</i>	<i>Śulitak Skanada</i>	<i>Śṛṅgikak Skandha</i>
Expert terminology in Sinhala	පූර්ණ ස්කන්ධ	පූර්වඅපර ස්කන්ධ	බංග ස්කන්ධ	ශූලිත ස්කන්ධ	ශ්‍රිංගිකස්කන්ධ
Tentative terms in English (from previous chapter)	Base St. 01	Base St. 02	Base St. 03	Base St. 04,05	Base St. 04,05

Figure 5.2 Base Characters: Terminology by Experts

The ascender and descender strokes were given a direct translation. *Arohana* means ascender -අරෝහණ ස්කන්ධ and *avarohana* means descender-අවරෝහණ. The knot, too, was given a direct translation and the suggested term was *Grantika*-ග්‍රන්තික. The hook was translated as *Dhāraka*-ධාරක meaning bearer. Since the navel eye convey two types of shapes; *Madhya* (mid) and *Patita* (bottom) each was suggested as two different terms. Therefore, the letters that bear the *nābhi akshi* (navel eye) at the mid-range was suggested as *nābhi dhāraka*-නාභිධාරක, meaning, navel bearer. Whereas the letters that are at the bottom was expressed according to its shape, which denoted an elephant's trunk, therefore it was termed as *Śunda dhāraka* - ඉන්ධධාරක, *Śundadhāraka* meaning trunk bearer. *Ganda*-ගන්ධි, meaning fruit, was suggested for the hump of the letter as it takes a shape of a (round) fruit.

Expert terminology in English	<i>Avaraohana</i>	<i>Arohana</i>	<i>Grantika</i>	<i>Śunḍa Dhāraka</i>	<i>Nabi Dhāraka</i>	<i>Gaṇḍa</i>
Expert terminology in Sinhala	අවරෝහණ ස්කන්ධ	අරෝහණ ස්කන්ධ	ග්‍රන්තික	ඉන්ධධාරක	නාභිධාරක	ගන්ධි
Tentative terms in English (from previous chapter)	Descender	Ascender	Knot	Hook	Hook	Hump

Figure 5.3 Terminology by Experts: Ascender, Descender, Knot, Hook, Hump

The stem was compared to an arm (*bāhuva*) by the experts; therefore, the arm was interpreted according to its position and direction. The term *Tiryak*-තිරියක් (horizontal) was suggested to letters with a horizontal arm. *Avanata*-අවනත (fallen) and *unnata*-උන්නත (upward) were terms suggested for diagonal or vertical arms. Spiral shaped visual feature was translated as *Śnkaya*-ශංකය, meaning spiral. Similarly a direct translation was suggested for the shoulder of the letter as *Uro*-උරෝ. The loop was given the term *pasha*, and according to its placement it was termed as *arohana pasha*-අරෝහණ පාශ (ascending loop), *madhya pasha*- මධ්‍ය පාශ (loop at the mid range) and *avarohana pasha*-අවරෝහණ පාශ (descending loop).

Expert terminology in English	<i>Avanata bāhuva</i>	<i>Unnata bāhuva</i>	<i>Tiryak bāhuva</i>	<i>Śhṅkaya</i>	<i>Arohana pasha</i>	<i>Uro</i>
Expert terminology in Sinhala	අවනත මානුව	උන්නත මානුව	තිර්යක් මානුව	ශංකය	අරෝහණ පාශ	උරු
Tentative terms in English (from previous chapter)	Stem	Stem	Stem	Spiral	Loop	Shoulder

Figure 5.4 Terminology by Experts: Stem, Spiral , Loop, Shoulder

The term ‘joint’ was directly translated as *Sandi*. The eye joint was suggested as *akshi dhāraka sandi*- අක්ෂිධාරක සංධි (eye bearing joint). The eyes that started at mid-range were termed as *nābhi dhāraka sandi* - නාභිධාරක සංධි (the joint that bears the navel). The other joint that had a *Śundaya* (trunk) was termed as *Śunda dhāraka sandi*- ඉන්ධිධාරක සංධි (the joint that bears the trunk). The curve to curve joint was suggested as the joint that has a broken (*Bhanga*) nature found in letters that have a *Pūrva-apara* (frontward-backward) body or a broken body. Nevertheless, the experts termed this joint as *dvivakra sandi*- ද්විවික සංධි (the joint that is made of two circles). The visual feature that joints two letterforms was suggested as *Chandra Vanka sandi*-චන්ද්‍රවංක සංධි (the joint that takes crescent shape). The terms used for intersections were suggested as *vedaka*-වෙදක meaning intersection and *agra*-අග්‍ර for terminals.

Expert terminology in English	<i>Akshi dhāraḥ s.</i>	<i>Nābhi dhāraka s.</i>	<i>Śuṇḍa dhāraḥ s.</i>	<i>Dvivakra s.</i>
Expert terminology in Sinhala	අක්ෂිධාරක සංධි	නාභිධාරක සංධි	ඉන්ධිධාරක සංධි	ද්විවික සංධි
Tentative terms in English (from previous chapter)	Eye joint	Eye joint	Eye joint	Curve to curve j.

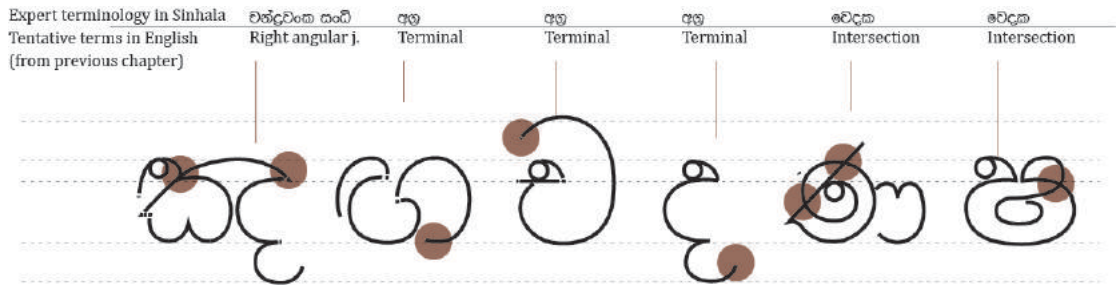


Figure 5.5 Terminology by Experts: Eye Joint, Curve to Curve Joint, Intersections and Terminals

5.1.2 Suggested Terminology by Experts

At the conclusion of the interviews, we were able to understand how the experts and the non-experts proposed terminology. All the proposed terms by both parties are included in Table 5.1. The fifth column of this table elaborates the terms proposed by the experts (discussed above). The column summarizes the Sinhala term and its meaning in English.

The experts with their knowledge on the language and experience of the frequent use of letters, presented a more systematic approach. They observed the letters and the visual properties that were grouped (in the form) and presented their thoughts. As a result of this the following points were identified:

- The eye (iris) was considered as a single visual property, yet the experts proposed a generic term for this eye as *Nabi akshi* and further proposed two more terms based on the location of the eye as *Madhya akshi* (Mid) and *Patita akshi*(bottom).
- Base stroke 04, 05 are defined as a single visual property because of the pointed nature of the shape. But, the experts suggested three terms as they identified two significant visual variations within this single visual property. The first visual variation was the horn shaped point and the second variation was the broken nature of the closed counter of base stroke 04. Therefore, the terms proposed were *Banga Skanada* (broken), *Śulitak Skanada* (pointed), *Śrngikak Skandha* (horn).

- Five types of ascender strokes and three types of descender strokes were presented to the experts, yet, they suggested one generic term for each category as *Arohana* (ascender), *Avaraohana* (descender).
- Several visual properties were given direct translation due to their visual expression, therefore the suggested terms are: *Grantika* (knot), *Śnkaya* (spiral), *Uro* (shoulder), *Sandi* (Joint), *vedaka* (Intersection), *agra* (Terminal).
- The hook is a visual property that is adjacent to the eye (iris) and has two types of visual placements, *Madhya* (Mid) and *Patita* (bottom). The experts proposed a generic term to denote both visual properties as *Dhārakaas* as it bears the eye (iris), and suggested separate terms for each: *Śunda Dhāraka* (trunk), to denote the trunk like nature and *Nabi Dhāraka* (navel), to denote the navel.
- The experts suggested this visual property to represent a hump in the human body, yet the direct translation to Sanskrit suggested *Ganda*, meaning fruit. Therefore, the experts concluded on the term *Ganda* to represent the visual property, hump.
- The stem was suggested to a *bāhuva* (arm). And visually translated to its direction as *Avanata*(fallen), *Unnata*(upward), *Tiryak* (Horizontal).
- The loop was given the term *pasha*, and according to its placement it was termed as *arohana pasha*-අරෝහණ පාශ (ascending loop), *madhya pasha*- මධ්‍ය පාශ (loop at the mid- range) and *avarohana pasha*-අවරෝහණ පාශ (descending loop).
- The four eye joints were reduced to three and the experts based the terminology on the earlier suggested terms. The generic term for the eye joint was a direct translation, termed as *Akshi dhārak Sandi* (eye joint); these joints represent most eyes except the navel eyes. Therefore, based on the terms used to define the *daraka*, the following terms were suggested; *nābhi dhāraka sandi* (the joint that bears the navel), *Śunda dhārak sandi* (the joint that bears the trunk). Similarly, Stem and the Point joints were given the following term: *Bāhu sandi* (Arm joint), *Śula sandi* (Point joint), and *Śṛngika sandi* (Horn joint).

- The curve to curve joints were narrowed to one term as *dvivakra sandi* (the joint that is made of two circles).

No	Tentative terms	Non-expert terminology	Expert terminology - Options Discussed	Expert terminology		
				English Meaning	Sinhala Term (Sanskrit)	
1.	Nose/point	නාසය, තුඩ, බැදී ඉර, ගැටය	ශුන්ඩ/ තුන්ඩ	Point	<i>Śūla</i>	ඉල
				Horn	<i>Śṛṅgika akshi</i>	ශෘංගික අක්ෂි
2	Hook	වක,ගෙල,නොඩය, ඇකය	නානිධාරක, ශුන්ඩධාරක	Bearer	<i>Dhāraka</i>	ධාරක
				Trunk bearer	<i>Śuṇḍa Dhāraka</i>	ශුන්ඩධාරක
				Navel bearer	<i>Nabi Dhāraka</i>	නානිධාරක,
3	Hump	හිස් බිංදුව, ගැටය, යට ගැටය	කකුඩ/ගන්ඩ	Fruit	<i>Gaṇḍa</i>	ගන්ඩ
4	Knot	ඇත, ඇස, ඇස් පිල්ල, ගැටය	ගුන්තික	Knot	<i>Grantika</i>	ගුන්තික
5	Loop	බිංදුව, අග ගැටය, හෙළුම්, පින්න	අරෝහන පාශ අවරෝහන පාශ මධ්‍ය පාශ	Loop	<i>Pasha</i>	පාශ
				Ascending loop	<i>Arohana pasha</i>	අරෝහණ පාශ
				Descending l.	<i>Avarohana p.</i>	අවරෝහ පාශ
				Loop at the middle	<i>Madhya pasha</i>	මධ්‍ය පාශ
6	Spiral	සර්පිල, උෞර්ණය, බිංදුව සහිත අඩ රවුම, ඇත	ශංකය	Spiral	<i>Śṅkaya -</i>	ශංකය
7	Stem	ඉර, උච්චය, අත	තිරිසක් බාහුව අවනත බහුව උන්නත බහුව	Arm	<i>Bāhuva</i>	බාහුව
				Horizontal arm	<i>Tiryak bāhuva</i>	තිරිසක් බාහුව
				Fallen arm	<i>Avanata b.</i>	අවනත බහුව
				Upward arm	<i>Unnata bāhuva</i>	උන්නත බහුව
8	Shoulder	සඤ්ඤකය, අවරනය, ඇන්ද	උරෝ ශීර්ෂය	Shoulder	<i>Uro</i>	උරෝ
9	Eye			Eye	<i>Akshi</i>	අක්ෂි
	Closed eye	කන, උඩු පිල්ල, ඔළුව	සංවෘත අක්ෂි	Closed eye	<i>Sanvrta akshi</i>	සංවෘත අක්ෂි
	Opened eye	උස	විවෘත අක්ෂි	Opened eye	<i>Vivrta akshi</i>	විවෘත අක්ෂි
	Eye with stem	ඇස සහ සෘජු ඉර, ඇස, ඇස වටය	ශෘංගික අක්ෂි	Horn Shaped e.	<i>Śṛṅgika akshi</i>	ශෘංගික අක්ෂි
	Eye with shoulder	ඇස සහ වක, සංග්‍රක ඇස, අවරණය,ඇස් ඇන්ද	ශුන්ඩ අක්ෂි	Trunk shaped e.	<i>Śuṇḍa akshi</i>	ශුන්ඩ අක්ෂි
	Eye (Iris)	උස	නානි අක්ෂි	Navel eye	<i>Nabi akshi</i>	නානි අක්ෂි

			මධ්‍ය අක්ෂි	Mid range eye	<i>Madhya akshi</i>	මධ්‍ය අක්ෂි
			පහිත අක්ෂි	Bottom range e.	<i>Patita akshi</i>	පහිත අක්ෂි
10	Curve to curve joint	ද්වික, චක්‍රයට චක්‍රය, නැමීම, කරුව, සන්දි	ද්වික සංධි	Joint made of two circles	<i>Curve to curve j.</i>	ද්විචක්‍ර සංධි
11	Right angular J.	සමකෝණ, සන්ධිය, බද	චන්ද්‍රවංක සංධි	The crescent shaped joint	<i>Chandra Vanḥa sandi</i>	චන්ද්‍රවංක සංධි
12	Eye Joint	-	අක්ෂිධාරකසංධි	Eye Joint	<i>Akshi dhāra k s.</i>	අක්ෂිධාරකසංධි
			නාභිධාරකසංධි	Navel joint	<i>nābhi dhāra ka sandi</i>	නාභිධාරකසංධි
			ශුන්ඛධාරක සංධි	Trunk joint	<i>Śuṇḍa dhāra k sandi</i>	ශුන්ඛධාරක සංධි
13	Curve to stem J.	-	බාහු	Arm joint	<i>Bāhu sandi</i>	බාහු සංධි
14	Curve angular J.	-	ශූල	Point joint	<i>Śula sandi</i>	ශූලසංධි
				Horn joint	<i>Śṛṅgika sandi</i>	ශෛෂ්‍ය සංධි
15	Ascender	රච්චුම, බද, මුලික රාමුව, ඇත	අරෝහණ ස්කන්ද	Ascender	<i>Arohana</i>	අරෝහණ ස්කන්ද
16	Base	උදරය, භාරකය, බඩ	පූර්ණ ස්කන්ද පූර්වඅපර ස්. / අමුඛ ස්. කොකු ශාලාක් ස්කන්ද බංග ඡේතන්ද	Complete (full) body	<i>Pūrṇa Skandha</i>	පූර්ණ ස්කන්ද
				Frontward - backward body	<i>Pūrva-apara S.</i>	පූර්වඅපර ස්
				Broken body	<i>Banga Skanada</i>	බංග ස්කන්ද
				Body with point	<i>Śulitak S.</i>	ශූලිතක් ස්කන්ද
				Horn shaped body	<i>Śṛṅgikak S.</i>	ශෛෂ්‍යක් ස්කන්ද
17	Descender	පාදම, උදරය, බර	අවරෝහණ ස්.	Descender	<i>Avaraohana</i>	අවරෝහණ ස්.
18	Terminal	-	අග්‍ර	Terminal	<i>Agra</i>	අග්‍ර
19	Intersection	ගැටය	චේදක	Intersection	<i>Vedaka</i>	චේදක

Table 5.1 : Proposed terms by Experts and Non-experts

5.1.3 Analysis on the Terminology

The terminology used by language experts conveyed more meaning to the shape of the letter, therefore, the terms proposed by the experts conveyed a logical system. But the terminology was direct translations of Sanskrit, which is rarely used colloquially. Where as the non-expert terminology conveyed colloquial terms even though the terminology did not have a logical base. Taking both proposals on

terminology, the following points were noted down as a proposal for further study in terminology:

- The visual expression, suggested by the experts conveyed a logical meaning to the terms because the terms were based on human, animal anatomy, and visual expressions of the shape that convey direct meaning.
- The terms suggested by the non-experts conveyed colloquial terminology, that could be practically used in design practice.

Based on the above points, we can propose further terminology. Nevertheless, we conclude the experiment with the expert terminology and cross-analyse this terminology with what is in use/practice in other scripts. So, based on the following work the terminology was cross-analyzed. Devanagari script by Naik, B.S.: *Typography of Devanagari* and Dalvi: *Conceptual model for Devanagari typefaces*. PhD Thesis., Bengali by Ross, F.: *The Printed Bengali Character and its Evolution* , Ross, F.: *Digital typeface design and font development for twenty-first century Bangla language processing*, and Chandra *et al* : *Anatomy of Bangali Letterform :A semiotic study*, Latin by Cheng, K.: *Designing Type.*, Arabic by Abulab, S.D.: *Anatomy of an Arabetic Type Design*, Tamil by Kumar, *Tamil Transformation of Tamil letterforms from Palm leaf manuscripts to early Letterpress printing*, PhD Thesis. The following table (5.2) presents the use of similar terminology in existent in other typographic practices.

No	Tentative terms	English Meaning(Expert terminology)	Already in use (in other scripts)					Introduced to Sinhala
			Arabic	Bengali	Devanagari	Latin	Tamil	
1.	Nose/point	Point				Y		

		Horn						Y
2	Hook	Bearer*						Y*
		Trunk bearer						
		Navel bearer						
3	Hump	Fruit					Y	
4	Knot	Knot		Y	Y			
5	Loop	Loop*	Y*	Y*	Y*			
		Ascending loop						
		Descending l.						
		Loop at the middle						
6	Spiral	Spiral						Y
7	Stem	Arm*				Y*		
		Horizontal arm						
		Fallen arm						
		Upward arm						
8	Shoulder	Shoulder				Y		
9	Eye	Eye*				Y*	Y*	
	Closed eye	Closed eye						
	Opened eye	Opened eye						
	Eye with stem	Horn Shaped e.						
	Eye with shoulder	Trunk shaped e.						
	Eye (Iris)	Navel eye						
		Mid range eye						
Bottom range e.								
10	Curve to curve joint	Joint made of two circles						Y
11	Right angular J.	The crescent shaped joint						Y
12	Eye Joint	Eye Joint						Y
		Navel joint						
		Trunk joint						
13	Curve to stem J.	Arm joint						Y
14	Curve angular J.	Point joint						Y
		Horn joint						
15	Ascender	Ascender		Y	Y	Y		
16	Base	Complete (full) body*		Y*	Y*	Y*		
		Frontward - backward body						
		Broken body						
		Body with point						
		Horn shaped body						

17	Descender	Descender		Y	Y	Y		
18	Terminal	Terminal	Y	Y	Y	Y	Y	
19	Intersection	Intersection	Y	Y	Y	Y	Y	
* Generic term								

Table 5.2 Similar terminologies in other typographic practices

With reference to the visual survey, the following observations on the Sinhala letterform and the existing literature are listed below.

Expert proposal on visual grouping: The identified 19 distinct visual properties (from the previous chapter) were further elaborated by the experts due to the identification of similar visual properties. Therefore, the 19 properties were further grouped, and as an outcome, certain visual properties were identified from its generic term and also with its distinct nature, as a result multiple terms were presented in table 5.1).

Proposed set of terms: The terms presented by the experts and the none-experts were helpful to understand how a specific property could have several interpretations. Nevertheless, if we consider the expert meaning to the visual property, we understand that the specified property could be presented in Sanskrit as well as colloquial Sinhala. Therefore, this knowledge can be further developed when proposing colloquial terms.

Expression of visual properties: In chapter two, we were able to understand that the existing terminology on the Sinhala letter-parts were based on visual and voice expression. Yet, all of the terms suggested here are based on visual expression, as the experts suggested terms by comparing visual similarities of the human anatomy to the letter anatomy.

With this knowledge on the terminology we conclude the first section of the chapter. The second section conducts a random visual survey on Sinhala typefaces from the inception of the printing press in Sri Lanka to the present day, based on the

background studies in chapter three. This was conducted to document a selection of Sinhala typefaces to facilitate the third part of this chapter.

5.2 Chronological order of Sinhala Typefaces

Visual properties of Sinhala typefaces are rarely discussed due to the absence of the Sinhala anatomy. As a result literature is limited on the earliest typefaces.

After the inception of the printing press, several Sinhala typefaces have come into existence due to socio-political and economic reasons; therefore the following survey plans to identify Sinhala typefaces, across a chronological timeline.

The literature on the development of the press is biased to political and social influence of the 18th and 19th century. This then makes documentation of the type design abrupt, confined and informal due to the gap between the literature and the primary source - type specimens. The early typeface, type-specimens, its designers and the process have not been explored, and this knowledge is critical for typographers and type designers as it demonstrates the early practices that were used, and can be used in the type design process today. To achieve the objective of this thesis, it was important to identify type specimens. To establish this, and since there is no systematically structured data on the early Sinhala typefaces, the objective of this survey was as follows:

- To chronologically identify Sinhala typefaces with the available literature and link the literature to type specimens.

In achieving the above objective the following sub-objectives were arrived at:

- To establish the type composing technology of each identified typeface.
- To estimate the meta-data (name of type, designer/type foundry/ press) of each identified typeface.

5.2.1 The variables; Sinhala type specimens of Archival material

The overall understanding on the socio-political and economic view on the development of the printing press discussed in the third chapter, directed key turning points that contribute to the research on Sinhala typeface. Based on the

availability of type specimens the study was divided into three time periods, and it was analyzed separately to derive at the variables.

- i. 1737 -1860 – Pre-Newspaper era
- ii. 1860 -1980 – Early Newspaper era
- iii. 1980 -2013 – Current Newspaper era

A. Variables of the Pre-Newspaper era

The first time period, observes the earliest prints and publications: placards, bibles, books. From a political viewpoint, it covers the Dutch, the British and the missionary printing press work and, from a sociological point of view the development of native printing presses. Non-native publications by the missionaries of the time, awoke a social reaction and consequently the uprising of native presses was seen. The printing press as an agent of change during this era had produced a multitude of print work from different establishments. Due to the social uprising and the sudden development of printing presses in the Island, documentation of such work was rarely found. Therefore, cataloguing of printed material was very rare until around 1868, by Murdoch and Nicolson. They compiled a comprehensive catalogue on the publications of the Dutch printing press, yet most prints were unable to be locally located. The missionary and native print materials and publications shared the same fate. Therefore, selected publications mentioned in literature were noted down as primary sources to identify type specimens. Since this era concludes just before the introduction of the first Sinhala newspaper, it was considered as the pre-newspaper era.

To locate the type specimens according to the available literature, the data was tabulated. The dates of publications were compiled on one axis with the title of the publication/ prints on another, the name of the printing presses; the location of the archival material was placed on the other two axes. Since literature rarely indicates the location of the archival material, a list of locations where the original prints can be observed was compiled initially. The list included the National Museum Library- Colombo, The Department of the National Archives- Colombo, Royal Asiatic

Society Library, Sri Lanka, and the Sri Jayewardenepura University Library etc. Each archive was visited to learn on the availability of the data (publications) required for the table. Since most data was unable to be located and, the indexing of archival material was based on the title or by the name of the author, the data needed to be rearranged and narrowed. The list was observed at these achieves and, was chronologically tabled to advance the study. The commencement of the chronological order was 1737 as it denotes the first Sinhala printed document. With this data, the table was completed and prepared for the visual analysis. (Annexure 5.2).

B. Variables of the Early Newspaper era

The second time period observed type specimens of newspapers as it records typefaces of more than one and a half centuries. The start of this era includes the first Sinhala newspaper and the end of the era stops by the latter part of letterpress printing. Newspapers were considered as a good chronological source to identify the use of typefaces. From a political viewpoint, There was a growing demand to declare Sri Lanka as an independent nation. Newspapers documented this transition period with multiple subject matter, which included the rising of nationalist movements, leftist movements, new political parties and most importantly the Nationalization of the Press. The increase of newspapers printed during this era, gave way for local type foundries. It is important also to note that the changing over from hot-metal to photo typesetting was introduced to the island during this time.

To identify the type specimens of the early newspaper era, a similar table as in the previous era was compiled. The start of this era is noted as 1860, with the documentation of the first Sinhala newspaper. The available sources were accessed from the Dept. of the National Archives- Colombo catalog of the Sinhala newspapers. It documents newspapers from 1860-1977 and indexed alphabetically. The overall count of newspapers was tabled to identify the growth of the number of Sinhala newspapers and was compiled into a graph and it is illustrated in Table 5.3.

A random selection of three newspapers to represent one decade was selected according to accessible nature and print quality. We observed 136 newspaper under different subject areas and, 36 newspapers were selected for the visual analysis. The table was completed in Annexure 5.2 and a few sample newspaper cover pages are illustrated in Figure 5.6. and the titles of all the newspapers observed are compiled in Annexure 5.3.



Figure 5.6 : Section of a newspaper samples- type specimens

C. Variables of the Modern Newspaper era

The third time period is the most recent. Typefaces used in newspapers and freely available typefaces (fonts) online were noted down for this study. The most recent technological changes happened with the introduction of the first digital Sinhala typeface and, digital typesetting resulted in several technological changes thereafter. Old typefaces were digitized with new names, new driver support systems were established to accommodate Sinhala. As a result, fluctuation of the number of Sinhala glyphs reduced and increased due to this technological change. The profession of

type designer was based on the individual's contribution towards the creation of fonts.

Typeface is termed as fonts during this era. Nevertheless, for the purpose of this thesis, the use of the term typeface continues. The selection of typefaces was discussed in two phases. The selection was initiated by learning on the most popular/highly ranked Sinhala newspapers used/sold today and by identifying the typeface used in them. The second phase was listing out freely available typefaces online, they were compared, grouped according to their visual similarities and narrowed down to a few typefaces. Based on both phases a few typefaces were identified (compared with the typefaces used on newspapers) and selected as type specimens of the modern newspaper era.

5.2.2 Methodology

This is discussed under the three time periods. Each time period has its individual method to identify typefaces needed for the 3rd part of this chapter.

A. Methodology Used to Identify Samples of Pre-Newspaper Era

To identify type specimens during this era, the survey was divided into three parts. Stage one identified variables based on a literature survey. It noted down the most appropriate publications and certain meta-data (the type designer, the printing press/ type foundry) of the pre-newspaper era found in literature on the early printing press. The data was then compiled into a table consisting of several columns. Each column contained a number, the title of publication, name of the printing press or publisher, the location of archival material, and a search code (Annexure 5.1). The titles of publications found in literature were chronologically arranged into rows in the same table. The table consists of twenty publications from 1737 to 1860. Each of the publications was observed and notes were penned down on the use of the typeface to accommodate the following stage.

Stage two, created stimulus cards on the data identified in stage one. A stimulus card contained the typeface used in the publication and they were

considered as type specimens. The card was made up of a string of selected Sinhala letters (specimens). The specimens were cropped out of randomly selected scanned pages of the identified publication. The pages and a pica ruler were scanned at 600dpi (dots per inch) to achieve high quality. Each stimulus card contains a number, and the size of the type. It was evident that most publications contain several typefaces within a page, to determine the heading, sub-headings and body. Since this is an initial study, all of these typefaces were taken into consideration. A total of twenty cards were composed and Figure 5.7 demonstrates four sample stimulus cards.



Figure 5.7 : Type specimen – sample stimulus cards

Stage three, analyzed the stimulus cards and grouped them according to visual similarities. The initial grouping helped to understand that similar typefaces took different weights and that there were a few commonly used typefaces. Nevertheless, certain typefaces were hard to examine in the initial grouping due to their minute visual variation. Therefore, the identified typefaces were further analyzed according to the size and their significant features.

Size: Height of the typeface

To determine the height, the pure consonant *th* (ඳ්) was selected as it touches three determining lines; the top, bottom and the baseline in the Sinhala anatomy. The observation of the pure consonant *th* (ඳ්) estimated the height of the typeface by placing the letter parallel to the pica ruler. Since the survey was built on original prints, the smudge of ink on paper would have varied by 1pt-2pt with the actual size of the face. However, among the twenty-stimulus cards, we were able to identify a range of typefaces. An example of the comparison of the typeface and the section of the pica ruler is showed in Figure 5.8.

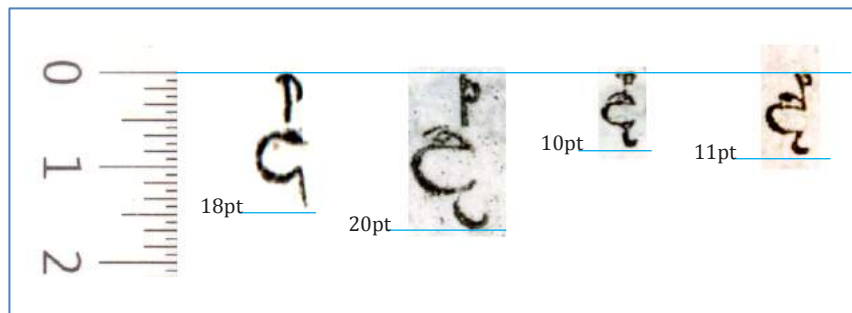


Figure 5.8 : Identifying the height of type specimens

Reference lines

As discussed in the previous chapter, the importance of reference lines in the anatomy of any script speaks a great deal of the typeface. Therefore, based on the identified reference lines in Sinhala, three letters that represent the ascenders, descenders and the base height were included in the stimulus card; letters *va*(ඳ), *la*(ඳ) and the *pa*(ඳ). To understand the characteristics of the type specimen, another two letters; pure consonant *th* (ඳ්) and pure consonant *m*(ඳ්) were added. Considering the pure consonant *th* (ඳ්) as the ideal height, the other letters were scaled to its height. The analysis was then led by placing the selected letter samples between the baseline and the ascender line. This was composed on parallel lines to identify how certain descenders *la*(ඳ) are shorter than the pure consonant *th* (ඳ්), or the descender. Similarly, in some cases the height of the pure consonant *th* (ඳ්) was not of the same height as the ascenders *va* (ඳ) or ascender with vowel *m* (ඳ්) and this is illustrated in figure 5.10. and has been judged by comparing the *pa*-height with the space provided for the ascender and descender (Figure 5.9).

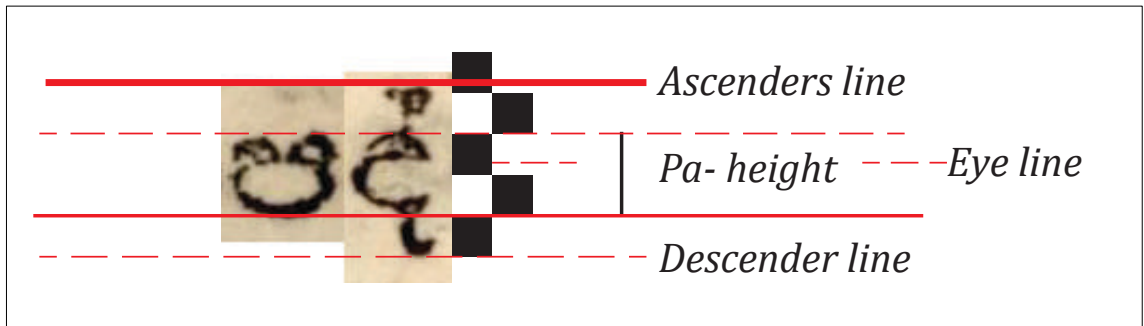


Figure 5.9 : Pa-height as the measurement

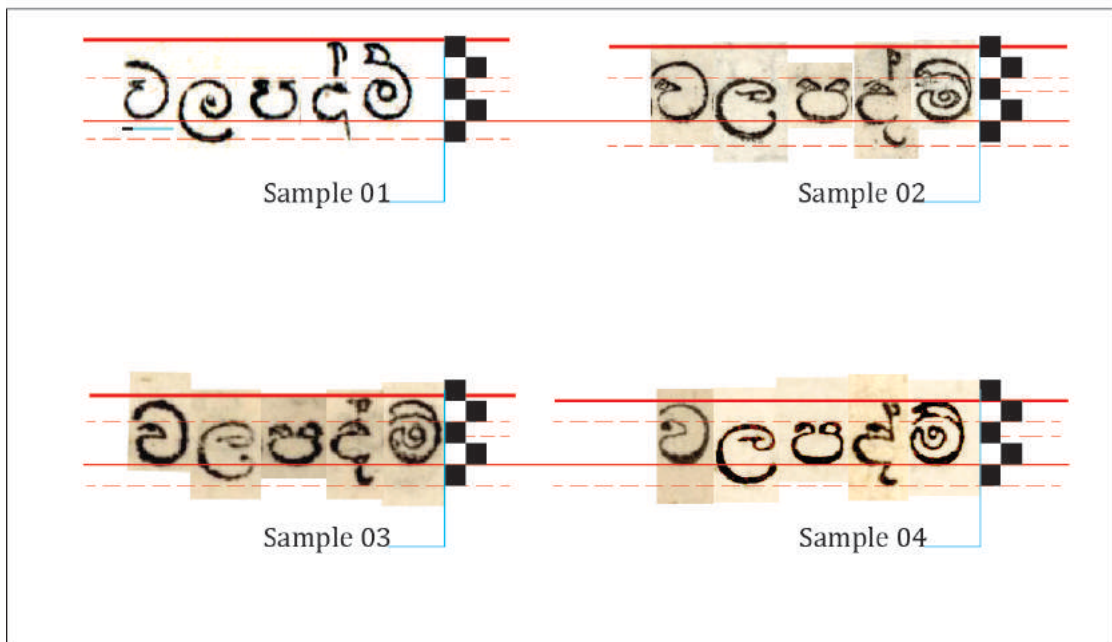


Figure 5.10 : Ascender and descender lines verses the top and the bottom most lines

Significant letterforms in typefaces

At the search to identify the different typefaces, the initial visual observation directed certain letters to stand out among other letters. This was because of the unique compositional qualities of selected letters in comparison with the other letters. Therefore, by observing these specific letters, we were able to identify the typeface. The letters identified were cerebrals *la* (ළ), *na* (න), dental *na* (ආ), guttural *ka* (ක) and the vowel sign *kombuwa* (ඔ). The cerebral *na* can be considered as one of the longest letters and is a good example to identify the horizontal scale of the letter, and

the *kombuwa* to be the shortest. The cerebral *la* contributes to the letter's vertical scale.

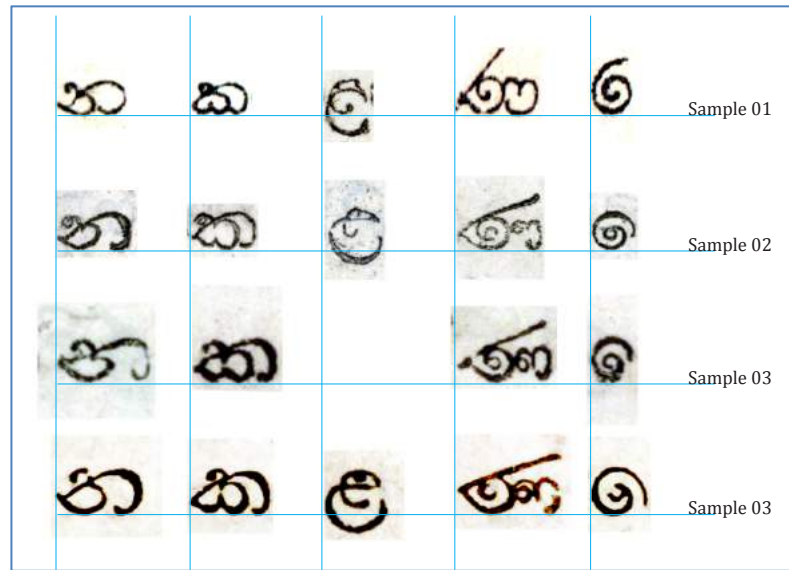


Figure 5.11: Significant visual variations of certain letters

i). Typefaces of the Pre Newspaper Era

Based on the above visual observation, we were able to identify the height and visual variations of each typeface that contributed to a rough number of typefaces that existed during the pre newspaper era.

Certain publications were composed with a combination of several similar typefaces; hence, each typeface was given an identification code on the order of its chronological appearance as (pre-newspaper era) pre 01, pre 02, pre 03 etc. The first publication, (placard) in 1737 consisted of two typefaces of 36pt (pre 01) and 18pt (pre 02), these sizes are quite large to consider as body text in today's context, but they were common during the pre-newspaper era. The next publication, the first Sinhala book printed locally, had used only the 36pt typeface as in the previous print. The characteristics of the first typeface were evident in three sizes, the third size (pre 03) was found in a publication two years after, in 1739. Pre 01 -03, typefaces can be considered as the most commonly used typeface in most publications till 1813. With the change of administrative power in the island, we find the next set of typefaces with the arrival of the missionaries. Their printing press work contributed towards

the next stylistically different typeface, and was originally casted in Serampore, India. This typeface was casted at 20pt and a smaller version of the same typeface was found in a publication in 1820, in 12pt. The next stylistically different typeface is found in 1824 (Pre 06), with a small type size of 10pt. A much similar typeface to the 1824 was found in 1846 with an even smaller type size of (Pre 07) 8pt. Both the 1824 and 1846 typefaces can be considered as similar typefaces but with minute size variation. From around the 40's the size of the body text used in publications is usually small, therefore, the earlier body texts, such as the 20pt Serampore typeface were found as display text (for headlines and sub-titles). By 1857 we find a cleaner typeface, with a size of 10pt. All of the above type specimen stimulus cards are demonstrated in table 5.4. The typefaces that had different sizes were narrowed down by selecting the most appropriate size and were re-numbered. The following table illustrates the typeface and the publications based on annexure 5.1 and how eight typefaces were narrowed to four samples. Type specimen (TS) 01 had three weights, TS 02 has two weights, TS 03 and TS 04 has only one size, but all of these typefaces were commonly used within this era.

Sample	Date of publications	Identification code no.	
1	1737	Pre 01, Pre 02	
2	1737	Pre 02	
3	1739	Pre 01, Pre 02	
4	1744	Pre 01, Pre 02	
5	1744	Pre 01, Pre 02	
6	1771/1780	Pre 01, Pre 02, Pre 3	
7	1813	Pre 04	
8	1815	Pre 04	
9	1817	Pre 04	
10	1819	Pre 04	
11	1820-1823	Pre 04	
12	1820	Pre 04, Pre 05	
13	1824	Pre 05, Pre 06	
14	1826		
15	1846	Pre 04, Pre 05, Pre 07	
16	1846	Pre 04, Pre 06	
17	1853	Pre 06	
18	1854		
19	1857	Pre 04, Pre 05, Pre 08	
20	1862		

Table 5.3: type specimen stimulus cards and the publication dates

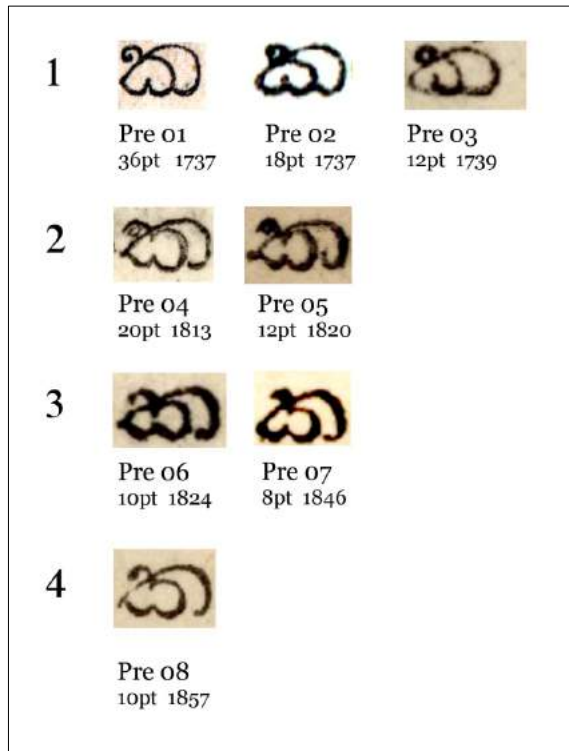


Figure 5.12: The selected four samples from the pre-newspaper era

ii). Meta-data of the identified type specimens

By observing the stimulus cards of the type specimens we were able to identify that the same face is used in several prints, and that it was casted in more than one size. All identified type specimens during the Dutch period (1656-1797) uses one typeface. It was designed by Gabriel Schade, the chief of the Dutch Armory in Colombo, (Hemapala 1998: 23). It comes in three sizes, yet it is doubtful if Schade completed the smallest size as this is only seen at the latter part of the Dutch period, whereas we learn that Schade died even before the first print was produced (Kularatne 2006:17). Nevertheless TS 01 comes in three weights: 36pt, 18pt, 12pt. The medium size was analyzed as most publications used this weight as the body text.

Meta-data of TS 01:

Name :TS 01
 Designer : Gabriel Schade
 Earliest print date : 1737 April
 Typesetting technique: Manual (Letterpress)

Press/ type foundry : Dutch Press, Colombo, Sri Lanka

Size variations : 36pt, 18pt, 12pt.



Figure 5.13: Stimulus card of the type specimen Pre 01

The second typeface is identified during the British rule. One typeface of equal size was used throughout the 1813 Bible and is cut and casted in Serampore – Mission Press (Kularatne 2006: 22). Even though this face is a fairly a large type we include it for the analysis as it is used as the body copy. We are unable to find out if the artwork was sent to India for cutting or if the complete production was done in India. Yet we know that the print was completed in India and shipped to Sri Lanka (Kularatne 2006: 220). We find the second weight of this type in the 1820 book of Psalms. Nevertheless the second type specimen is believed to have been completed by W.M. Harvard of the Wesleyans Missionary Press. We learn that he arrives in the island in 1815 and immediately he works on a new typeface; and by this time the Serampore matrixes and punches were bought by the Colombo Auxiliary Bible Society (CABS).

Meta-data of TS 02:

Name : TS 02

Designer : No record

Earliest print date : 1813

Typesetting technique: Manual (Letterpress)

Press/ type foundry : Serampore Mission Press, Calcutta, India

Size variations : 20pt, 12pt.



Figure 5.14: Stimulus card of the type specimen Pre 02

The third typeface is identified not far off, but four years after at the Wesleyans Missionary Press. There is no record of the designer, since Harvard leaves the island, we learn of James Nicolson casting a type in 1864 (2006: 221). Nevertheless this is a much smaller typeface of 10 pts. It can be considered as the most commonly used face, probably because of its size. The fourth typeface is found in the 1957 New Testament printed at the Wesleyan Missionary Press with no record of who the designer was. It is 11pt. It is important to note that most type specimens are composed with both of these faces mixed up. Therefore, in the analysis it became very hard to understand the uniformity of one typeface. This type of mixed up type composition is common with most publications as the preference was given to the content and not to the beauty of the print.

Meta-data of TS 03:

Name :TS 03
 Designer : No record (W.M. Harvard)
 Earliest print date : 1824
 Typesetting technique: Manual (Letterpress)
 Press/ type foundry : Wesleyans Missionary Press, Colombo Sri Lanka ???
 Size variations : 10pt.



Figure 5.15: Stimulus card of the type specimen Pre 03

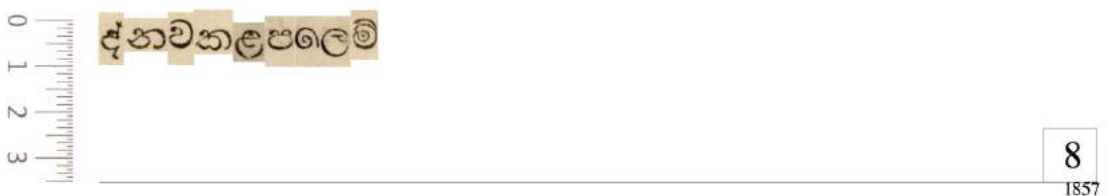


Figure 5.16: Stimulus card of the type specimen Pre 04

Meta-data of TS 04:

Name :TS 04
Designer : No record (W.M. Harvard)
Earliest print date : 1857
Typesetting technique: Manual (Letterpress)
Press/ type foundry : Wesleyans Missionary Press, Colombo Sri Lanka
Size variations : 11pt.

iii). Finding and conclusion of the Pre-Newspaper era

The overall understanding on the sociopolitical and economic view on the development of the printing press directs to key turning points that contribute to the overall research on Sinhala typefaces. To look at existing literature, the early prints and by observing type specimens the research bridges the gap on meta-data of Sinhala typefaces of the pre-newspaper era. As a result we were able to link literature with the primary source – type specimens, and chronologically identify the pre-newspaper era typefaces. This knowledge helped to identify certain meta-data of typefaces which can be considered as a pioneering study. The following points are noted as further study:

- **Clarity of the type size:** we observed that the clarity of the original prints varies due to its print quality. Even though the scanning was done at high quality the impression of the letter differs from the original size of the type. Nevertheless the print can be estimated with a variation of 1pt-2pt.
- **Selection of Samples:** we observed a range of archival publications at the selected locations. Since the selection was based on literature, publications by a large number of native presses were un-identified. Therefore, to establish more typefaces of this era, an in-depth study needs to be done on the native publications.

B. Methodology Used to Identify Samples of Early-Newspaper Era

Since the era starts with the first Sinhala newspaper in 1860, the selection of type specimens were based on newspaper prints. The process was initiated by observing the catalog of Sinhala newspapers at the Department of National Archives (DNA). The DNA records all the registered newspapers from its inception till today and gives

access to observe or to photograph newspapers till 1977. It was observed that certain newspapers had a short lifespan and some had an interrupted flow of prints. Yet, all of the cataloged Sinhala newspaper titles were noted down chronologically and tabled, and then converted into a graph in Table 5.3 to understand the growth of the newspaper industry. The graph comprises each year, from 1860-1977 in the *x* axis, and the *y* axis indicates the number of newspapers printed. From the inception till around the 1920's; a random count of twenty papers per year was visible with an exception in 1815, it indicates a slight growth beyond twenty newspapers. The next immense growth was visible in 1924 and showed a growth beyond forty newspapers per year. This growth drops by the early 1930's and keeps a rate of forty per year and declines by 1944 to less than twenty newspapers. But, thereafter, the growth of the number of prints per year had grown ever since, with minor drops in certain years. By 1956 it hit the range of sixty newspapers per year and by 1965 it grew further. By 1977, the rate of printed newspapers per year had grown up to more than a hundred. The following graph helped to reveal the development of newspapers registered in the country as background for the overall research and for the following survey.

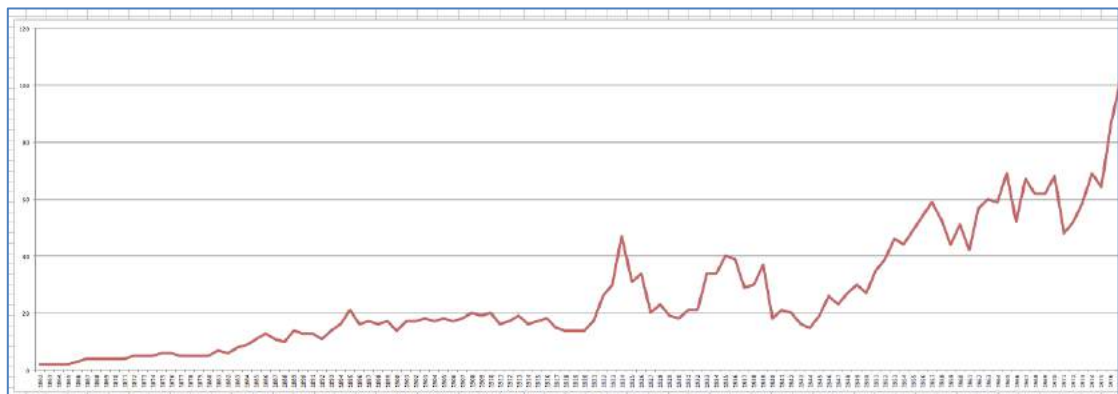


Table 5.4: Graph of the number of Newspapers in print from 1862-1977

The survey documents three randomly selected newspapers per decade from 1860 -1977. A total of 36 newspapers were selected among 136 observed. But, an exception was made for the first three decades due to the limitation of printed newspapers. Therefore, the first three decades included a total of eleven newspapers, and to complete the count of 36 one newspaper was added to the last decade.

After the selection of the newspapers, stimulus cards of type specimens were made with a string of randomly selected Sinhala letters. Each stimulus card was composed as in the pre- newspaper era. The pages were photographed on high resolution with a dpi range of 150-600, by a hand held camera, therefore, the quality of the specimens were not up to standard to observe it's printed letter but good enough to identify typefaces. Nevertheless, the specimens were cropped out of randomly selected photographed pages. Each sample included a number for identification purpose and part of a pica ruler to estimate the size of the type.

The third part of the survey looked at catalogues and type specimens of type foundries. The catalogues indicate the availability of metal types, its size and the address of the foundry. The oldest catalogue dates to the year 1892 by N. J. Cooray and Sons Ltd. and the other is Chitra Type Founders established in 1953 by the third generation of N. J. Cooray, both locally accessible. These catalogues included display typefaces, but typefaces less than 14pt were not included in the study. Meanwhile, prints of copies of correspondence records, proofs, specimens and drawings at Monotype headquarters in Salford, Surrey, UK and type specimen samples of Linotype cooperation, USA were observed (Rafeal 2013). Monotype Corporation and Linotype company established themselves for their hot-metal composing technique, therefore, we were able to define the composing method, mechanical (letterpress) typesetting or for hot-metal type composing technique. As a result, a list of typefaces was noted down for visual observation. All of the type specimens were scanned; a sentence and a common letter (found within the samples) were cropped and resized into one standard size for comparative analysis. The stimuli included the name of typefaces given by the foundry, size and the name of the foundry. The list of meta-data of the typefaces of catalogues and type specimens is as follows:

N. J. Cooray Type foundry	Chitra Type foundry	Monotype foundry	Linotype foundry	Other
Mono Sudu 8pt	Mono Sudu 8pt	Monotype 557 8pt	Linotype 11pt	

Mono Sudu 10pt	Mono Sudu 10pt	Monotype 557 10pt	Linotype Sinhalese Light 10pt	
Mono Sudu 12pt	Mono Sudu 12pt	Monotype 557 12pt		
		Monotype 557 14pt		
Bourgeois (9pt)	Chitra Sudu 12pt			
Small Pica Modern(11pt)	Chithra Sudu 14pt			
14point (14pt)	Chitra Sudu 10pt			
Two-line Brevier (16pt)				
				Oxford University Press
				Apothecaries Press
				L’Imprimerie Nationale
				The British Library

Table 5.5: List of meta-data of the typefaces of catalogues and type specimens

The fourth part of the survey included the visual analysis. The type specimens from catalogues were initially analyzed as certain names of typefaces were repeated. Therefore, the stimulus cards with the same name were compiled together. As a result the ‘mono’ typefaces indicated as ‘mono *sudu*’ in both local foundries referred to the same face, but the original name of the typeface mono 557 included a range of type sizes from 8pt, 10pt, 12pt and 14pt. A sample letter from both catalogues and the Monotype 10pt is illustrated to indicate the visual similarities (5.17). Monotype 577 was designed for the monotype casting machines; we arrive at the conclusion that this letter was used for hot-metal printing. But it is indeed a question of knowing if there were that much monotype casting machines or if the matrix was used for casting the monotype face for movable type. Nevertheless, having certain meta-data of typefaces in hand the next stage of the visual analysis was conducted. Oxford University Press and L’Imprimerie Nationale were not recognized in any of the sample specimens as they were not locally accessible. Nevertheless, part of the visual analysis of early typefaces was published earlier by Saraiva and Samarawickrama in 2015 at the 6th Typographic meeting in Portugal.

As the fifth part of the survey, the 36 type specimens were visually observed and grouped based on the visual similarities. In conclusion a total of six typefaces were

identified to represent this era. The methodology used to select the six typefaces is discussed in the following section.

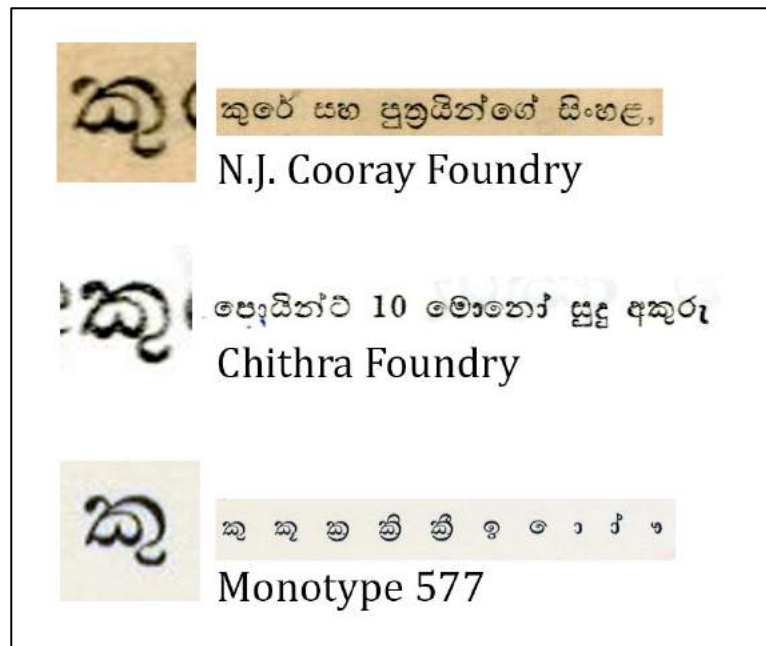


Figure 5.17: Sample letter of Mono typeface-N.J Cooray, Chithra and Monotype 577

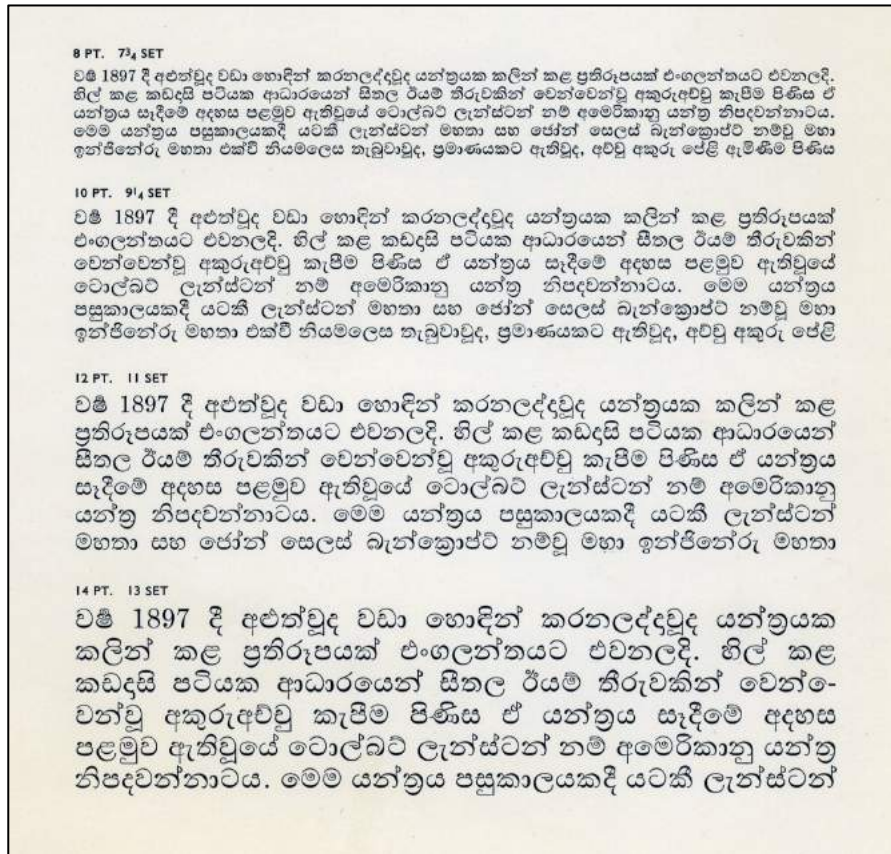


Figure 5.18: Monotype 577 Series

Source: Saraiva R. (2012)

Stages of the Survey

All 36 Stimulus cards were categorized based on visual observation.

- *Stage one:* The stimulus cards were given an identification code on the order of their chronological appearance as (early-newspaper era) E.np 01, E.np 02, E.np 03 etc.
- *Stage two:* The grouping was conducted by observing typefaces that share similar letterforms. Each group was given a number, and reorganized.
- *Stage three:* The above groups were compared with the pre-newspaper era samples and with the earlier identified (stimulus cards) of type foundry typefaces. They were noted down and tabled to select the typefaces.
- *Stage four:* The selected typefaces were listed out and were prepared for discussion as in the third part of this chapter.

Stage one

A count of 136 newspapers was observed and recorded using two devices: a hand held pen scanner and a camera. The above count was based on the accessibility of data at the DNA. To observe selected earliest newspapers special permission was granted, due to their fragile physical state. Certain newspapers were scanned with a resolution of 900 dpi and the rest was photographed with a resolution between 150-600dpi. There were few concerns during the visual recording process:

- Due to the uneven scanned surface the hand needed to be held steady, and since this was not done professionally there were instances when certain letters showed a jerk or were blurred that made the observation difficult.
- Due to the irregular distance between the camera and the newspaper, it was difficult to record the actual size of the typeface. Meanwhile, there were instances that the newspaper was held at an angle, which made the letters perspective.
- Due to low-resolution scanning and photographing letters were pixilated and this disturbed the clarity of the letter.

Among the technical difficulties, a random set of samples with better clarity was selected as samples for the study. These samples met the criteria of three newspapers per decade, and a total of 36 type specimens were selected to prepare stimulus cards. These cards included the same set of letters used in the pre-newspaper era for comparison purpose. All of the selected sample newspapers with their accessible code are included in annexure 5.3.

Stage 02

Stage two was initiated by compiling the stimulus cards with similar typefaces. The cards were then categorized and numbered into twelve groups. Certain typefaces were easily recognized due to its distinct nature such as the typeface of group 10, while some were identified before in the pre-newspaper era. The rest of the typeface groups that were not recognized needed to be further analyzed due to the visual similarity. During the analysis process there were certain groups of typefaces that had a mixture of typefaces, in such cases the most commonly used typeface among the letters were grouped together. An example of such an instance is stimulus card 11 and 19, as most letters are identical but the minute visual variations in letters such as *da, na, va, ka* and

kombuwa put them into different groups (Figure 5.19). At the conclusion of this stage all 36 type-specimens were grouped into twelve groups and Tabled 5.5.



Figure 5.19: Group 09 in comparison with type specimen 08 and 04

Group no.	Stimulus card number	Ground no.	Stimulus card number
01	01, 07	07	13, 14, 23
02	02, 06	08	18, 19, 21, 25, 26, 27, 28, 29, 31, 36
03	03, 04	09	15, 17, 22
04	05, 10, 11, 20	10	24
05	08, 09	11	30, 32, 33, 34
06	12, 16	12	31

Table 5.6: Grouping of the 36 type specimens into 12 groups

Stage 03

This stage focused on the meta-data of the identified twelve typeface groups. The meta-data of typefaces were evident in two locations. One was meta-data found in original catalogs of type foundries or original proofs of typefaces. And the other was the meta-data identified in the pre-newspaper era typefaces. To summarize this further, the above Table 5.5 was extended with three more columns. Therefore, in the

overall table, column three included the recognized data, and included the meta-data of certain typefaces.

Stimulus card 01, 07 was identified as TS (Type Specimen) 03 of the pre-newspaper era and stimulus card 02, 06 was identified as TS 04. The stimulus cards that contained the type specimens of type foundries were compared with the following twelve groups. Group 04 and 08 were very much similar among the stimulus cards, except in the letter *na* and the *hal* sign. The type specimens in group 04 resembled N.J. Cooray’s small pica Modern typeface. And the group 08 resembles another vision of N.J Cooray’s typeface documented in the Apothecaries Press around the 1950’s (Rafael 200:37), but the earliest of this typeface was found in a 1927 newspaper. Therefore, we can presume that Cooray’s typefaces were developed with the development of printing press work in the country. Meanwhile, group 12 comprised one typeface and that was of Mono 577 series. The next significant set of letters grouped was found in group 11 and this was of Chithra *Sudu* (white) typeface. Since the above identified typefaces were mostly photographed, we were unable to present the actual size but only to estimate it. Nevertheless, at the end of this stage, six groups of typefaces documented certain meta-data. The rest of the six type-specimen groups were difficult to differentiate. Group 09 had certain letters of group 08 and 04. Among the other visual variations, it was evident that certain groups had mixed typefaces. As a result, group 03, 07 and 09 had mixed typefaces making the clarity of the typeface difficult. Group six on the other hand contained specific letterforms similar to group 12 and an exception was found in-group 10.



Figure 5.20: group 06 in comparison with group 12 (mono 577)

Taking all of the above into consideration, the following points were reflected upon to select the final six typeface groups of the early newspaper era:

- Omitting of type-specimen groups that were identified in the pre-newspaper era.
- Omitting of type-specimen groups that contained a mixture of typefaces.
- Selecting of type-specimen groups that were identified based on certain meta-data.
- Selecting of type-specimen groups that contained a specific typeface.

All of the above is summarized in the Table 5.6.

Ground no.	Stimulus card number	Recognized typefaces	Stimulus with mixed letters	Selected
01	01, 07	TS 03 Pre-newspaper era	N/A	-
02	02, 06	TS 04 Pre-newspaper era	N/A	-
03	03, 04	N/R	Yes	-
04	05, 10, 11, 20	Small pica Modern - N.J. Cooray type foundry	N/A	Selected
05	08, 09	N/R	Yes	-
06	12, 16	N/R	No	Selected
07	13, 14, 23	N/R	Yes	-
08	18, 19, 21, 25, 26, 27, 28, 29, 31, 36	N. J. Cooray found at the Apothecaries Press	N/A	Selected
09	15, 17, 22	N/R	Yes	-
10	24	N/R	No	Selected
11	30, 32, 33, 34	Chithra Sudu - Chithra Type founders	N/A	Selected
12	31	Mono 577 - Monotype cooperation	N/A	Selected
N/R - Not recognized N/A - Not applicable				

Table 5.7: Selection of six type specimens from the 12 type specimens

Stage 04

This stage records the distinct nature of each selected typeface of the early newspaper era. It discusses the significant letterforms in typefaces through selected letters and a vowel sign, followed by the proportions of the typefaces in position to the reference lines. The size of the typeface is not included in this study due the insufficient clarity of the type-specimens during the visual recording process.

Significant letterforms in early newspaper typefaces

As in the pre-newspaper, significant letterforms were identified to understand the nature of the typeface. All the eyes of the letter *na* in all six typefaces are very much similar. The determining visual variations of this letter are found at the nose and at the terminals. The nose of groups 02, 03, 05, 06 are in parallel to the base line and terminals of group 01, 04, 06 are pointed up towards the closed counter of the letter. The letter *ka* is very similar across all typefaces except at the nose. Sample 03, 05 has the nose touching the base line, while the 01, 02, 06 are slightly above the baseline. The noteworthy variation of the nose of the letter *ka* is found in group 04. The cerebral *la* is an elaborated and well decorated letter such as the cerebral *na*. Across the cerebral *la* there are two significant visual variations at the eyes, one is significantly separated while the other found in groups 01, 03, 06 are linked together to form one eye. The cerebral *na* can be broken into three parts, as the ascender stroke, nose and the shoulder that extends to a base shape. Most significant visual variation among all the letters, group 02 stands out due to the position of the ascender stroke that is drawn above the spiral. Meanwhile the nose of the cerebral *na* is pointed down but above the baseline, none of the nose touch the base line unlike the letter *ka* or composed parallel as the letter *na*. The *kombuwa*, the only form selected for this analysis conveys a lot about the typeface, and most of the signs hold minute visual variations. Nevertheless, the terminal of the *kombuwa* can be grouped as ones that points to the base line, parallel to the base line and touches the base line. By observing such visual variations we were able to identify the significant features that distinct the typeface.



Figure 5.21: Significant visual variations of certain letters – early newspaper era

Reference lines used in the early newspaper era typefaces

As in the pre-newspaper era, this section selected a similar set of letters and was analyzed by placing the letters on five reference lines. Considering the *pa* as the ideal base height, all typefaces were placed on the base line and the line that touches the eye of the letter was considered as the eye line (figure 5.9). Two squares of equal width were placed between the eye line and the base line across all the typefaces, to understand the proportions of base height to the ascender and the descender lines. The ascender height of group 04, 08, 11 and 12 are very much similar while the descender height of group 06, 08, 05 and 06 are the same. Group 04 has a shorter and

group 10 has the shortest descender height. Among this visual analysis group 10 stood out as the typeface that has a larger base height in comparison with the ascender and descender height of the typeface. (As) the height of the pure consonant *da* includes a *hal* sign to the consonant, *da* can be considered as the tallest letter within the type specimens. This helped to understand how the ascender and the descender strokes touch these respective lines. So if we consider the pure consonant *da* as the height of the typeface that touches the extreme ascender and the descender lines, there are instances that certain letters within the typefaces do not touch these lines. The descender height of the *la* and the cerebral *la* of the typeface in group 06 is less than the height of the pure consonant *da*. And this height is even more in group 10 and 12. Similarly, the ascender height indicated in the pure consonant *da* is greater in typefaces of group 08 and 12. The above discussed is summarized in the figure below.

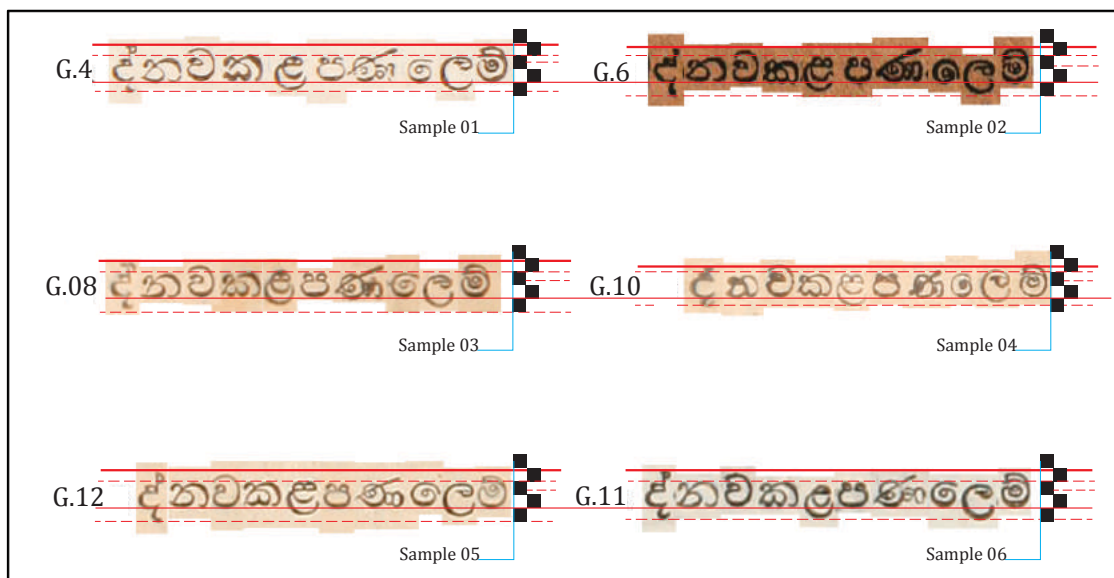


Figure 5.22: Ascender and descender lines versus the top and the bottom most lines

1). Typefaces of the Early Newspaper Era

Based on the above visual observation we were able to identify a rough count of typefaces used during 1860-1977. Type specimens 05, 10, 11 and 20 were grouped into one group, while 12 and 16 was grouped as the second group. The largest number of type specimens was found in the third group with nearly nine newspapers using this typeface from 1927 to 1971. This large time slot conveys how much this typeface

(in group 03) was frequently used across the century. Meanwhile, group four and five had only one type specimen to represent these typefaces among the 36 newspapers. The group six conveyed a more recent typeface that starts from around 1967 to 1978. We find five newspapers using this typeface making it the second largest typeface used in this time period. The following figure conveys the six selected typefaces of the early newspaper era. It also conveys a certain pattern on the usage of typefaces at certain time periods and ones that were common across the century. Each type specimen coded as 'E' represent the term 'early' newspaper era. Therefore, the coded number included can be compared with annexure 5.3 to know the title of the newspaper and the year which the specimen was selected from.

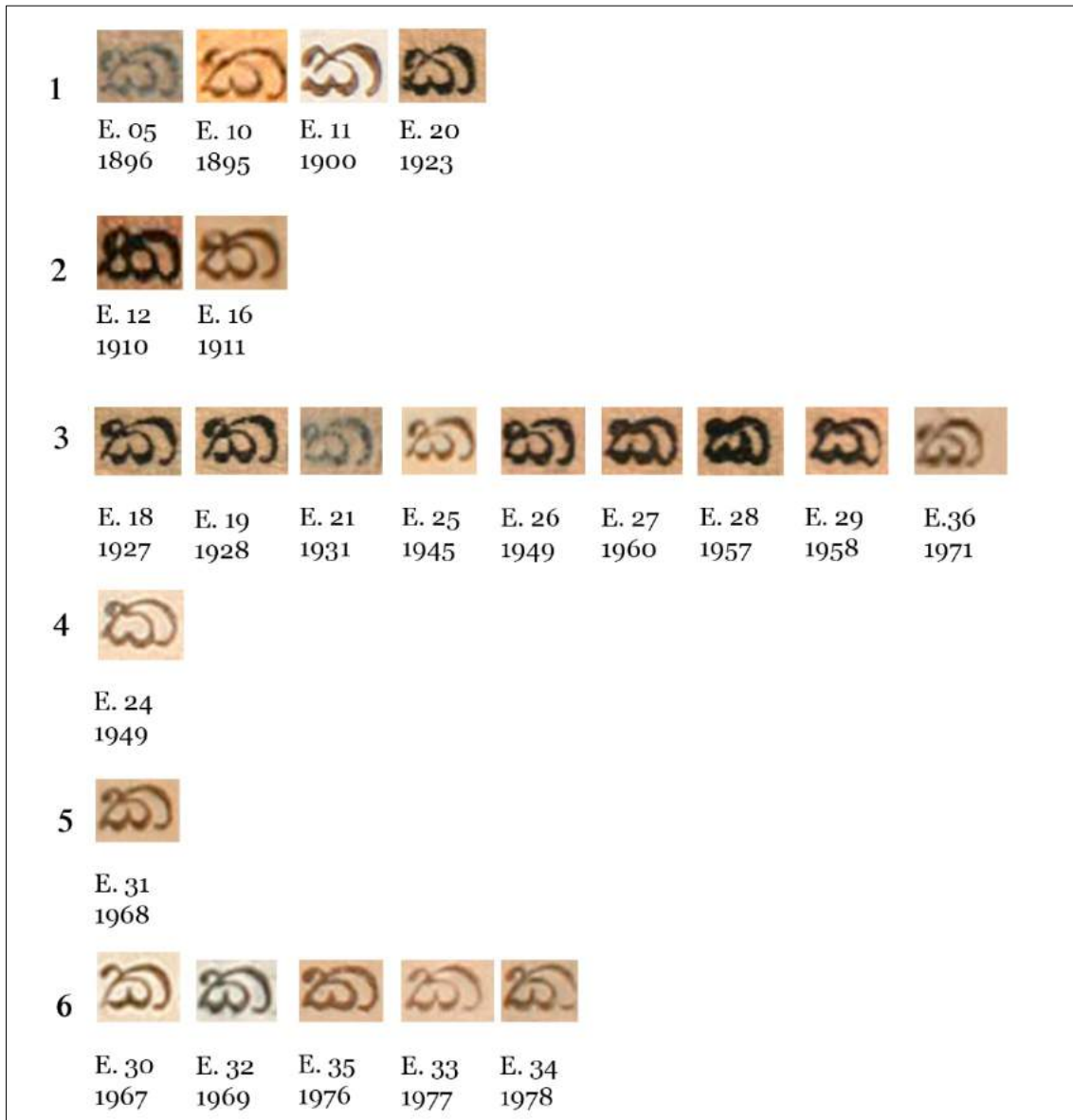


Figure 5.23: The selected six samples from the early-newspaper era

ii). Meta-data of the Identified type Specimens

The first typeface that represent this era resembles the work of N.J Cooray, who is considered as a native and a pioneer type designer. The sample resembles a typeface from his catalog, which indicates the start of the type foundry to be 1892. Since the type specimens are from newspapers after 1896 one can presume that this typefaces is the work of N. J. Cooray.

Meta-data of TS 05:

Name : Small pica Modern
Designer : N. J. Cooray
Earliest print date : 1896 (rough estimate)
Press/ Type foundry : N. J. Cooray and Sons Ltd, Dematagoda Place, Colombo



11
1900

Figure 5.24: Stimulus card of the type specimen (E.) 05

Sample two has very little evidence on the typeface, except that it resembles a pre-newspaper era typeface due to the behavior of the cerebral *na*. Nevertheless, this typeface is in between two styles of typefaces, as the rest of the typefaces resemble the other typefaces. Another aspect about this typeface is it has a close resemblance to the sample 05 typefaces. Sample 03 is largely used among the 36 samples selected and is similar to sample 01. Even though this typeface is not found in the catalog of N.J. Cooray, Rafael shares a sample of Cooray's typeface found in the Apothecaries Press in the 1950's. The differentiation of the sample 01 and this is the different shape used in the *hal* sign. Since the study does not compare the type size we are unable to identify if it's the same typeface of a size variation. Nevertheless, the meta-data of sample 02 and 03 are as follows:

Meta-data of TS 06:

Name : No record
Designer : No record
Earliest print date : 1910 (rough estimate)
Press/ Type foundry : No record



12
1910

Figure 5.25: Stimulus card of the type specimen (E.) 06

Meta-data of TS 07:

Name : No record
Designer : N. J. Cooray
Earliest print date : 1927 (rough estimate)
Press/ Type foundry : N. J. Cooray and Sons Ltd, Dematagoda Place, Colombo



19
1928

Figure 5.26: Stimulus card of the type specimen (E.) 07

Sample 04 can be considered as the most outstanding typeface among the samples. It has a large base height and more rounder. Due to this reason, the typeface looks a fairly large type. The newspaper that contains this typeface was printed and published in an independent press known as the Times of Ceylon. It is believed to have started in 1940's and one can presume that this typeface was designed for the use of the newspaper – *Lankadeepa*, published later by the Times of Ceylon newspaper group. Nevertheless, we are left with very little evidence of the meta-data of the typefaces.

Meta-data of TS 08:

Name : No record (Lankadeepa typeface)
Designer : No record
Earliest print date : 1949 (rough estimate)
Press/ Type foundry : Times of Ceylon, Printing Press



24
1949

Figure 5.27: Stimulus card of the type specimen (E.) 08

Sample 05, too has only one type specimen, yet certain letters of this typeface stood out. When comparing the copy of the original proof of Monotype 577 series, it was evident that this typeface resembles it. Since the Monotype 577 series was designed for hot-metal printing we understand that this typeface was used for hot-metal printing. And it is important to note that the print too is much clearer than the rest of the type specimens. The meta-data of the specimen is as follows:

Meta-data of TS 09:

Name : Monotype 577
 Designer : No record
 Earliest print date : 1968 (rough estimate)
 Press/ Type foundry : Monotype Corporation
 Size variation : No record



Figure 5.28: Stimulus card of the type specimen (E.) 09

The sixth and the final sample is also a commonly used typeface among the selected samples. This typeface was identified as Chithra *sudu*, designed by N. J. Cooray jr. this typeface resembles sample 01 and 03 and yet a significant visual variation of this typeface is the floating nature of the cerebral *na*.

Meta-data of TS 10:

Name : Chithra Sudu
 Designer : N. J. Cooray Jr
 Earliest print date : 1967 (rough estimate)
 Press/ Type foundry : Chitra Type Founders, 963, Maradana Road, Colombo 08.



Figure 5.29: Stimulus card of the type specimen (E.) 10

C). Methodology Used to Identify Samples of Modern-Newspaper Era

This era groomed the development of the digital typefaces. The start of this era is noted as 1978 because the previous era ended by the 1977. This was also the time where technological changes happened within the printing industry. Type composing techniques started to evolve with the introduction to photo-type composing and digital type composing. This led to a high demand towards typeface and later resulted in an outpouring of copies of existing typefaces. To identify typefaces of this era, Sinhala typefaces that are found on the Internet were observed. Seventy typefaces were compiled into stimulus cards as in the previous section. A string of letters and a paragraph was included with the name of the typeface.

The second part of the survey was the visual observation and grouping of the similar typefaces and comparing them with two catalogs to identify the original name of the typeface. Nevertheless, since there were a large number of names used to describe one typeface, all of the names were listed out in annexure 5.6, with the names used in the two catalogs. Among this large list it was evident that the typefaces were easily narrowed down to a few typefaces. Among this list, five typefaces were selected as type specimens. The other two typefaces were selected based on two criteria. One was the most commonly used typefaces used in newspapers today, and the other was the commonly listed as the typeface copied as a digital typeface. On conclusion five typefaces were identified to represent the modern newspaper era.

i). Typefaces of the Modern Newspaper era

A count of nearly 200 typefaces currently used was observed, and a random count of seventy typefaces was selected for the study. All of the seventy typefaces were compiled into stimulus cards. Since the typefaces were freely available or easily accessible digitally, no resolution issues mattered. The stimulus card was made up of the same string of letters as in the previous section, yet included the name of the typeface rather than an identification code as all typefaces were identified by its name.

Name of font	Sample
Mi_Lipi	දුනවකළපයාලෙම්
AA Amali	දුනවකළපයාලෙම්
OKDDESIE	දුනවකළපයාලෙම්
Amalee	දුනවකළපයාලෙම්
OKDSMAN	දුනවකළපයාලෙම්
Chamara Normal	දුනවකළපයාලෙම්
DS Satsara	දුනවකළපයාලෙම්
Aradhana Bold	දුනවකළපයාලෙම්
DL-Araliya	දුනවකළපයාලෙම්
Aradana	දුනවකළපයාලෙම්
AHBanti	දුනවකළපයාලෙම්
Ranaviru-PC	දුනවකළපයාලෙම්
AHerash	දුනවකළපයාලෙම්
DS Dilini	දුනවකළපයාලෙම්
DL Araliya Shatter	දුනවකළපයාලෙම්
AHCow	දුනවකළපයාලෙම්

Figure 5.30: Grouping of type specimens of the Modern News Paper era

The second stage of the survey focused on the visual data across the seventy typefaces. This was conducted by comparing the stimulus cards and grouping them according to their visual nature. At this stage, we were able to identify how one typeface takes different visual variations and uses different names. For example the following typeface takes has a light, regular, bold and a decorative visual variation under different names. The bold version of the same typeface is found under different names such as Aradhana Bold, DI-Aralya, Aradan, AH Banti, Ranviru-PC, Atterash and DS Dilini. This common use of having multiple names for a single typeface was tabled according to its visual similarity. Meanwhile the reason for this was the need and shortage of Sinhala digital typeface in the early 1990's and the sudden boost of type designers, rather than type drafters. This was discussed in detail in the 3rd chapter.

Nevertheless, the seventy typefaces were narrowed down to nice typefaces. Each group that shared the same visual features of a single typeface included different visual attributes given to the typeface.

The third part of the survey was the selection of the typefaces needed for the third part of this chapter, and this was conducted in stages. The first selection of typefaces was based on the above table and the selection of typefaces was based on the most commonly used typefaces in newspapers on print and online. As a result, the first selection of typefaces pointed out three typefaces and the second identified two typefaces making the total count to be five typefaces to represent the modern newspaper era. The typeface that has the most number of names was considered as the most commonly used typeface within the table 5.7, as a result the first three typefaces that has the largest count was considered. And among these three group's random typefaces were selected. The second selection of typefaces was conducted by compiling a list of the most popular Sinhala newspaper titles, they were tabled with the company it was publishing together with the typeface used as the body text.

Name of newspaper	Publishing company	Typeface used
Lankadeepa	Times of Ceylon	FM-Abaya
Rivira	Media <u>cooperation</u>	FM-Abaya
Silumina	ANCL	FM-Abaya
Lakbima/ Mavbima	Sumathi Publication	FM-Abaya
Divaina	Upali	Divaina

Table 5.8: Commonly used typefaces in current (top selling) printed newspapers

Among this list, it was evident that FM-Abaya was commonly used while the web font varies based on the device. Mac uses Sinhala Sangam MN since 2004, and Windows platform is using Isoka Potha (revival of Monotype Sinhala), Nirmala UI since Windows 8 and Linux uses LKLUG. Nevertheless, to narrow the selection process one typeface was selected from one platform. The selection was the Mac's Sinhala

Sangam MN. At the conclusion of this survey, the following five typefaces were selected to represent the Modern typeface era.

ii). Meta-data of the identified type specimens

Meta-data of TS 11:

Name : FMAbhaya
Designer : Pushpananda Ekanayaka
Date of Version : 1998
Copy rights reserved : Font Master- Pushpananda Ekanayaka

ද්‍රව්‍යවකලපණලෙඹ

11

Figure 5.31: Stimulus card of the type specimen (M.)11

Meta-data of TS 12:

Name : Mg-Amalee
Designer : No record
Date of Version : 1999
Copy rights reserved : Michigan Graphics (Pvt) Ltd.
Size variation :

ද්‍රව්‍යවකලපණලෙඹ

12

Figure 5.32: Stimulus card of the type specimen (M.)12

Meta-data of TS 13:

Name : MiAmila2000
Designer : No record

Date of Version : 1999
Copy rights reserved : Microimage

ද්‍රව්‍යවිකල්ප පණිවුඩ

13

Figure 5.33: Stimulus card of the type specimen (M.)13

Meta-data of TS 14:

Name : DL-Manel
Designer : A.M.D. Lanerolle
Date of Version : 1996
Copy rights reserved : A.M.D. Lanerolle (553/13) Arawwala, Pannipitiya
Size variation :

ද්‍රව්‍යවිකල්ප පණිවුඩ

14

Figure 5.34: Stimulus card of the type specimen (M.)14

Meta-data of TS 15:

Name : Sinhala Sangama MN
Designer : Muthu Nathimaran
Date of Version : 2004
Copy rights reserved : Muthu Nathimaran
Size variation :

ද්‍රව්‍යවිකල්ප පණිවුඩ

15

Figure 5.35: Stimulus card of the type specimen (M.)15

Three different survey methods helped to identify fifteen typefaces across three time periods. The typefaces were selected to discuss the anatomical features of Sinhala typefaces from its inception.

This section is compiled with the knowledge gained in the previous two sections. The first selection discussed the importance of the anatomical features of typefaces and type terminology. It proposed certain terminology to describe anatomical features that could be implemented in the field of Sinhala typography. The second part of the chapter used different methods to identify existing Sinhala typefaces from its inception. As a result a total of fifteen typefaces were identified across (1737-2015) nearly three centuries. The anatomical visual properties of the selected typefaces are discussed in the following section.

5.3 Visual Analysis of Anatomical features of Sinhala typefaces

The following survey is conducted to understand the visual variation of typefaces that contributes to the anatomy of Sinhala. The selected typefaces for this analysis are taken from the previous section of this chapter. Therefore, among the three time periods a total of 15 typefaces (4 typefaces – pre newspaper era, 6 typefaces – early newspaper era, 5 typefaces – modern newspaper era) were analyzed. All of the specimen cards used in the analysis are attached in Annexure 5.6.

This section portrays two main aspects of typefaces: the tool and the hand. These two aspects are discussed individually in detail across the distinct visual properties identified in chapter four.

By observing the tool, one can arrive at the flesh of the typeface, which portrays the appearance of the exterior boundaries of the stroke in a typeface. And based on these boundaries the grey value can be examined. Another aspect of the tool can be discussed by elaborating on the contrast and the stress of the typeface. Meanwhile the hand demonstrates the way the typeface is illustrated.

5.3.1 The Tool

In the type design process one of the first activities the designer does is to select the tool. Even though in today's context the multiple uses of tools are made to draw; tools can be defined as the instrument such as the pen, which is used to draw type. The commonly used tools are copper nibs, mono-linear pen/stylus, brushes etc., and, in this case of Sinhala typefaces used as body text show two varieties of tools. A tool that has a single point illustrates mono-linear typefaces, and a copper nib pen illustrates modulated typefaces. Most typefaces in the pre-newspaper and the early newspaper era do not show a controlled practice of the tool, and their irregular stroke thickness demonstrates a large number of modulated typefaces among Sinhala.

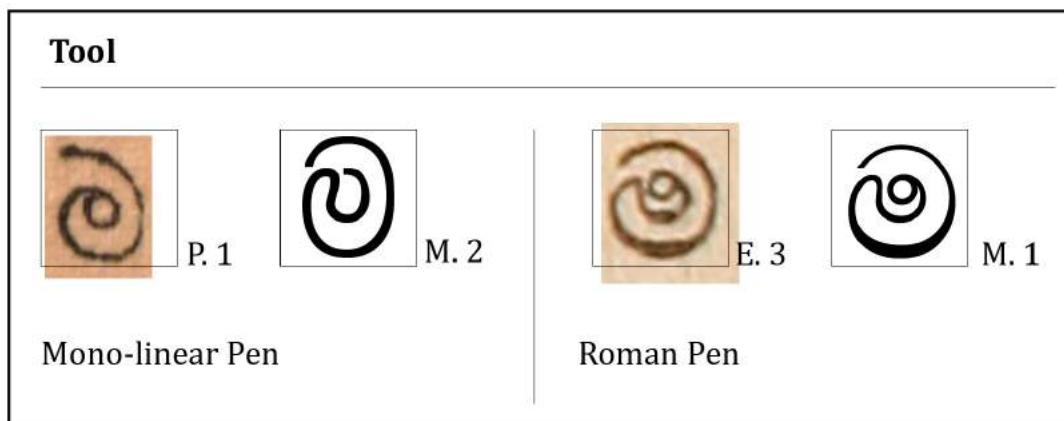


Figure 5.36 : The Tool

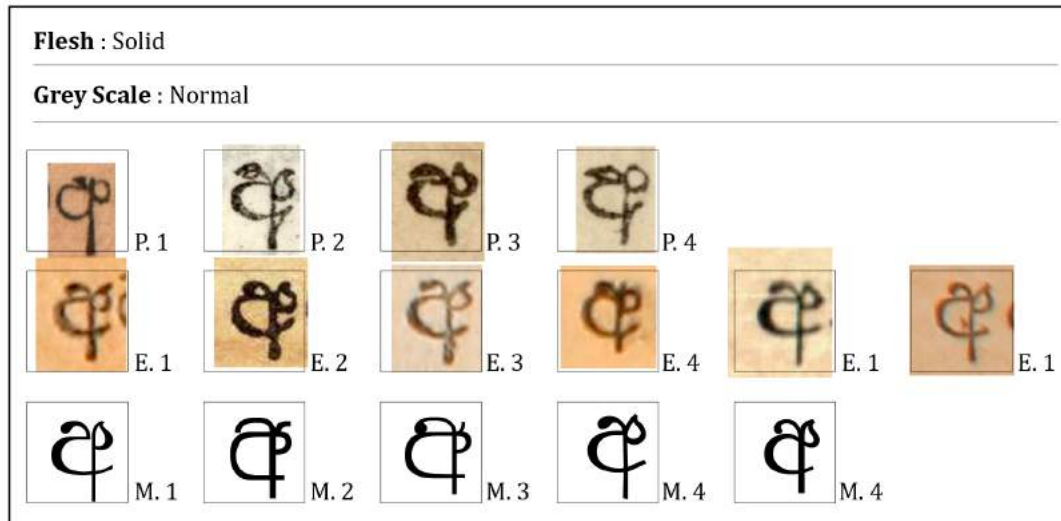
5.3.2 Flesh and the Grey Value

The stroke boundaries that make the typeface are considered as the flesh of the typeface. In display typefaces we find typefaces created with interrupted strokes (dotted/ dashed strokes) or non- solid strokes to define the main stroke, and this is considered as the flesh of the typeface. Yet among the 15 type specimens it was evident that all of them had a solid build.

Similarly, the grey value among these typefaces is the same as they can be grouped into one. What is considered as Grey value is the overall darkness of letters as perceived by typographers. This can also be termed as Light, Normal, Semi-Bold etc.

E.2, E.4 and E.6 do convey a high grey value in the following figure 5.37, but this could be due to the overall spread of ink on the selected type-specimen. Nevertheless, all typefaces can be grouped as normal or regular.

Figure 5.37 : Flesh and the Grey Value



5.3.3 Contrast and Axis

The contrast of a typeface can be identified by the thickness and the thinness of the stroke of any typeface. Since most type specimens are from printed material and the spread of ink dissolves the actual stroke thickness or thinness, this analysis is not accurate but approximated. Contrast can be judged in general as no contrast, low contrast, medium contrast and high contrast. Yet, Among the type specimens chosen this can be grouped in as no contrast, low and medium contrast. No contrast typefaces follow a mono-liner stroke thickness while the low and medium convey a modulated linear stroke based on the cant of the tool.

The contrast can be identified by understanding the axis or the stress. Stress is the angle of the thinnest part of the stroke, It conveys the direction of a curve stroke and that changes the weight of the stroke. The stress depends on the tool or/and the hand. And as a result this stroke transition can be assessed as none, gradual, rapid, and instant. 'None' denotes typefaces that are mono-liner and the rest depends on the cant tool and the hand. This is discussed further and illustrated on the base, ascender and descender characters, in figure 5.39 to understand the visual variation of the strokes

in Sinhala typefaces. Meanwhile, the direction of the overall typefaces is noted as none, vertical, horizontal, right inclined and left inclined.

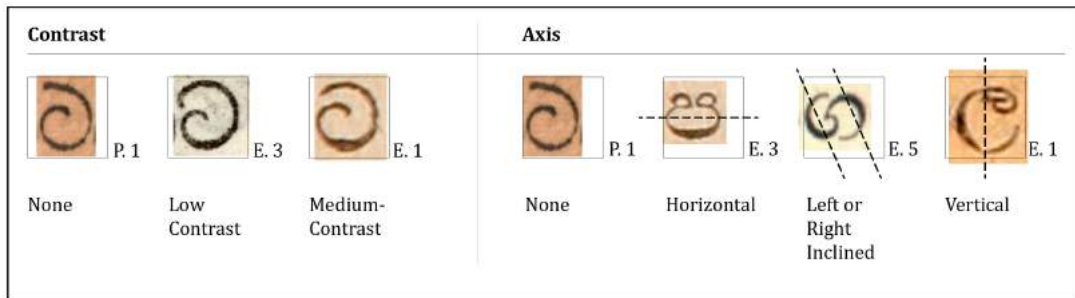


Figure 5.38: Contrast and Axis

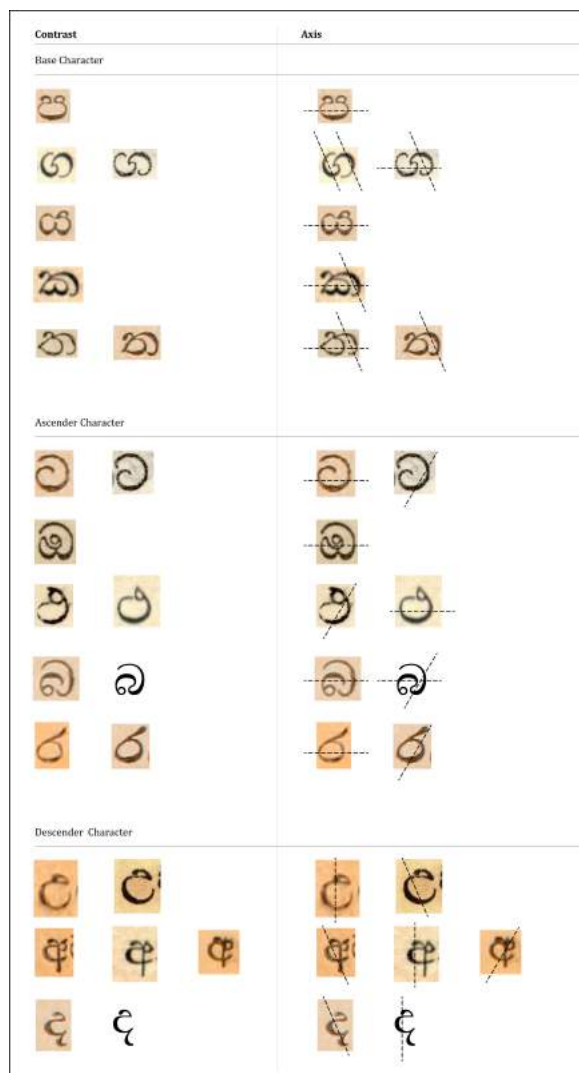


Figure 5.39 : Contrast and Axis of the Base, Ascender and Descender Characters

5.3.4 Terminals

Terminals in typefaces can be identified most significantly, due to their consistency across the typefaces. Terminals too are directly related to the tool as the shape corresponds to the tool. Terminals are considered as the start and the end of a stroke. Since most Sinhala letters start with the eye, the following analysis discusses only the end terminals of the stroke. The distinct variations of terminals in Sinhala were identified in chapter four, and they were brought forward for the analysis; while the 'eye' of the letters is discussed under the next topic 'hand'. Among the ten terminals, two were omitted in this analysis as they represent only one letter.

The most significant visual variation of the terminals is its rounded termination. This is due to the use of a mono-linear tool, while a horizontal, oblique or a swoosh, portray a cant tool (fig 5.40). Nevertheless, the Sinhala type specimens that are printed may communicate differently due to the print quality. Therefore, it has been estimated to the closest shape. Terminals are discussed by selecting one sample letter to represent each terminal. Among the terminals three exceptions that stand out (figure 5.4b), and they are discussed separately under 'loop' and 'eye'. The observation across all Sinhala typefaces demonstrate that most typefaces do not convey consistency in terminals

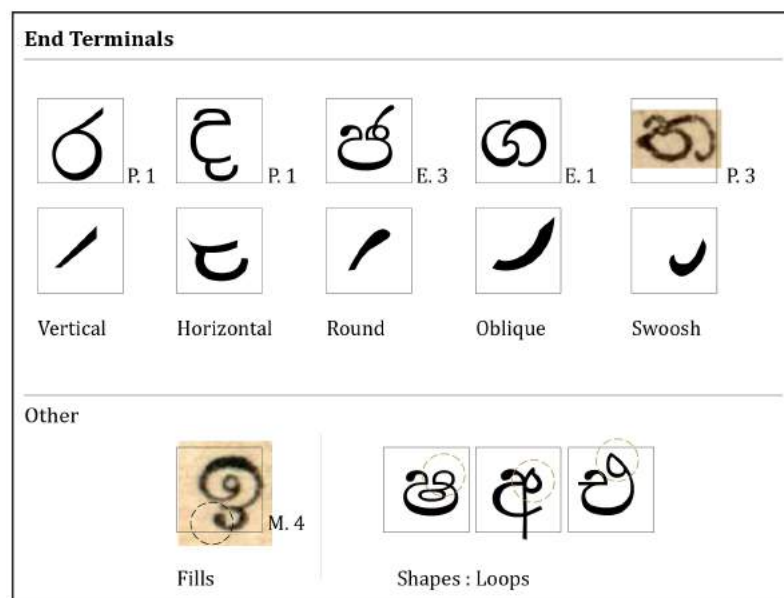


Figure 5.40 : Types of End Terminals

5.3.5 The Hand

The hand conveys the style of the typeface based on the way it is written. In the type design process, the designer controls the hand and that is portrayed by the stroke of the typeface. Even though the tool conveys the consistency of the stroke, the hand manipulates the tool. As a result transition of the stroke-contrast varies due to the angle, rotation and the pressure of the hand.

Classification systems such as MaxmililenVox and Thibaudeau use the hand as a criterion when observing typefaces. Among these groups handwritten, rational, humanistic and geometric hands are well discussed. The 'handwritten hand' conveys typefaces that are less regular with perfect geometric shapes and trait the human handwriting. Such an example of a typeface is evident in p.2. Another hand is the 'humanistic' hand, this conveys a style similar to the handwritten style, but more regularized and rationalized with more strict clear strokes. The circular strokes are more deliberately drawn. This type of style is usually common among the selected Sinhala type specimens. The significance of this hand is that its terminals are usually standardized and maintain a high level of consistency.

The 'rational hand' is usually optically corrected typefaces, which can be identified in typefaces of recent times. Yet, such a hand is found in typefaces of N.J. Cooray (E.3) and Monotype (E.5). An indirect copy of these two typefaces is FM Abaya (M.1), and FM Abaya that portrays clearer stroke shapes and can be considered as a typeface of a rational hand. Typefaces that are predominantly identified by their geometric nature convey the 'geometric hand'. Since most Sinhala typefaces have circular geometry, This can be considered as the extreme form. All of the typefaces selected are illustrated in the figure below (Figure 5.41).

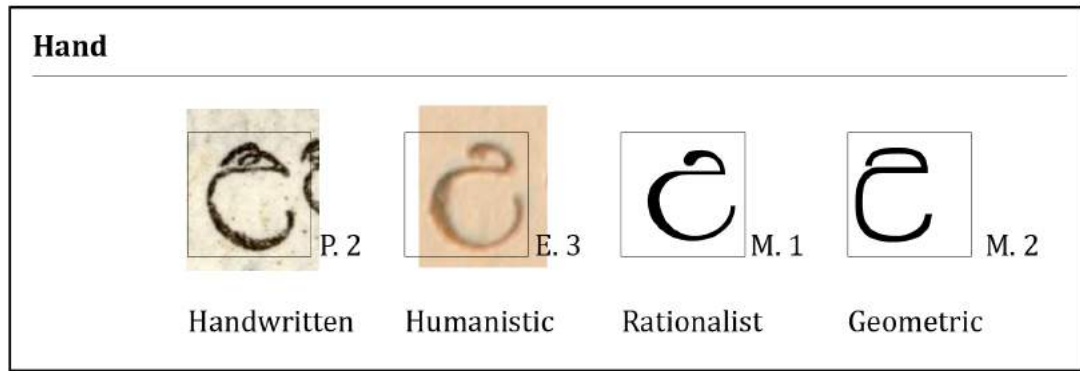


Figure 5.41: Use of Hand Found in Sinhala Typefaces

5.3.6 Counters

The counters are the negative spaces within each letter. Certain Sinhala letters are inherently made of open and closed counters. Yet, within typefaces there are instances that the inherent open counters are left closed based on the hand. To explain this further, the counter of base, ascender and descender is discussed in figure 5.42- 44. Most ascenders and descenders have an inherently open counter. Thus, due to the spread of ink they may appear as closed counters. Meanwhile, the base shape characters are made up of a closed counter (pa), open counters (ya), and a combination of open and closed counters such as 'ka' and 'na'.

The eye of the Sinhala letters consists of minute visual variations. The divided five categories are illustrated in figure 5.45-46. They are made up of a combination of open and closed counters. The closed counters are found as filled in or open. And the other variation is the omitting of the eye or its discontinuity of the stroke.

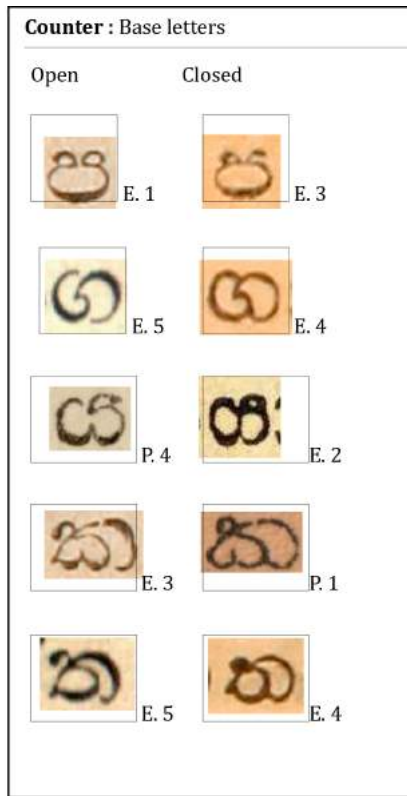


Figure 5.42 : Counter - Base

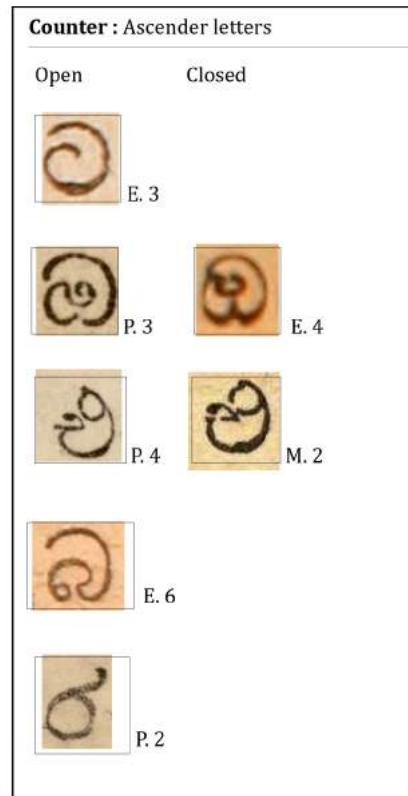


Figure 5.43 : Counter – Ascender

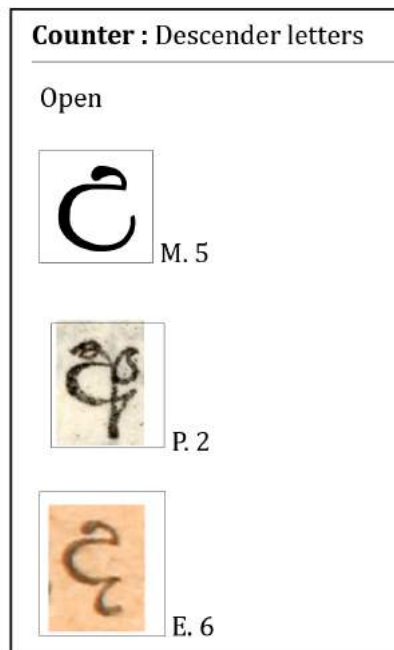


Figure 5.44 : Counter - Descender

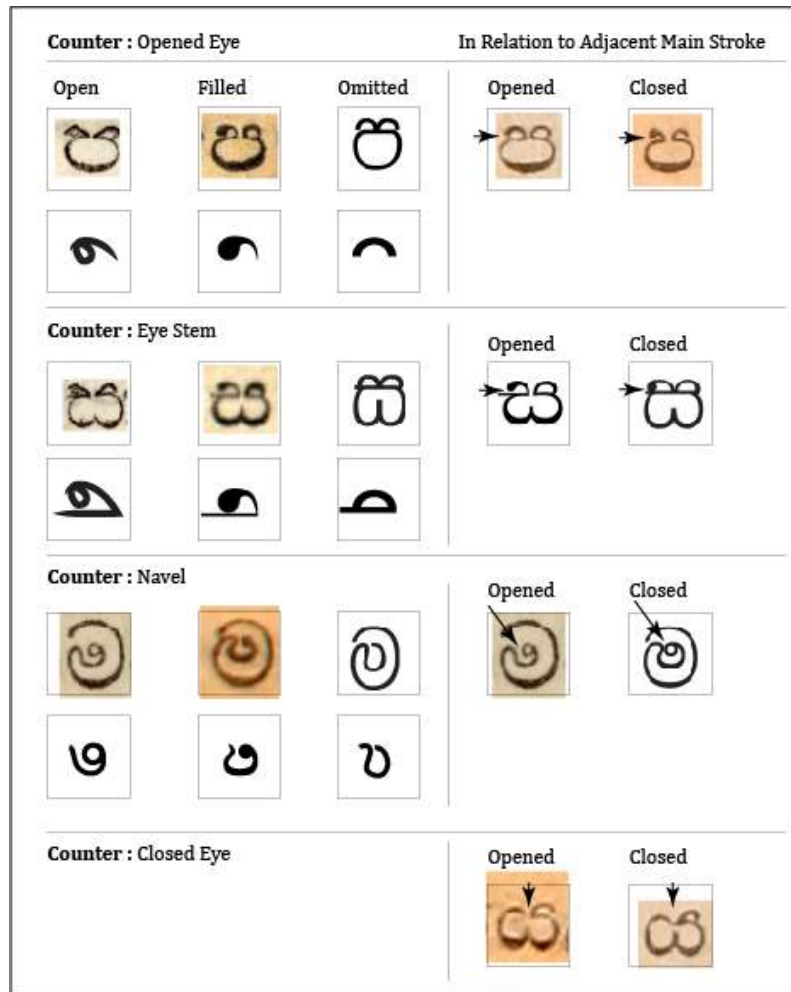


Figure 5.45 : Counter – Opened eye, Closed Eye, Horned Eye, Navel Eye

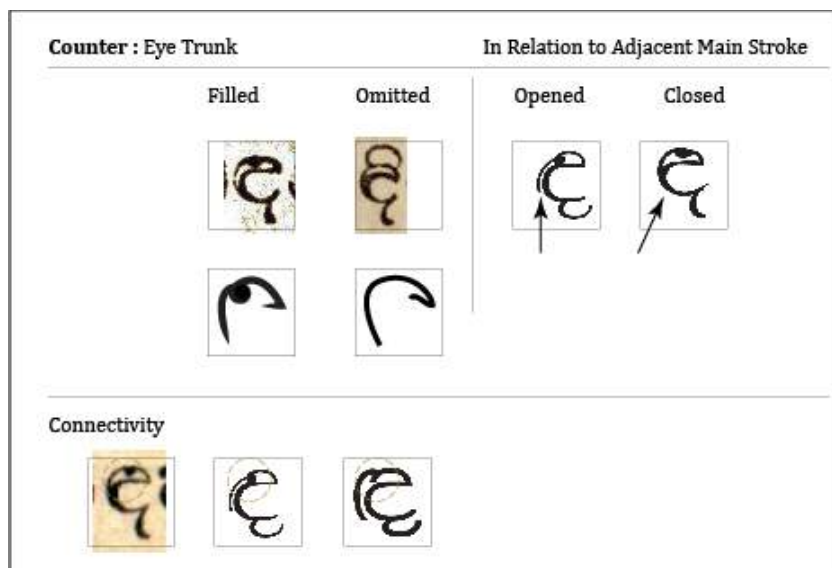


Figure 5.46 : Counter – Trunk Eye

5.3.7 Eye Joint

Five types of eye joinery were identified in chapter four, and this type of joint can be considered as how the eye of the letter joins the rest of the letter. Since the eye is considered as the start of the letter it joins to the base, ascender or descender strokes. As a result, most joints are located at the eye line. An exception is noted in characters with the navel eye; as they are usually found between the eye line and the base line.

In general, the eye joint takes three significant visual variations. It takes an angular, high angular, and a rounded shape (Figure 5.47). The angular takes a high angle that is usually found below or parallel to the eye-line. There are instances that the parallel eye joints touch the adjacent stroke, making the joint unclear. Nevertheless, these eye joints are usually placed at the eye-line and found parallel to it. Whereas the navel eye at the bottom range is placed at the base line and connects to the hook. This is elaborately illustrated in figure 5.48. A sample of each eye joint is explained.

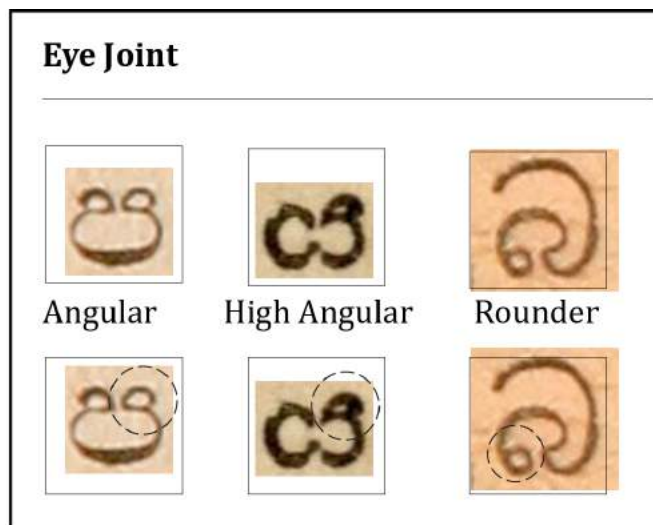


Figure 5.47 : Visual Variation of the Eye Joints
















Eye Joint : Each Eye Category			
	Angular	High Angular	Rounder
Open eye			
Closed eye			
Eye trunk			
Eye Stem			
Navel			

Figure 5.48 : Representation of each Category and the Visual Variation

5.3.8 Curve-to-Curve Joint

The curve-to-curve joint is found when two circular shapes join each other. As discussed in chapter four, this joint is found in three main locations. Most curve-to-curve joints are found at the base line, in base characters and ascenders. Descenders are joint vertically at the baseline or below. Meanwhile the third type of curve-to-curve joint is found between the baseline and the eye line (Figure 5.49).

The joint has multiple visual variations and they are horizontal, curve-linear, angular rounder, vertical, or either found separately from each other but adjacent to it. This is discussed among the three main strokes in Figure 5.50.

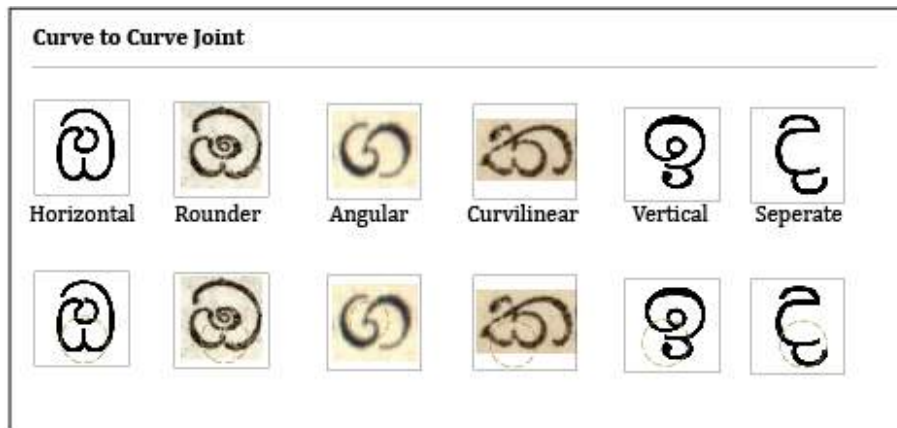


Figure 5.49 : Visual Variation of the Curve-to-Curve Joint

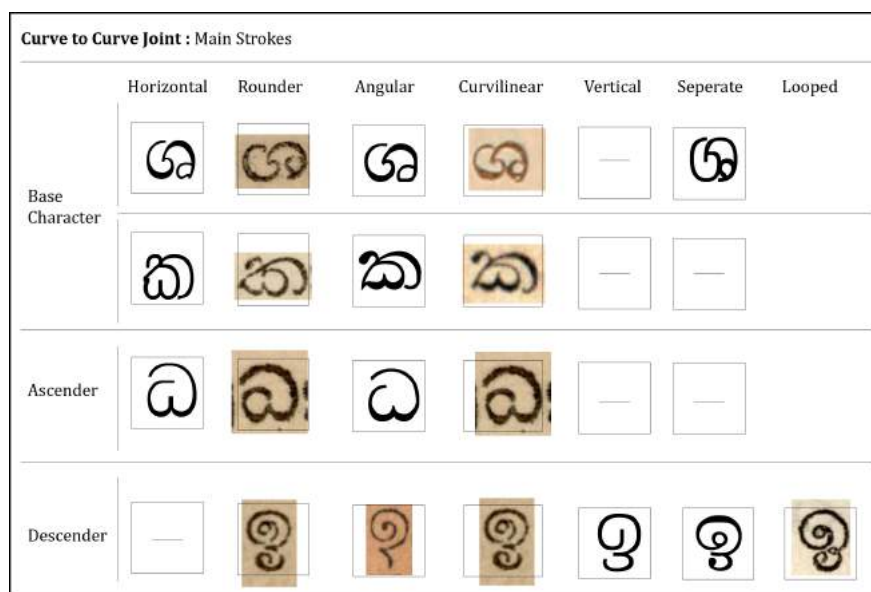


Figure 5.50 : Representation of each Category – Curve-to-Curve Joint

5.3.9 Curve to Arm Joint

This joint goes inclined with the eye joint as it describes how a curve stroke joins a vertical, horizontal or a diagonal arm. In Sinhala, there is only one letter that has a vertical, and one letter that has a horizontal arm. Meanwhile, there are a few more letters that have diagonal strokes and they are usually joint to an eye, knot, point or a base shape. The location of the joint varies due to the nature of the letter, but it is usually found between the eye and the baseline. All letters that have this joint are considered as either an ascender or a descender.

There are three main visual variations on how the curve stroke joins the arm. They are angular, vertical and diagonal. This is further discussed with a sample to elaborate on the location of the joint. When a perpendicular line is drawn at the center of the letter, the location changes and this is explained in Figure 5.51.

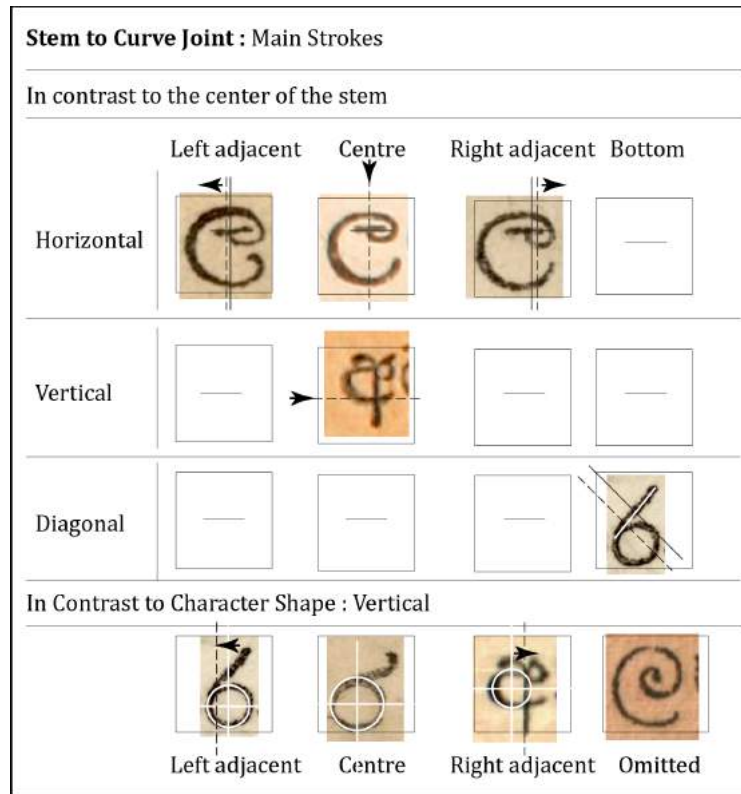


Figure 5.51 : Location of the Curve to Arm Joint

5.3.10 Crescent Shaped Joint

This joint is found only in two letters, but can be considered when creating conjunct letter shapes that share the same visual property. The crescent shaped joint is a connection between two characters. The half of the base letter *ka* joins the eye of the *da* or the dental *da*. Since both parts of the letters are curve liner, the connecting stroke takes a crescent shape. Since these two letters were not used before the modern newspaper era, as frequently as in the modern era, the analysis is based on conjunct letters that have a similar joint (Annexure 5.6). The left joint of the faced down crescent shape is always a part of an intersection and the other part is either a part of the eye or an ascender stroke. Figure 5.52 explains the visual variation of this joint.

Crescent Shaped Joint



Figure 5.52 : Crescent shaped joint

5.3.11 Point/ Horn Joint

This joint represents a turn at the joint, and how the stroke transitions into a curvilinear stroke. This joint is always found at the base line, or slightly above. It takes four visual variations; angular, horizontal, rounder or separate.

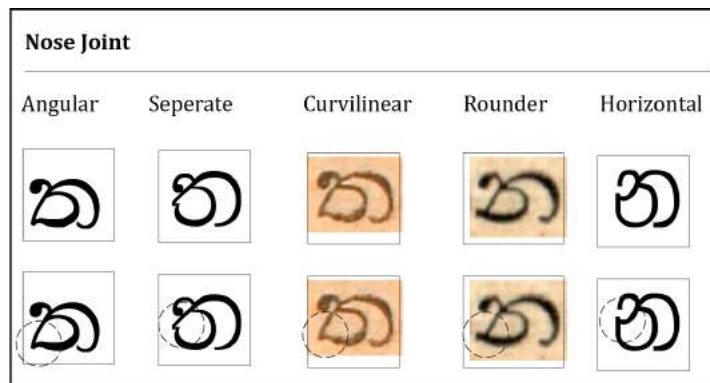


Figure 5.53 : Visual Variation of the Point/Horn Joint

5.3.12 Distinct visual property: Hump

This section discusses how each of the identified visual properties in chapter four is applied on the fifteen type specimens, to understand anatomical visual variations. These visual variations are discussed with an overall understanding of the behavior of all letters that share the distinct property, and it is explained with selected letters.

There are only two letters that share this property. We have identified the letter *mba* as the best example to explain the visual variation of this property. The

hump appears as a wrinkle on a smooth ascender or a base stroke. It can also be described as a substitute to a curve-to-curve joint, replaced with a horizontal stroke. This visual property takes two distinct shapes based on its turn as smooth and sharp. Both these shapes take several stylistic approaches based on the direction of the hand. As a result, the counter space increase and decrease are illustrated in Figure 5.54.

Meanwhile, the contrast of the hump has two visual variations (Figure 5.55) when composed as a modulated character. When the top part of the hump is illustrated as a mono-liner stroke, the hump conveys a high contrast due to the thick adjacent stroke at the bottom, and the low contrast hump is constructed with a thick stroke to complement the thick adjacent stroke at the bottom.

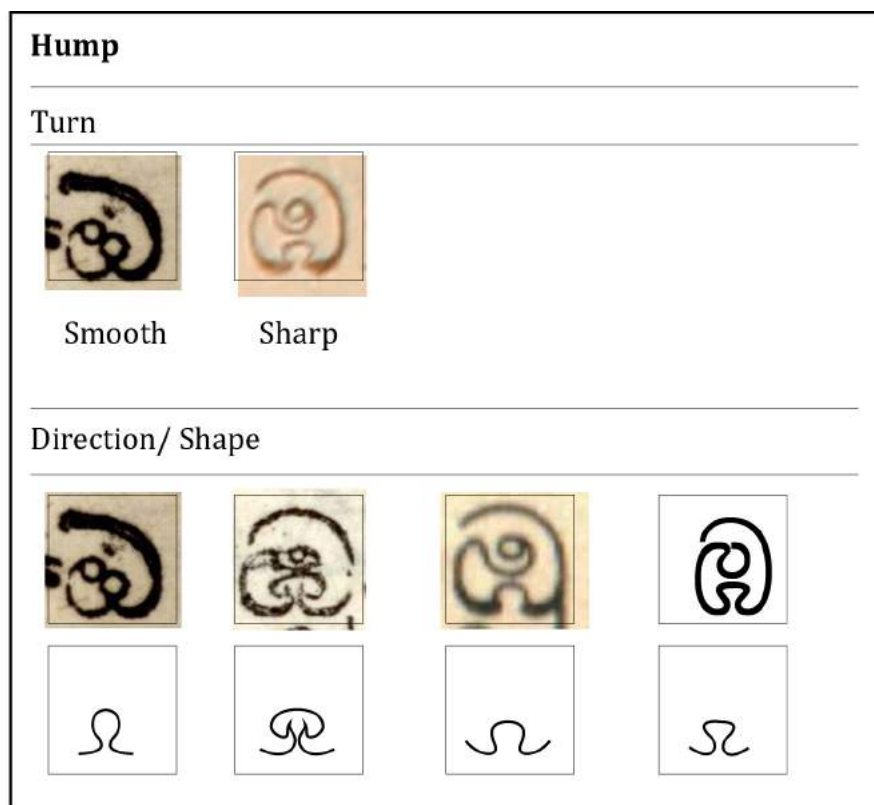


Figure 5.54 : Visual Variations - Hump

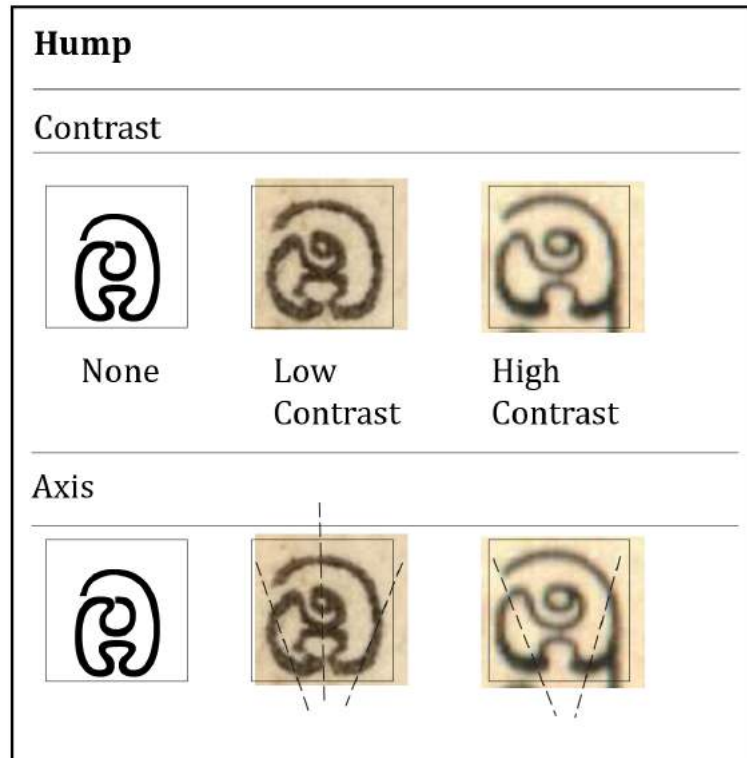


Figure 5.55 : Contrast and Axis - Hump

5.3.13 Distinct visual property : Point/Horn

This visual property explains how two strokes from different directions meet. Based on the direction of the point, we find two significant visual variations. When the direction is pointed up towards the ascender line the property was termed as 'horn', when pointed down it was termed as 'point'. The visual variation of this property is created based on the turn of the hand; therefore, we note that the horn takes a smooth and a sharp turn, while the point takes only a sharp turn.

There are several stylistic visual variations of this property and they are based on the direction of the hand and tool as explained in Figure 5.56. The horn is visually pointed up, but there are instances the direction of the horn is parallel and close to the baseline. This style diverts into several visual variations by increasing the space between the horn and the baseline, and with the changing of the angle. This is very much similar to the point, except the direction of the point is towards the base line.

The contrast of the point and the horn is significant only to modulated typefaces. Therefore, with the change of the axis, we identify a low and a high contrast (figure 5.57).

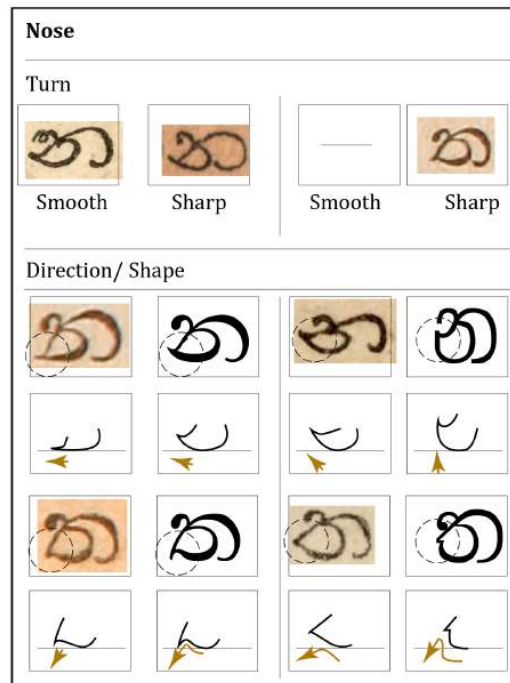


Figure 5.56 : Visual Variations - Point and Horn

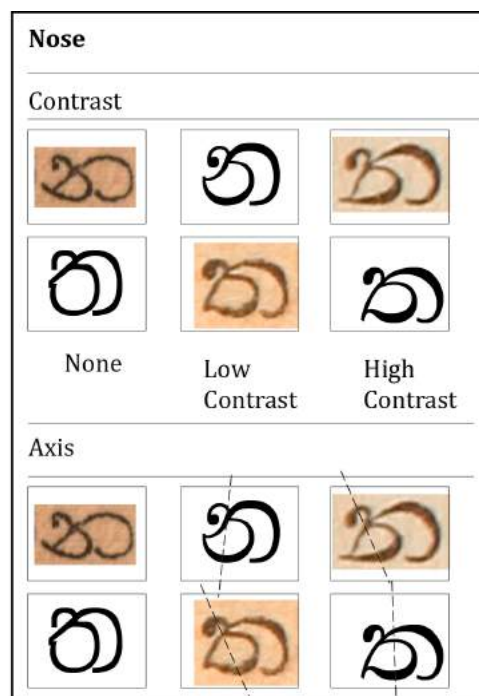


Figure 5.57 : Contrast and Axis - Point and Horn

5.3.14 Distinct Visual property : Shoulder

The direction of the stroke portrays three visual variations; smooth, sharp and stylistic in reference to the letter *gna*. Yet, based on the direction of the hand and tool, three significant visual variations were noted. As a result, the space between the shoulder and the base character increases and decreases. This usage of space results with close and open counters and also influences its stylistic approaches.

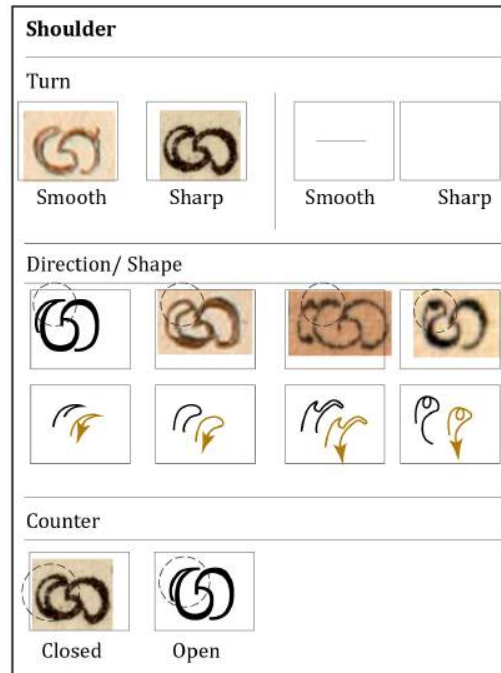


Figure 5.58 : Visual Variations – Shoulder style 01

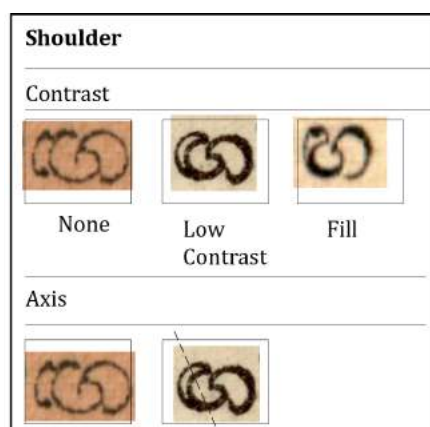


Figure 5.59 : Contrast and Axis - Shoulder style 01

An exception can be noted with the shoulder of the letter *na*. The shoulder is placed adjacent to the rest of the letter and can be considered as a separate placement of the letter. Therefore, the composition of the shoulder in the letter *na* takes three visual variations specific to the counter as closed, open, and open and closed. These three variations are further expanded into several other stylistic variations as illustrated in Figure 5.60. Meanwhile, the contrast of the shoulder with the rest of the letter can be identified as none, low, and stylistic. The axis portrays several visual variations on the contrast of the shoulder of the letter *na*.

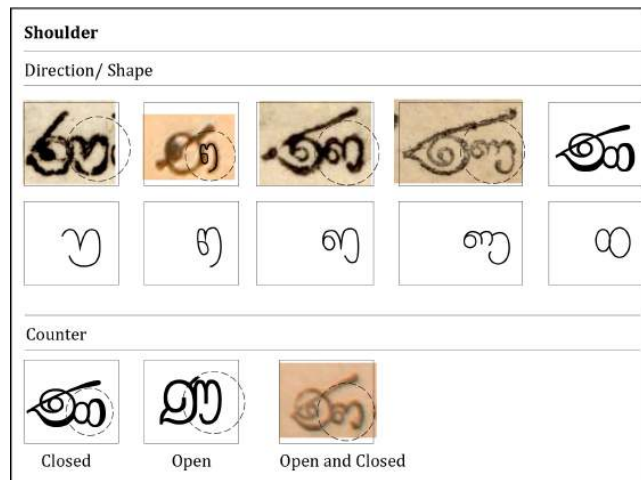


Figure 5.60 : Visual Variations – Shoulder style 02

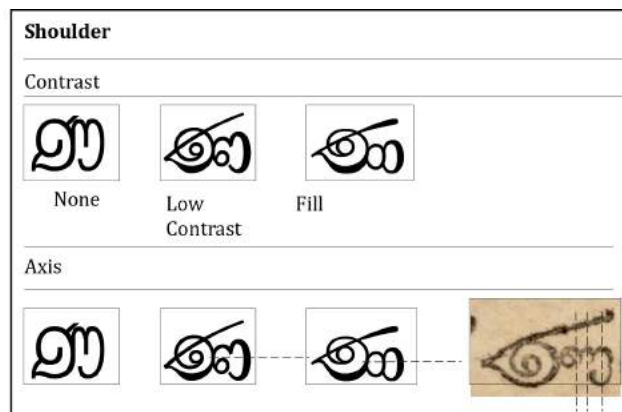


Figure 5.61 : Contrast and Axis - Shoulder style 02

5.3.15 Distinct visual property: Loop

The visual variation of the loop is discussed across its three distinct (sub) visual properties. The locations of the loop can be found at the base line, ascender line and the eye line. Nevertheless, the shape of the construction of the loop is somewhat the same, as it is defined as the way the stroke changes direction and overlaps without crossing over. At the point where the stroke changes direction there are two visual variations: smooth, sharp and stylistic, across all three sub-visual properties.

Another aspect about this distinct property is the uniformity among the typeface. For example the 'stylistic' visual variation of the loop is found across each typeface. But the contrast of the loop among the three sub-visual properties is different, as it is based on the hand and the tool. Therefore, taking all of this into consideration the contrast is grouped into -- none, low contrast, medium contrast and high contrast (Figure 5.63).

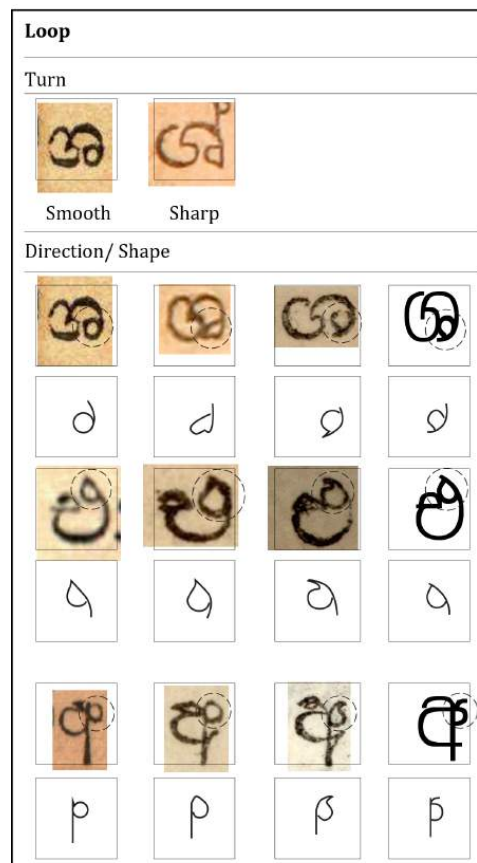


Figure 5.62 : Visual Variations – Loop

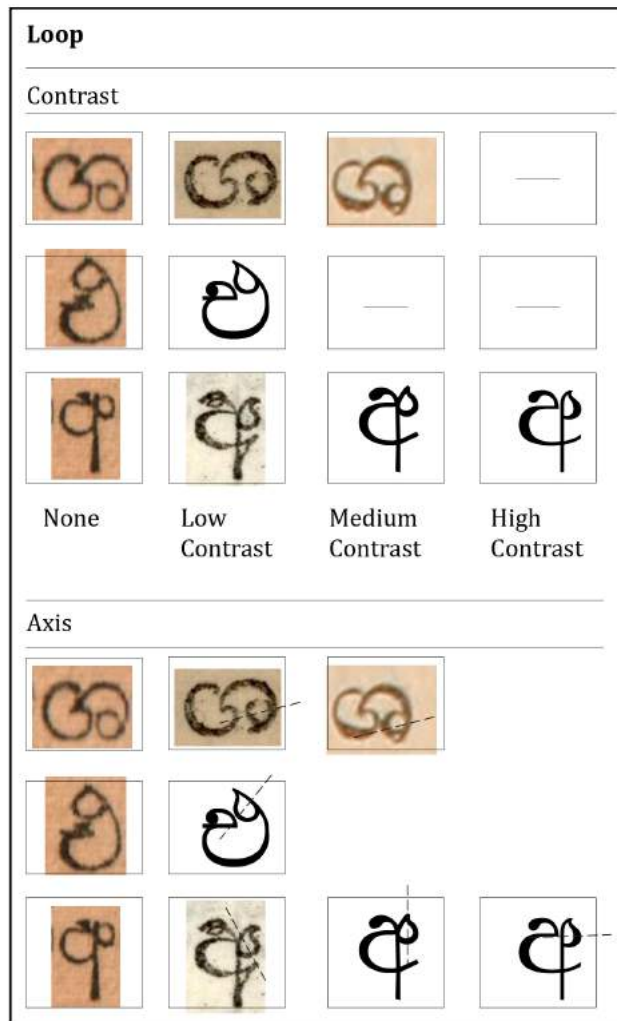


Figure 5.63 : Contrast and Axis - Loop

5.3.16 Distinct visual property: Spiral

The spiral is found only with two letters and they both illustrated together to understand the direction. For example, even though the spiral looks similar in both letters (*i, na*) the direction varies. The analysis grouped the direction of the spiral as: wedge spiral, full spiral, half spiral and the spiral that is constructed without an eye (eye omitted). The counter of the spiral takes three visual variations, as closed, open, and open and closed. Among these groups, the open counter is a result of a spiral that starts without an eye (omitted eye), while the open and closed counter is a result of the eye, as the eye works as a closed counter and the rest of the spiral work as an open counter.

The visual variation of the contrast of the letters is very much similar to the rest of the letters as they can be grouped as -- none, low contrast, medium contrast and high contrast. And the axis also varies significantly into several directions. This is illustrated in Figure 5.65.

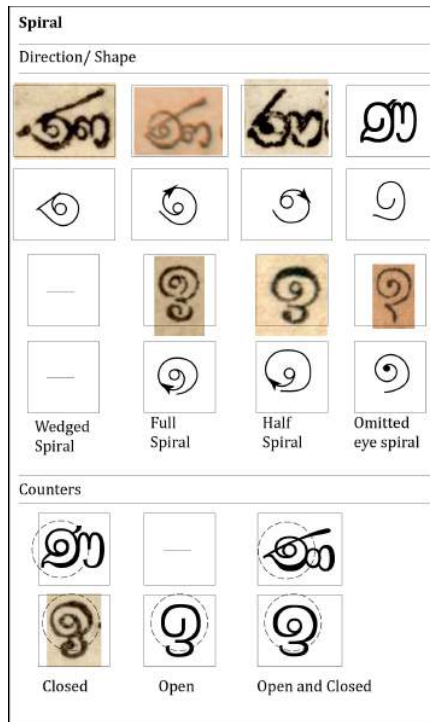


Figure 5.64 : Visual Variations – Spiral

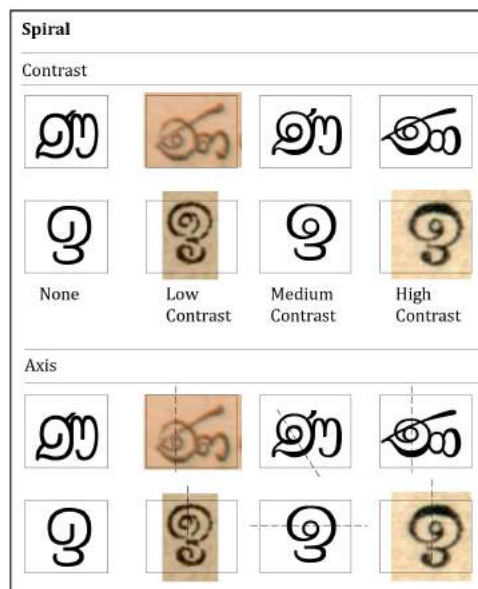


Figure 5.65 : Contrast and Axis - Spiral

And with this we conclude the visual analysis; the visual variations of Sinhala typefaces, based on the tool and the hand. As a result, we arrive at knowledge on contrast, axis, and direction of strokes that portray the appearance of the exterior boundaries of the stroke in typefaces.

5.4 Summary and Organization of the Theoretical Framework

This section summarizes the overall study and presents the structure of the theoretical framework. The framework represents a set of theories within the domain of Sinhala typography and the relationships between those theories. The aim of creating this framework was to capture, assess, develop and combine tacit typographical knowledge on Sinhala. And to achieve this we focused on anatomical features of Sinhala type. The Theory was built within a flow of five stages:

Stage one: Discussed the existing knowledge on Sinhala typography based on available literature sources. To understand the existing knowledge we observed the structure of the Sinhala letter parts discussed in language and its visual development. The existing nomenclature and the morphological parameters were collected and tabled initially (chapter two). The existing knowledge also included documenting the practices of the use of reference lines and grids in Sinhala (chapter four).

Stage two: Similar to stage one, existing knowledge on Sinhala typefaces was acquired based on literature sources. We discussed the growth of Sinhala typefaces to compare and establish meta-data of Sinhala typefaces (chapters three and five).

Stage three: The distinct visual properties of each Sinhala letter were captured based on a hybrid methodology (research spiral method with visual survey method). It defined a set of reference lines and a grid for Sinhala type. As a result, 19 distinct visual properties were identified with 59 sub-properties (chapter four).

Stage four: To establish the anatomy of Sinhala type with the identified visual properties, nomenclature was analyzed. The survey was conducted with expert and

non-expert interviews. As a result, the visual properties of the Sinhala letter were further refined (chapters four and five).

Stage five: To finalize on the anatomy of Sinhala, the identified visual properties were further analyzed across existing typefaces, to understand the visual variation of typefaces and stylistic approaches (in chapter five). At this stage the contributing factors that make the anatomy; reference lines, *pa*-height, letter structure (chapter four), nomenclature, morphological features of typefaces based on the visual variations (chapter five) were established.

5.5 Summary and conclusion of the chapter

The concluding contribution towards the theoretical framework was compiled and summarized in this chapter. The chapter presented three surveys. The first part identified visual properties and proposed a common vocabulary to facilitate the suggested anatomy of Sinhala. This was discussed on the terminology determined by an expert interview, and a non-expert interview, together with terms used by other scripts. The second part of the chapter was a survey on the existing Sinhala typefaces from the inception of the printing press. It discussed the meta-data of the selected typefaces. The third part of the chapter is a visual survey on the visual variations of the Sinhala typefaces.

The absence of knowledge on Sinhala typefaces, lack of research and observation on the morphological features of Sinhala typefaces, discussed in chapters two and three, were addressed at the conclusion of this chapter and chapter four. Meanwhile, in the next chapter, we validate this Sinhala typographic knowledge (theoretical framework) on the anatomical features of Sinhala and outline the contribution of the thesis.

THE ANATOMY OF SINHALA: CONTRIBUTION TO TYPE DESIGN

The previous two chapters presented the factors that constitute the Sinhala anatomy. It identified distinct visual properties of each Sinhala letter and visual variations of Sinhala typefaces as a contribution to the field of Sinhala typography. This was an outcome of the background study, where we discussed the limitations of literature on Sinhala letterform and type. Chapters two and three explained the significance of the anatomical features of the Sinhala letter in Sinhala typography. The knowledge gained across the previous chapters is validated in this chapter by using this knowledge to generate the root letters for Sinhala type design. To achieve this, the chapter presents the experiment in three sections. The first part discusses the concept of root letter and how the letters were generated in other scripts. The second part discusses the methodology used to develop the root letters and, the analysis of the experiment. The third part analyzes the competency of the methods used to identify the root letters by testing and reviewing and presenting, the root letters for Sinhala type design.

6.1 Introduction to Root Letters

The objective of identifying the root letters is to ease the type design process. The root letters are a set of selected letters that contain common visual properties among other letters. The term 'root letter' derives from the Indian philosophic concept of '*bijakshara*' (*bija* meaning seed and *akshara* meaning letter); and hypothesises a set of primordial letters which contain the germ of an entire font and uses the term 'root letters' to communicate this idea (Dalvi 2010: 238). In the Latin type design process Matthew Carter (designer of Latin typeface, Bell centennial,etc) use the lowercase *h* as a root letter. He states that this letter contains several properties, common to other letters and supports the process of composing more letters out of it (Figure 6.1). Other than the key letters, Latin uses certain words such as the *Hamburg words* described as '*Hamburgevons*' practiced by Carol Twombly, '*Hamburgetypes*' and '*Hamburgetypesiv*' by David Earls; '*ashesion*', is another key word introduced recently by Gerry Leonidas at the MA in typeface design programme at the University of Reading. He states the point with 'adhesion' was to identify a set of shapes that allow

people to very quickly “get a feel for the style of the typeface; and also differentiating elements in the typeface” (Leonidas: 2001). He disregards the letter o (even though it is included in the word) as it is the only complete symmetric letter unique to itself and proposes *b,d,p,q* as they give an overview of how a round counter is accompanied with a vertical stroke. The lowercase *a* is identified as a key identity by Leonidas as it requires important decisions on the other letters (e, s etc.) composed within the x-height. It speaks of the relationship between the bottom and the top halves of the letter, which can propagate other letters and the overall typeface. Similarly, Dalvi states, the representative set of letters must contain the maximum number of properties, and he states this by keeping Devanagari letterforms in mind (Dalvi 2010: 243).

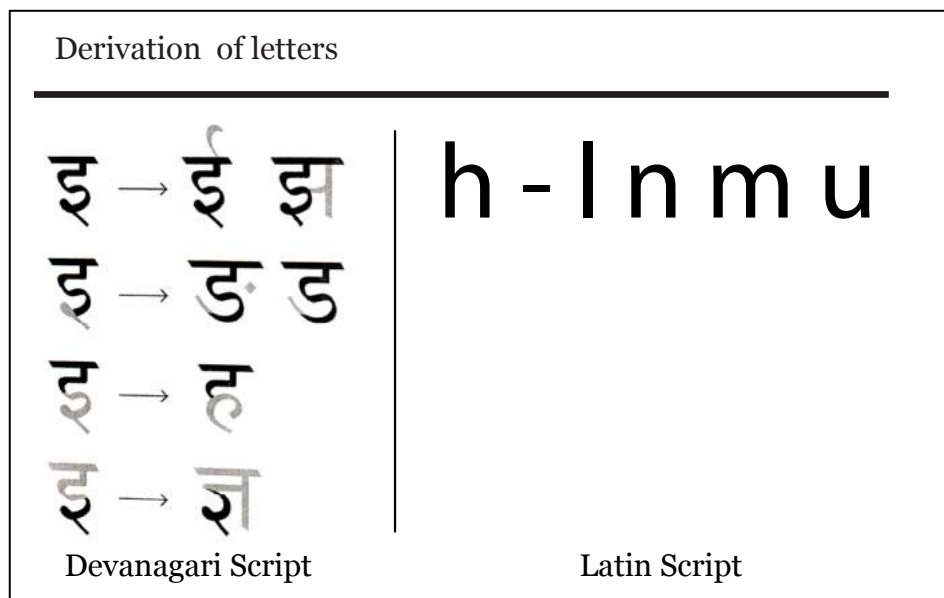


Figure 6.1: The composition of other letters derived from one single letter derivation

Such practice is rare for the Sinhala script as discussed in the background studies. We discussed that the type design process was inclusive within a limited number of self-taught professionals. Their practice was random since the objective of creating typefaces was purpose driven. Goudy (designer of Latin typeface *Old Style Goudy*, *Copperplate Gothic*, *Trajan* etc.) too begins the designing of a new typeface with only a ‘definite thought’ as the final appearance in mind. This thought was not

more than the shape or position of the dot of the lower case i, or a peculiar movement or swell of a curve, or the shape or proportion of a single capital” (Goudy1977 :81)

Similar to Goudy’s, Ekenayaka, a current Sinhala type designer spoke about his type design process to have the same concept of selecting random letters to accomplish that final ‘definite thought’ (Ekanayake 2015).

As a result of the limited number of professionals in the field in Sri Lanka, and the lack of formal education on the subject of type design and typography, a limited number of typefaces are found today. Therefore, identifying the root letters for Sinhala contributes to formalize the type design process. Therefore, findings of the anatomical properties of Sinhala as discussed in earlier chapters, are used to identify the root letters for Sinhala.

6.2 Methodology : Generating the Root Letters for Sinhala

This section examines Dalvi’s theory of ‘Minimal letters with maximum properties’. He used this theory to generate root letters for Devanagari. Dalvi’s calculation method is a pioneer experiment and the only proposal applied to Indic script; therefore, the author tested it on the Sinhala script to establish its competency in achieving the main objective of the experiment:

- To identify the root letters for the Sinhala type design

During the process of achieving the main objective, several sub-objectives were arrived at, especially on the factors associated with the calculation and the influence it had on the final result. The sub-objectives were:

- To establish a suitable methodology to achieve the main objective
- To understand how much Dalvi’s calculation method had been effective when applied for Sinhala

6.2.1 Composite Properties Versus Stroke Primitives

To calculate the root letters, the main variable was the visual properties of the selected (script) letterform. Dalvi’s experiment consisted of Devanagari letter properties, and since this experiment is on the Sinhala letter, the earlier (Chapter four) identified visual properties of the Sinhala letter were taken for the experiment.

i). Selection of Composite Properties According to Dalvi

Dalvi arrives at the variables(properties) by observing 50 font samples. Even though the typefaces were partially random and partially selective, the concluding variables were based on clusters that were interpreted according to the following parameters: counters, turns, knots, grey value, vertical terminals, contrast, axis, broad/tall, tool and the inclinations. Dalvi describes these properties as composite properties as the variables are conceptualized according to the findings (in an initial study of his) and through a visual survey.

ii). Selection of Stroke Primitives according to the proposed grid

This method was proposed to overcome the lapses identified in Dalvi's method, when applying to Sinhala. Because Dalvi's experiment was conducted on composite properties of the Devanagari letter whereas this experiment was conducted on the distinct visual properties of Sinhala also known as stroke primitives.

Letter properties for Sinhala were identified by the author in chapter four and published earlier (Face Forward Conference, Dublin, Dec 2015). These variables too were identified through a visual survey discussed in chapter four: 19 distinct visual properties and 68 sub-properties. In the case of the Sinhala letter, the author tests the same concept of 'Minimal letters with maximum properties' on the basis of a proposed grid structure and the letter properties. The grid is proposed with the learning from the five guidelines, and letter properties are in relation to the typeface proposed by the National Institute of Education (NIE) on the construction of the Sinhala letter. Dalvi describes the findings of the Sinhala letter properties to be atomic properties; since the strokes can be considered as a combination of two or more properties and proposes the term 'stroke primitives'(Dalvi 2015). The derivation of stroke primitives based on the grid and letter structure is illustrated in Figure 6.2.



Figure 6.2: The derivation of stroke primitives based on the grid and letter structure

6.2.2 The Experiment

The method used to identify the root letters (RL) for Sinhala was based on the knowledge acquired by Dalvi's model towards calculating the minimum letters with

maximum properties. It was conducted in a tabular fashion with letters on one axis and the visual properties on the other (Figure 6.3).

No.	Variables	DF	eye						Base Stroke					Ascender						
			Properties	eye 1	eye 2	eye 3	eye 4	eye 5	eye 6	BS 1	BS 2	BS 3	BS 4	BS 5	As 1	As 2	As 3	As 4	As 5	As 6
1	අ				1															
2	ඉ							1												
3	ඊ																		1	
4	උ				1															
5	ඌ			1	1						1									
6	ඍ					1			1											
7	ඎ					1												1		
8	ඏ							1								1				
9	ඐ				1							1								
10	එ							1								1				
11	ඒ								1											
12	උ			1		1					1									
13	ඌ								1								1			
14	ඍ									1										
15	ඎ					1									1					
16	ඏ			1	1														1	
17	ඐ				1														1	
18	එ				1							1				1				
19	ඒ						1					1								
20	උ				1		1												1	
21	ඌ														1					
22	ඍ														1				1	
23	ඎ					1										1				
24	ඏ					1												1	1	
25	ඐ								1										1	
26	එ					1	1									1				
27	ඒ				1								1							
28	උ																	1		
29	ඌ					1														
30	ඍ															1				
31	ඎ				1								1							
32	ඏ						1													
33	ඐ			1	1					1										
34	එ				1													1		
35	ඒ								1									1		
36	උ					1				1										
37	ඌ							1								1				
38	ඍ							1								1				
39	ඎ			1							1									
40	ඏ																		1	
41	ඐ																			
42	එ				1										1					
43	ඒ									1										
44	උ			1	1					1										
45	ඌ			1		1					1									
46	ඍ				1						1									
47	ඎ			1																
48	ඏ											1								
49				8	16	8	5	3	5	3	5	5	3	2	5	7	2	4	2	6

Figure 6.3 : Section of the Score sheet minimal letters with maximum properties

The final tally presented a score to each letter. The letters that had the highest score were noted as the letters that had the maximum visual properties. Therefore, according to Dalvi's concept, we believe that the letters that had the heights score could be considered as the root letters for Sinhala. But, we noticed (in chapter four) that certain visual properties are unique to certain Sinhala letters. Therefore, if these letters that had unique features are included as root letters (identified above), it limits the number of letters the root letter can generate. Therefore, in the following section we identified the unique letters by re-examining the score sheet. The distinct visual properties that had a score of 1 were noted as the unique letters.

6.2.3 The Unique Letters among the Sinhala script

To identify the unique letters in the Sinhala script; the total score of the properties was summed up and placed in ascending order. The properties that had the lowest score were noted as unique letters of Sinhala. A set of 10 letters was noted and they were omitted from the initial RL sets, to build a competent set. The following letters were identified as the unique letters of Sinhala based on the score results:

1.0	Unique letters in Sinhala
	ආ, ඝ, ඞ, ට, ඨ, ඩ, ණ, ඬ, ත, ඣ, ඤ, ඦ, ට, ඨ, ඩ

Table 6.1 : Unique among the rest of the Sinhala letters

6.2.5 The Number of Properties in Each Root Letter

To identify the maximum number of letters captured by the identified set of root letters (RL 01) sample card system was used. The sample card was made up of three sections. The first section (a) includes all visual properties the (root) letter is made of. The second (b) section includes each property and all other letters that share the same visual property. Section (c) lists out all the letters, a single (root) letter can generate. This is done by calculating the number of times a letter occurs in section (b), therefore section (c) presents the list of letters in ascending order based on the number of properties it generates. The results are compiled in section (d). This is

explained in Figure 6.4 with the example of root letter 01. Section (a) includes all visual properties the letter *kna* generates and (b) includes each property and all other letters that share the same visual property. By scheming the number of times each letter occurs we recognize the letters that share the most number of properties to the least number of properties in section (c); as a result we are able to identify the number of properties each letter generates in section (d). Among this list the first three letters that had the maximum properties were brought forward (Figure 6.5).

Root letter : 1		
a.		
	Eye 04, Nose/Point 01, Shoulder 03	Base stroke 04, Descending stroke 03, Eye joint 04, Curve to C Joint 02, Right angular J, Curve and angular J 01, Intersection 02, Terminal 08
b.		
Eye 04		ကော့ကော့ကော့
Base Stroke		ကော့ကော့ကော့
Descender Stroke		ကော့ကော့ကော့
Nose/ Point		ကော့ကော့ကော့
Shoulder		ကော့ကော့ကော့
<hr/>		
Eye Joint 04		ကော့ကော့ကော့
Curve to Curve Jt 02		ကော့ကော့ကော့
Curve to Curve Jt 04		ကော့ကော့ကော့
Right angular Jt		ကော့ကော့
Curve angular Jt 01		ကော့ကော့ကော့
Intersection 01		ကော့ကော့ကော့
Intersection 02		ကော့ကော့ကော့
Terminal 08		ကော့ကော့ကော့
<hr/>		
c. Letters derived from the Root letter : 1		
	ကော့ကော့ကော့ကော့ကော့ကော့ကော့ကော့	

Figure 6.4 Sample card of root letter *kna*: its visual properties and common letters



Figure 6.5 Letter deriving out of root letter *kna*

6.3 Analysis and the Results of the Experiment

The analysis is conducted in two stages. The first section discusses the methods used to generate the root letters for Sinhala: Dalvi’s calculating method and the proposed grid method.

Identifying the root letters for Sinhala

Methods used to accomplish the objective of the study were achieved here, but they showed two different sets of root letters. The set derived out of Dalvi’s calculation

method is noted as the root letter set 01(RL 01), and the set derived out of the proposed grid is noted as the root letter set 02 (RL 02).

6.3.1 RL Set 01: Minimum letters with maximum properties

The concept of Dalvi was to identify the minimum letters that have the maximum amount of variables – in other words how many variables does a letter contain? Dalvi and the author arrive at the categorical data using two different techniques, prior used ranked (ordinal) data by questioning semi-experts with *yes, no, may be* answers and thereby giving each answer a score of 1, 0, 0.5. The author used descriptive (nominal) data by placing the letters on a grid with *yes* with a score on 1 and *no* with a score of 0 to count the number of occurrences in each category.

The data was tabulated in the same way as Dalvi and calculated to arrive at the letters that have the highest score. Figure 6.3 gives a schematic layout of the data matrix. Each letter was given a number and placed on the subsequent rows, while the 68 letter properties (68 columns) under the 19 distinguished features (as sub-topics) were placed along the columns. According to the responses all the property scores were summed up to arrive at the final score for each letter. The minimal set of letters that had the highest score was identified as the root letters for Sinhala. The root letter set (RL 01) are: *nya* (ඤ), *nja* (ඞ), *na* (ඹ), *jha* (ඛ), *cha* (ඡ), *a* (අ), *iru* (ඍ), *ilu* (ඌ), *nda* (ඹ), *ka* (ක). Among this list of root letters we were able to identify unique letters among Sinhala letters. Therefore, the competency of this set was tested in the following section (6.4)

6.3.2 RL Set 02: Letters within the proposed grid

The derivation of the RL identified by the proposed grid method was based on a visual analysis. Each letter was constructed on the grid by manipulating the base shape (circle), giving an initial guide on the proportions of the propagated typeface.

Starting with the base-height, all the base strokes (BS) primitives, ascending stroke (AS) primitives, Descending stroke (DS) primitives and the placement of the eye were analyzed to arrive at a set of root letters (Figure 6.2).

The following explains the visual analysis and the selection of each letter to be a RL

(the numbering of the stroke primitives is based on the figure 6.2).

1. Base stroke primitive 01 - The visual analysis initiates with the pa- height represented with two parallel circles placed on the *madya rekha* (base line) with one touching the *akshi rekha* (eye line) and the other touching the *athuru rekha* (in-between line). Since there is only one letter that explains both the circular property and the line height, the letter *pa* (ॐ) is considered as the first root letter. It can substitute to the letter x (height) of the Latin letter.

It is important to note that the circle that represents the *pa* (ॐ) is vertically symmetric but it varies when composed into a typeface. Figure 6.6 illustrates this visual variation.

Composition of the Base stroke 01

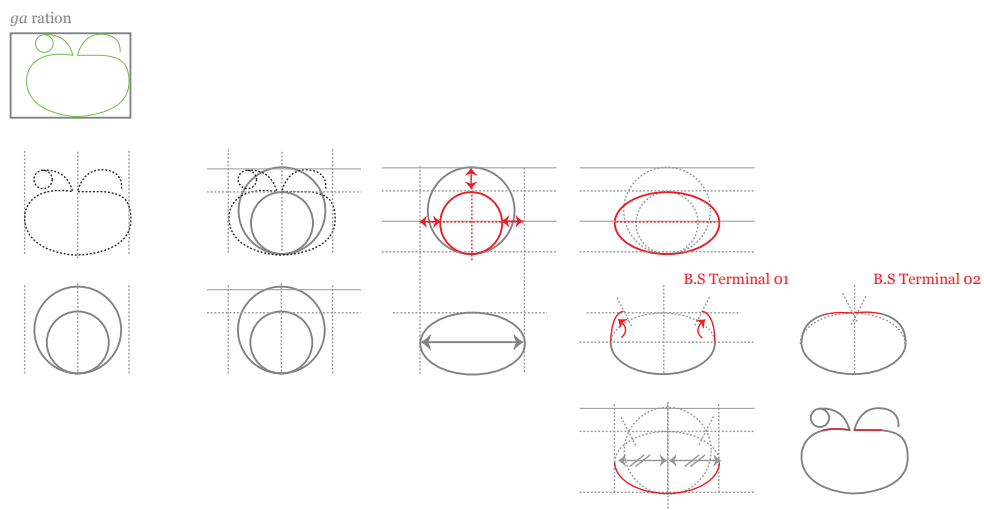


Figure 6.6: Root letter 01- *pa* (ॐ)

2. Base stroke primitive 02 and 03 - This is created when a base height circle is duplicated parallel to the *madya rekha* (base line). The letter that is created within this grid takes two forms according to the composition of two small circles. BS 02 is well represented with the letter *ga* (ॐ) and BS 03 is represented with the letter *sa* (ॐ). Therefore, if one creates either letter the grid supports the composition of the other. Based on this visual structure the letter *ga* (ॐ) was selected as the second root letter.

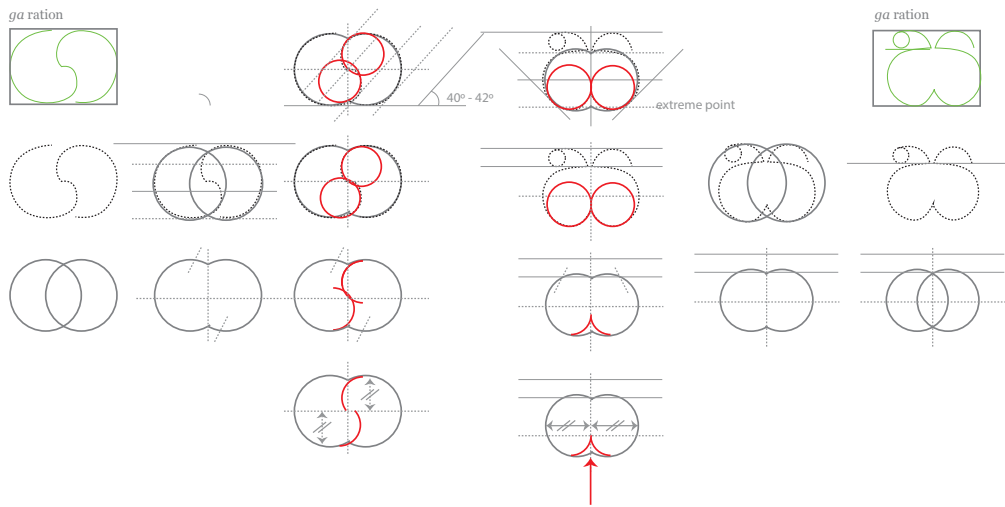


Figure 6.7: Root letter 02- *ga* (ϡ)

3. Base stroke primitive 04 and 05 – The base stroke primitive 05 is a stroke, which overlaps another by creating an enclosed full circle and continues to form another curvature represented with the letter *tha* (ϣ). BS 04 is a combination of BS 03 and BS 05 making it a much larger width letter *ka* (ϣ). Therefore, if one creates this letter BS 04 and BS 02 can be created. Therefore it was selected as the 3rd root letter.

Composition of the ascender stroke primitive 01

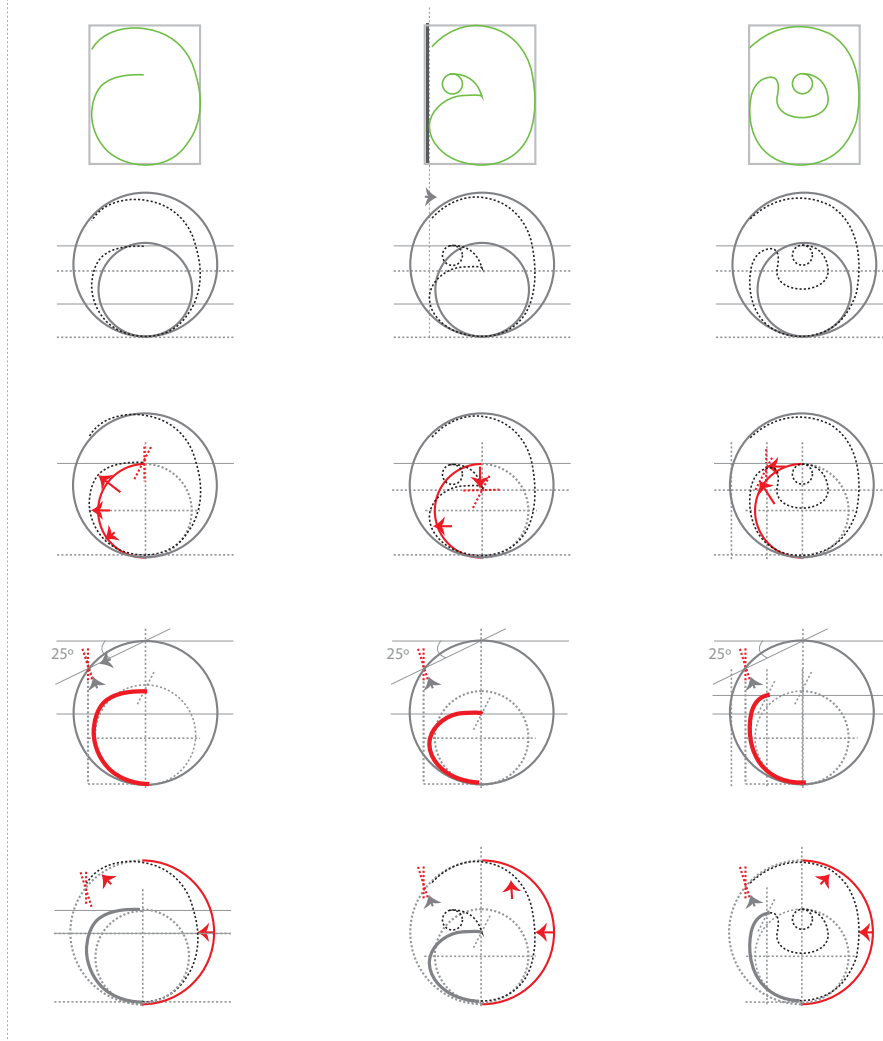


Figure 6.9: Root letter 04- *ma*(©)

5. Ascending stroke primitive 02 – Like in the BS 03 this ascending stroke is accompanied with two small circles parallel to the *madya rekha* (base line). When selecting the appropriate letter to represent this stroke primitive, the formation of the eye was again considered as we find more options. The *saññaka* (half- nasal sound) letter *nda* (©) was obtained as the 5th root letter, as it represented a combination of eye 03 and eye 04. This letter other than the ascending stroke can be considered as the best option to represent the eye (figure 6.10).

The Base stroke primitive o2 and the eye compositions

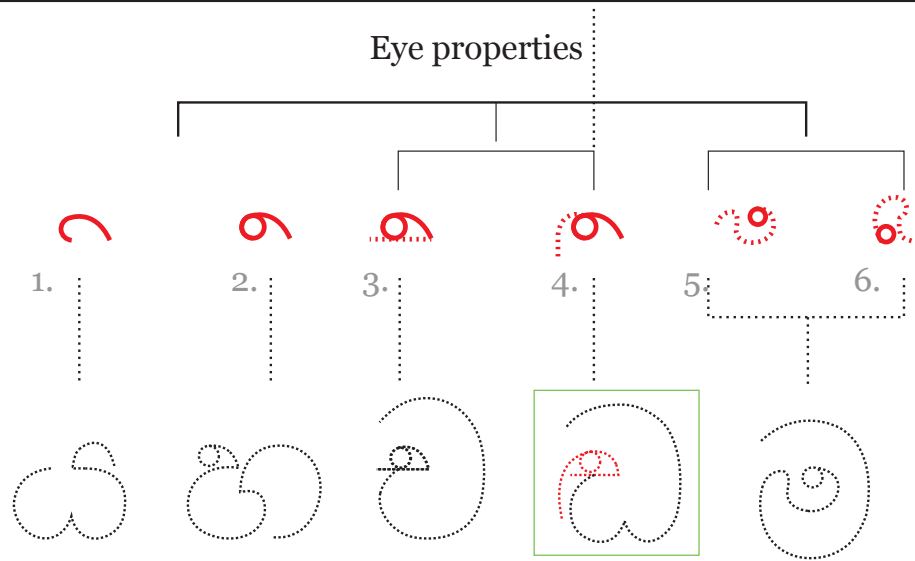


Figure 6.10: Root letter 05- the eye of the *nda*(@)

6. Ascending stroke primitive 03 – By changing the position of the two small circles this ascending stroke can be constructed with the above letter. Yet, due to the importance of the eye 06, which is constructed between the *madya rekha* (base line) and the *akshi rekha* (eye line), this ascending stroke is included as a root letter. The representative letter is *ba* (@).

Composition of the ascender stroke primitive o2 and o3

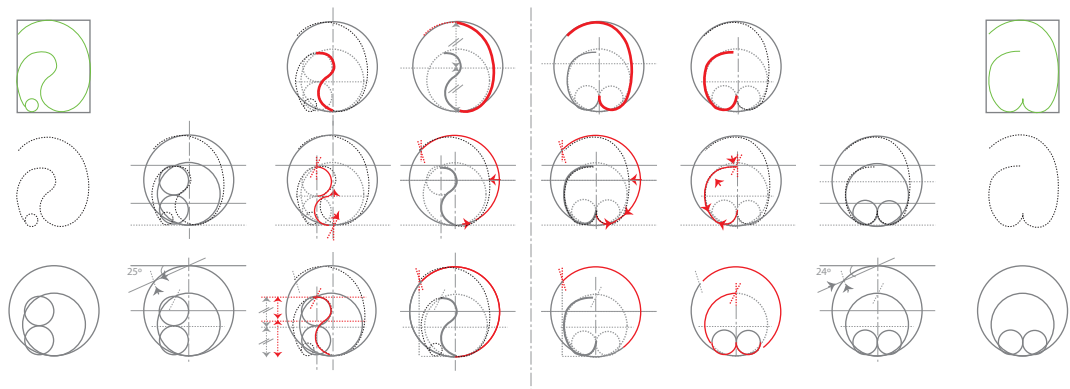


Figure 6.11: Root letter 06- *ba*(@)

7. Ascending stroke primitive 05 – The common property among ascending stroke primitive 02, 03 and the current stroke 05 is the two small circles. Therefore, one could compose the bottom half of the letters that have this feature but not the ascending stroke. This becomes another feature among the ascending strokes as it contains a loop at the *arohana rekha* (ascender line). To represent this feature, the letter *ta* (त) is selected.

Composition of the ascender stroke primitive 05

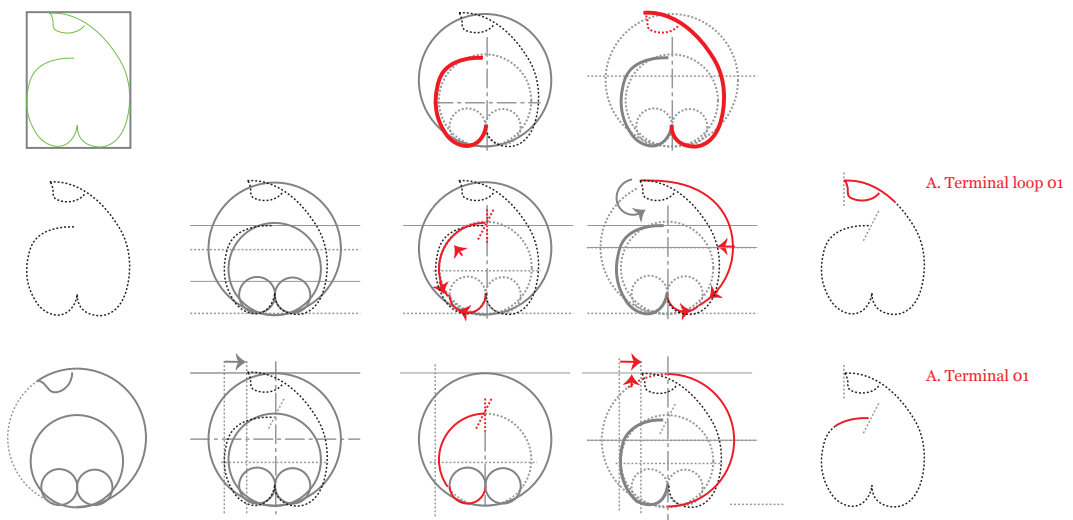


Figure 6.12: Root letter 07- *ta* (त)

8. Ascending stroke primitive 06 – Among the properties, the most number of variations of primitive strokes is found within ascending letters, each stroke varies from another. This represents the diagonal ascending stroke primitive and the letter *ra* (र) is identified as the most appropriate letter to generate the other letters. The position of the diagonal stroke varies, yet the terminating feature can be common to derive the letter *i* (इ), *na* (न), *ja* (ज).

Composition of the ascender stroke primitive 06

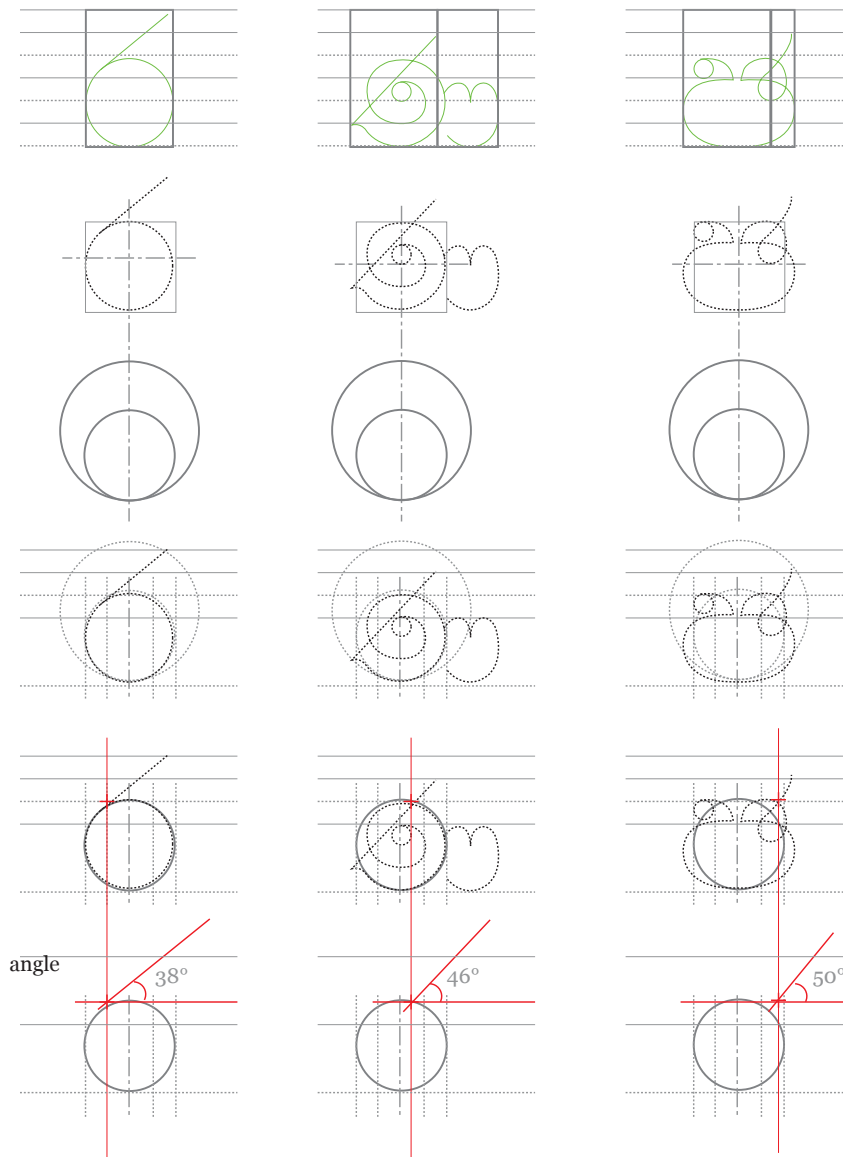


Figure 6.13: Root letter 08- *ra*(ó)

9. Descending stroke primitive 01- The least number of letters are found among the descenders, and among 3 out of 5 fall into the category of unique letters. To represent the most basic descender stroke primitive, the letter *u* (e) is considered as the 9th root letter. By identifying the curve of the circular grid, two unique letters can be generated *la* (e), *la* (e). Thus, this gives the descending stroke parameter for the other descenders.

Composition of the descender stroke primitive 01

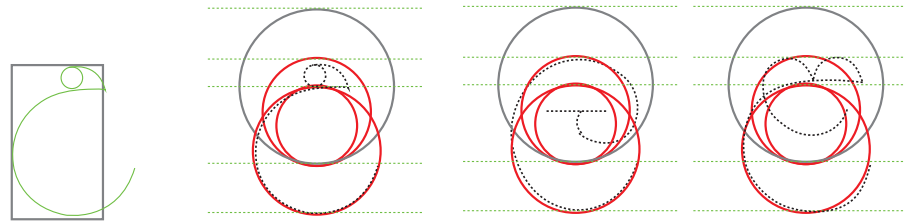


Figure 6.14: Root letter 09- $u(\text{උ})$

10. Descending stroke primitive 03 – The last root letter is represented with the letter *da* (දා). Placing two small circles, one on top of the other, standing on the descender line or hanging from the eye line, can create this stroke primitive. This grid structure can be used to generate two unique letters *a* (අ) and *i* (ඉ) (both vowels).

Even though the root letters were based on the main stroke primitives, all of the eye found within the Sinhala alphabet is included, when selecting the most appropriate letter to represent the circular shapes of the grid.

Composition of the descender stroke primitive 03

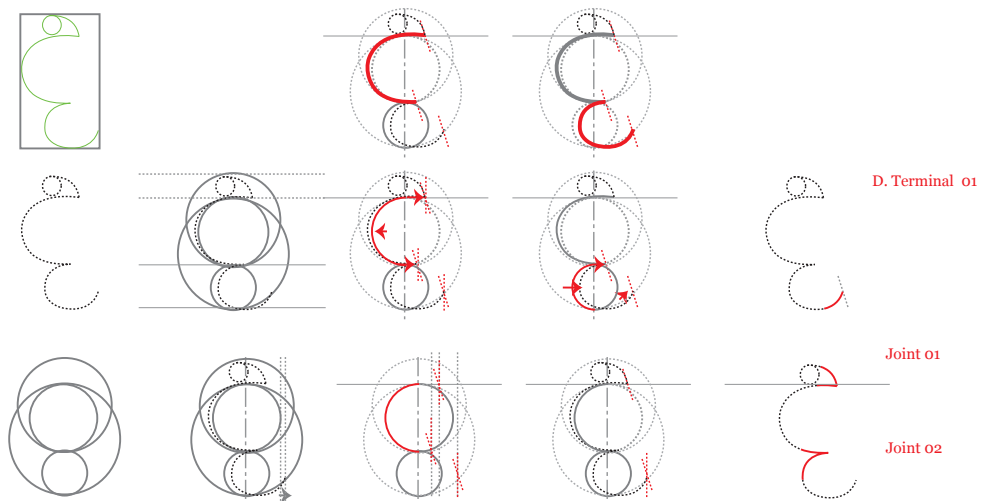


Figure 6.15: Root letter 10- $da(\text{දා})$

Results of the Root letter set 01 and 02

Using the two above methods we arrived at two sets of root letters. And the RL 01 is *nya* (ඤ), *nja* (ඡ), *na* (ඣ), *jha* (ඤ), *cha* (ජ), *a* (අ), *iru* (ඍ), *ilu* (ඞ), *nda* (ඹ), *ka* (ක) and RL 02 is *pa* (ප), *ga* (ග), *ka* (ක), *ma* (ම), *nda* (ඹ), *ba* (ඔ), *ta* (ඨ), *ra* (ඊ), *u* (උ), *da* (ඌ).

6.4 Competency of Both Methods to Identify the Sinhala Root Letters

Since both sets of RL are results of two different methods, each set's competency is being tested according to two criteria, which are listed below.

1. The number of letters each RL set generates
2. The number of properties each RL set generates

Having unique letters (Table 6.1) within the root letters is controversial to the concept of 'root letters', as the RL should root out the maximum number of letters from it. Therefore, the unique letters were omitted in both sets. The results were such that, 3 unique letters were found in RL 01 and none in RL 02. By omitting the unique letters found in RL 01 It was concluded with: ඤ, ඡ, ඤ, ජ, ඍ, ඞ, ක, ඔ, ඨ, ඊ and RL 02 continued as before: RL 02 is *pa* (ප), *ga* (ග), *ka* (ක), *ma* (ම), *nda* (ඹ), *ba* (ඔ), *ta* (ඨ), *ra* (ඊ), *u* (උ), *da* (ඌ).

6.4.1 Maximum number of Letters each Set Generates

The sample cards (Figure 6.3) helped to understand an overview of each letter and the letters that share the most number of property in ascending order. The listing of the three most appropriate letters of each root letter helped to calculate the total number and the list of letters each RL can generate. As a result we find a range of 05-15 letters generated by RL 01 and a range of 20-30 letters generated by RL 02.

The limit to the 05-15 letters was due to two reasons;

1. The identified RLs were among the generated set of letters,
2. The repetition of the same set of letters among most RLs.

To justify this situation, all letters that were categorized in ascending order as illustrated in Figure 6.5 (RL 01 – letters with maximum to minimum properties) were tabulated. This was analyzed according to the occurrence of the generating

letters. For example, if the first RL of RL 01 (*nya* (ඤ),) generates ඌ, ඛ, ඞ none of these occurred (generated) letters will be considered as a root letter. This is examined row by row, by omitting the generating letters, leaving the next best option and leaving room to generate more letters. As a result the RL 01 set was re-arranged as *nya* (ඤ), *nja* (ජ), *iru* (ඤ), *nda* (ඳ), *kha* (ඳ), *tha* (ඞ), *o* (ඹ), *ndha* (ඪ), *da* (ඳ), *bha* (ඞ). Using this result it was tested again to identify the number of letters captured. The final result calculated 20-30 letters. Since the RL 02 does not have any of the generating letters as a RL, it continued as before.

6.4.2 Results of the Competency Test

Within the context of Dalvi's calculation method, the above re-arranged set of letters could be considered as the final set of RL 01. This set together with the RL 02 was tabled to identify the maximum number of properties captured within the root letters. 49 out of the 68 atomic properties were common among both sets but varied individually. Nevertheless, 40 out of 49 properties were captured under RL 01 and 41 under RL 02, giving an indication of both sets of root letters being competent.

In conclusion, the two methods used to identify the root letters for the Sinhala letters, presents two sets of root letters- RL sets 01 and 02. RL 01 was easily calculated, yet when it was tested on its competency against Dalvi's concept, the methodology needed to be re-adjusted. Therefore, the initial RL 01 was modified. It omitted the unique letters, and the letters that were repeated (generating letters). As result RL 01 comprised the following letters : *nya* (ඤ), *nja* (ජ), *iru* (ඤ), *nda* (ඳ), *kha* (ඳ), *tha* (ඞ), *o* (ඹ), *ndha* (ඪ), *da* (ඳ), *bha* (ඞ) and since there were no modifications to the methodology that generated RL 02, it continued as the following letters *pa* (ඵ), *ga* (ඟ), *ka* (ක), *ma* (ම), *nda* (ඳ), *ba* (බ), *ta* (ධ), *ra* (ඊ), *u* (උ), *da* (ඳ). The following table gives an overview of the competency of RL 01 and 02. Therefore, either one can be used as the RL for Sinhala, but its preferences can only be tested when applied to the typeface design process, and it is left for further study.

Root letters for Sinhala: evaluation	Unique letters	Max letters - range	Max properties
RL 01 – initial calculation	3	05 -15	NA
RL 01 <i>nya</i> (ඤ), <i>nja</i> (ඞ), <i>iru</i> (ඞෂ), <i>nda</i> (ඞඳ), <i>kha</i> (ඞඳ), <i>tha</i> (ඞඳ), <i>o</i> (ඞඳ), <i>ndha</i> (ඞඳ), <i>da</i> (ඞඳ), <i>bha</i> (ඞඳ)	0	20 -30	40/49
RL 02 <i>pa</i> (ඞඳ), <i>ga</i> (ඞඳ), <i>ka</i> (ඞඳ), <i>ma</i> (ඞඳ), <i>nda</i> (ඞඳ), <i>ba</i> (ඞඳ), <i>ta</i> (ඞඳ), <i>ra</i> (ඞඳ), <i>u</i> (ඞඳ), <i>da</i> (ඞඳ).	0	20 -30	41/49

Table 6.2 : Root letter 01 and 02 evaluation

At the conclusion of this experiment and in achieving the objective, we learnt the following observations and findings:

Dalvi's calculation method –The understanding of this calculation method was based on the concept of root letters, meaning that the identified letters needed to contain the maximum properties to generate an entire font. Therefore, even if the initial findings on the RL 01 contained the maximum properties, the key letters include unique letters. As a result the number of letters this set could generate was limited. Thus, by justifying this by re-adjusting the methodology – a set of root letters was arrived at.

The proposed grid method –This can be considered as another method to identify root letters for a script. With the grid and the properties in order, one can identify the root letters. Testing this method on another script is left for further study.

The proportions of the Sinhala letter –The finding of this experiment was based on the typeface proposed by the NEC. It is a mono-linear letter that gives a clear view

of the structure and the composition of the letter, but not the proportions of the letter and its stroke weights. Therefore, to identify the proportions of the Sinhala letter one could analyze it with other typefaces on the proposed grid.

Unique letters for Sinhala –All letters are created with a combination of strokes and properties. Certain properties are limited to certain letters, making them unique among the other properties. During this study, a set of 10 letters that can be considered as unique letters among the rest of the letters were identified. This is the first study done to develop a methodology to identify the unique letters for Sinhala.

Appropriate set of root letters for Sinhala –The two sets of root letters are used to fulfill the purpose of accelerating the type design process. Yet, the question of the most appropriate or favored among the type design students, professionals is still to be tested and left for further study.

Root letters –One can use any method to arrive at a set of key letters. There is no definite process to identify it, but the methods used here were an option to generate the key letters for any other script. Yet, in order to identify such letters, the most essential variable is the defining visual properties of a letter. Another important aspect is that there is no fixed rule to use the findings (root letters), as it is only a simple guide to accelerate the process of type design.

6.5 Summary and conclusion of the chapter

In this chapter, we introduced the root letters for Sinhala type design based on the findings of the factors that constitute the Sinhala anatomy. We demonstrated the significance of knowing the distinct visual properties of each Sinhala letter in identifying the root letters.

Dalvi's calculation method is a pioneer experiment and the only proposal applied to Indic script. The method identifies the minimum set of letters that have the maximum visual properties. Therefore, this method was adapted to identify the root letters for Sinhala. To calculate the root letters, the main variable was the visual properties of the selected (script) letterform. Dalvi's experiment consisted of

Devanagari letter properties, and the author experimented on the identified visual properties of the Sinhala letter. Yet, both these scripts arrived at identifying the visual properties on two different approaches. Therefore, the competency of both methods were tested and reviewed before presenting the root letters for Sinhala type design.

The initial findings on the RL include unique letters; this was identified as a blunder in the method, when adapted to Sinhala properties. Therefore, by re-adjusting the methodology – a set of root letters was identified and the letters consisted of letters with multiple visual properties. The other method proposed by the author, the proposed grid method, consisted a set of root letters with the least number of visual properties. Both sets are presented as RL 01 and RL 02 to be adopted based on the choice of the type designer when designing Sinhala typefaces. In conclusion we were able to successfully demonstrate and validate the practical applicability of the theoretical framework for Sinhala anatomy.

CONCLUSION

We introduced that this thesis presents various knowledge-building activities to develop Sinhala typographic epistemology. To achieve this we build upon the fundamental knowledge of the anatomy of type. The key components of the anatomy; such as visual properties of letterforms, visual variations of typefaces, reference lines, grids and typographic vocabulary among Sinhala and other typographic practices were discussed. In comparison to the standardized typographic systems, we identified and justified the spares typographic knowledge in Sinhala. Therefore, this epistemological study aimed at examining morphological characteristics of Sinhala letters that articulates the anatomy through a historical outline on Sinhala typefaces. As a result, the thesis focused on two major areas: the anatomy of Sinhala type and the historical development of Sinhala typefaces.

Over the centuries, the Sinhala letter transformed from the 7th century within several mediums to arrive at the present letterform and to a typeface. To understand this phenomenon, epigraphists and linguists have documented the Sinhala letterform. The epigraphical viewpoint is documented until the 15th century and, the language specialists limit it to a linguistic angle. The letter that metamorphosed into a typeface is rarely documented as a specialized subject, but we find rudiments of literature on typefaces documented in discussion on the development of the press, and its technological changes. However, the existing documentation on the Sinhala letter does not adequately describe the Sinhala anatomy. Another aspect we identified is the informal practices in the designing of Sinhala typefaces, as the process was confined to individuals and had developed as family businesses that lead to an undocumented, informal and confined Sinhala type design process.

7.1 Objective

At present, there exists a gap of knowledge on Sinhala typography, therefore, the present study examined the following questions:

1. What are the existing theories on Sinhala typography? What are the anatomical features that describe the Sinhala letter? what terminology is used to define these morphological features of the Sinhala letter?
2. Can we expand and build a theoretical framework that can present the various aspects of Sinhala anatomy?
3. What are the current systems in use that describes letter-parts, visual variations and terminology? can that be articulated as formal knowledge in type designing? If yes how can we validate it?

To address the above questions, the thesis was organized according on the above three areas and synthesized into three parts: defining the problem, identification of the anatomical features and testing of the theory. Each section is discussed below, within the two major areas: the anatomy of Sinhala type and the historical development of Sinhala typefaces.

7.2 Defining the Problem

To define the research problem, we looked at existing theories on the anatomy of type. In comparison to standardized typographic systems (such as Arabic, Devanagari, Latin, Tamil) we understood that there exists a relationship among each letterform based to the script, and that the specified letterforms and their distinct visual properties are the essential components of type and typography. Also, we discussed that these visual properties, together with certain elements such as reference lines, grids, and vocabulary, builds a specified system relevant to a script and this system is defined as the anatomy of type. The elements that contribute to the anatomy were discussed in detail in chapter four across other scripts. Therefore, we were able to define the elements of the anatomy of type, and cross-examined that these terms with existing literature on Sinhala. The following table indicates the elements of the anatomy based on selected standardized typographic systems of the world.

Contributing elements of the anatomy of type	Specified to script and common within the domain knowledge of typography				
	Arabic	Bengali	Devanagari	Latin	Tamil
Reference Lines	Yes (5 lines)	Yes (6 lines)	Yes (6 lines)	Yes (4 lines)	Yes (4 lines)
Base-character height	Yes	Yes (x-height)	Yes (Kana-height)	Yes (x-height)	Yes (pa-height)
Terminology	Yes	Yes	Yes	Yes	Yes
Letterforms (distinct visual properties)	Yes	Yes	Yes	Yes	Yes
Visual variations of typefaces (based on the tool and hand)	Yes	Yes	Yes	Yes	Yes

Table 7.1 Contributing elements of the anatomy of type specified to script

With the knowledge of the elements of the anatomy, a number of literature surveys were conducted specific to Sinhala. Therefore, in the second part of the chapter four (4.2) we continued on the search towards the existing practices of reference lines used in Sinhala. As an outcome we arrive at multiple uses of reference lines (4 lines, 5 lines and 6 lines) yet, none of these reference lines catered to a typographic need. The grid for Sinhala was proposed at this stage based on a visual cluster analysis, which presented the closest geometric shape for Sinhala. Together with the grid and reference line, the base character height for Sinhala was established and the base character height with a *pa*-height for Sinhala.

The third element, the vocabulary was discussed in chapters two and five. Yet, the survey on the existing vocabulary was discussed in chapter two (2.4). The survey captured how experts on Sinhala language and other relevant subject areas termed

the Sinhala letter part. The survey was conducted to understand the existing terminology. With the results of this survey, we identified the informal practices: the multiple uses of terms to describe one letter-part; limited knowledge on the visual description of Sinhala letterforms relevant to typography. It was evident that the reason for this knowledge gap was the lack of documentation of typefaces.

The most significant and the essential element of the anatomy is the morphological characteristic of letterforms. Therefore, in chapter three (3.2) we conducted another survey on the first Sinhala typefaces and the letter structure. The visual analysis of the survey was conducted across the existing limited knowledge on the visual features of the Sinhala letterforms. The outcome of this resulted in a genuine need to understand letter properties. This was then followed up with another literature survey on the chronological development of the Sinhala typefaces.

At the end of all the literature and visual surveys we were able to define the problem, and it was summarized into three main aspects:

- (a) The inadequate knowledge on the visual description of Sinhala letterforms.
- (b) Lack of documentation on Sinhala typefaces and the inclusive type design process.
- (c) The anatomy of other scripts that can influence Sinhala typography.

All this is discussed and compiled across chapter 02, 03, 04 and 05, and a summary of the survey as discussed above is tabled below to access the relevant survey within the chapters.

Defining the problem	Methodology	Location within the thesis	Summarized aspects
Existing knowledge on terminology	Literature survey	Chapter 2.4	(c)
Existing knowledge on visual description of letterforms	Visual survey	Chapter 3.2	(a)
Existing knowledge on Sinhala typefaces	Literature survey	Chapter 3.3	(b)

Existing knowledge on reference lines and base character height	Literature survey	Chapter 4.2	(c)
Existing knowledge on grid	Visual cluster analysis	Chapter 4.3	(c)

Table 7.2 List of surveys conducted to define the problem

7.3 Identification of the anatomical features

This part of the thesis formulated the main contribution of the study. It focused on identifying the anatomical features of Sinhala. By doing so, it worked as a solution towards the existing non-standardized epistemological knowledge on Sinhala typography.

This part comprised of three main components: The first part discussed the distinct visual properties (DVP) of Sinhala letterforms, followed in the second part by presenting a vocabulary to define the DVP. The third part discussed the visual variations of Sinhala typefaces to sum up the anatomical features.

To identify the distinct visual properties of Sinhala letterform, we developed a combined research method: research spiral method and visual analysis method. As a result, we were able to identify the visual properties that are common among all Sinhala letters and also those that are unique among the rest. Meanwhile, we listed out all the visual properties that are common within Sinhala letters as DVP. The DVPs were then given tentative terminology for identification purpose, which then lead to the development of new nomenclature. With the use of a non-expert and expert interview method, the tentative terminology was refined. The proposed terminology was then cross analyzed, with existing typographic terms used in other scripts. As a result, the identified DVPs were given a standardized set of terms that can be used in typographic practice.

The DVPs were then visually analyzed across multiple Sinhala typefaces. The selected typefaces for the analysis were an outcome of the documentation of the chronological development of typefaces in chapter three. Each of the time periods (based on a literature survey) was analyzed individually. Three different survey

methods helped to identify 15 typefaces as type specimens and their meta-data as in chapter five (5.2). The 15 typefaces were selected with 4 type specimens from the pre-newspaper era, 6 from the early newspaper era, and 5 from the modern newspaper era. To achieve this, 8 typefaces were observed among the pre-newspaper era, 36 observed in the early newspaper era and 70 typefaces observed in the modern newspaper era.

Thereafter, the selected 15 type specimens were used to complete this section through a visual survey. The survey documented the visual variation of typefaces based on the tool and hand, and was further discussed on the flesh of the typeface, the grey value, contrast, axis, terminals and counter spaces. It was then summed up by presenting the visual variations of each of the DVPs and their behavior within these selected Sinhala typefaces.

At the conclusion of identifying the anatomical features of Sinhala, we can now summarize the overall structure of the theoretical framework. The flow of the development of the framework is as follows:

Stage one and two: Defined the problem by discussing the existing knowledge on Sinhala typography based on available literature sources. It was further discussed with the growth of the number of Sinhala typefaces and the establishment of meta-data of Sinhala typefaces.

Stage three: The distinct visual properties of each Sinhala letter were captured based on a hybrid methodology (research spiral method with visual survey method). It defined a set of reference lines and a grid for Sinhala type. As a result, 19 distinct visual properties were identified with 59 sub-properties (chapter four). These identified distinct visual properties contributes to the fundamental knowledge of Sinhala typographic educations.

Stage four: To establish the anatomy of Sinhala type with the identified visual properties, nomenclature was analyzed. A survey was conducted with expert and

non-expert interviews. As a result, the visual properties of the Sinhala letter were further refined (chapters four and five).

Stage five: To finalize on the anatomy of Sinhala, the identified visual properties were further analyzed across existing typefaces, to understand the visual variation of typefaces and stylistic approaches (in chapter five). At this stage the contributing factors that make the anatomy: reference lines, *pa*-height, letter structure (chapter four), nomenclature, morphological features of typefaces based on the visual variations (chapter five) were established.

7.4 Testing of the theory

This part discussed the testing of the theoretical knowledge built on the previous two parts. To achieve this we selected the DVPs identified under the anatomical features and tested to develop the root letters for Sinhala. The root letters are considered as the key set of selected letters that contain common visual properties among other letters. Using two methods: a qualitative and quantitative method, we were able to achieve this. The quantitative method was tested on an existing theory (Dalvi's – minimum letters with maximum properties) and the qualitative method was the testing of the grid proposed in chapter four.

The first method tabularized the distinct features and categorized them by using two techniques: ranking data and descriptive data. The second method was based on a visual analysis by reconstructing the letters on the proposed grid. The competency of both methods was tested quantitatively to identify the minimum letters that have the maximum letter properties. It was tested on the maximum letter range and the maximum property range the letters can generate. Results of both methods convey similar results using two different approaches.

At the end of testing the theory, we were able to justify that the theoretical framework on the anatomy of Sinhala type, resolved issues encountered in the type design process. For example identifying the key set of selected letters that contain common visual properties to initiate an academic type design process. Through the

development and the assessment of this theoretical knowledge, we suggest that this knowledge expands into typographic education and more specific to Sinhala typography. It also has the capacity to expand into new research opportunities. Nevertheless, we demonstrate the significance of this research within different context:

- Subject of typography is taught in most design schools/ Institutes/ Universities in Sri Lanka but the syllabuses are confined to Latin typography due to available material. Since the research knowledge contributes to the fundamentals of Sinhala typography (the anatomy), this fills an existing gap in Sinhala typographic education.
- Most digital typefaces available today are designed by a limited set of designers, they either copy existing letterpress typefaces, or experiment with type with no academic background. As a result most existing typefaces lack originality or either have technological issues in using the typefaces. Yet, with the knowledge on meta-data of early typefaces we are able to locate the origin of most letterpress typefaces and to acknowledge early Sinhala type designers and their work. This knowledge contributes towards Sinhala type classification.
- The professionals who are designing Sinhala typefaces work within a confined environment therefore we find no common vocabulary to describe, understand, analyse Sinhala type. The research built on type nomenclature that can be used within the type community and professionals, so we all could relate to one language.

7.5 Summary of the major findings

The findings and the significance of the research is discussed here in the same order as they appear in the thesis:

The background studies are presented in chapter two and three.

Through the background study in Chapter Two, we show that the Sinhala letter were derived out of a long tradition of writing; yet there is no formal documentation on the structure (graphical description) of the Sinhala letter. The existing knowledge on the structure of the letter is limited to epigraphic findings and concludes by the 15th

century. This is in contrast to the domain knowledge that exists other typographic systems. Further, a survey on the existing use of terminology that describes the Sinhala letter parts, explained that the existing practices are based on using terms to describe the visual form (visual expression) and as a part of the representative sound of the letter. Yet, the existing terminology used to describe these letter parts was limited to vowel signs and non-alphabetical signs. The terming was based on the expert's choice, and not on a formalized typographic knowledge system.

The background study in Chapter three discussed the development of the Sinhala typefaces as part of socio-political reasons and as a result, we find an absence of literature on early Sinhala typefaces and its meta-data. As a result of this absence, there is also an absence of literature on typographic knowledge on Sinhala. Based on a literature survey on the development of the printing press in Sri Lanka, we were able to present the technological changes and chronological development of the growth of Sinhala typefaces, till it reached the current digital typeface stage.

A literature study was conducted in Chapter Four on the anatomy specific to other scripts to capture the existing knowledge on the Sinhala anatomy, and it identified the ambiguous terminology on the Sinhala anatomy and the need to identify the morphological characteristics of each Sinhala letter. Using the research spiral method, each letter was considered as a case, and analyzed to capture the distinct nature of each letter and the common visual properties in Sinhala.

In Chapter Five, a theoretical framework on the anatomy of Sinhala was summed up. A survey was conducted on building terminology to define the Sinhala letter parts based on an experts and non-experts interviews. This finding was consolidated with the knowledge on typographic knowledge systems of other scripts. This chapter also identified typefaces across a timeline and proposed meta-data of typefaces. These typefaces were considered as type specimens for a visual survey to document the visual variation of Sinhala typefaces. The anatomical features were summed with a visual survey across select type specimens to establish the use of tool and hand in Sinhala typefaces.

Chapter Six tested the theoretical framework built upon the previous chapters in identifying the root letters for designing Sinhala type. We argued that identifying of the root letters was based on the theoretical framework and that it allowed the use of knowledge and understanding of Sinhala letterform. This validation process discussed within this chapter resulted with two sets of root letters that can be used in designing Sinhala type. It also identified the morphologically unique letters among the Sinhala letters.

7.6 Contribution of New Knowledge through the research

The most significant contribution of the thesis and its primary objective was to create a theoretical framework for Sinhala anatomy. In order to achieve this goal, the following findings together with the main contribution are presented below:

- Establishing the anatomy of Sinhala type: this included the relevant elements of the anatomy specific to Sinhala, which includes:
 - Distinct visual properties of each Sinhala letter
 - Visual variations of Sinhala typefaces
 - Reference lines and grid for Sinhala
 - Terminology to define Sinhala letter properties
 - Defining the base character height for Sinhala

- Defining the identified distinct visual properties of Sinhala type and listing out the number of letters each property shares.

- Contribution towards the history of Sinhala typefaces and printing
 - Demarcation of Sinhala printing phases based on the technological changes of the Sinhala type, period, and purpose of print.
 - Time based classification of early typefaces and meta-data.
 - Chronological visual documentation of early printed typefaces.

- Identifying and defining of Sinhala letterforms and its composition
 - Visual composition of non-alphabetical consonant sign.
 - Visual composition of half-nasals (*Sannaka*).

- Visual composition of conjunct combinations, conjunct consonant and ligatures.
- Recognizing root letters for Sinhala type design process and the unique letter within Sinhala.

7.7 Limitations of the study

The limitations of the thesis can be pointed to several aspects of a typeface. Yet, the thesis dealt with only regular, text typefaces and did not consider bold, cursive (italic), and display typefaces. The type specimens selected for the study were based only on locally accessible data that were systematically archived at the Colombo National Museum Library, the Department of National Archives, the National Library, Colombo and the Sri Jayawardenapura University Library. The theoretical framework on the anatomy of Sinhala was built solely on the Sinhala letters and not on its vowel sign combinations, non-alphabetical consonant signs, consonant clusters or ligatures. The validation of the theoretical model only tested the distinct visual properties in discovering the root letters for Sinhala, whereas other anatomical elements were disregarded.

7.8 Possibilities for future work

This research would benefit typographers, type historians, type designers and type researchers in understanding the Sinhala letterform and the anatomy of Sinhala typography. The knowledge would enhance the subject of Sinhala typography and the type design process relevant to Sinhala for the future. Apart from this, there are plenty of research opportunities that open up within Sinhala typography, as this research can be considered a significant research in the field of Sinhala typography. Following are some of the research opportunities:

Type Design opportunities with the manipulation of the proposed grid

The thesis proposed a grid to analyze Sinhala letterforms and took the closest geometric shape: the circle, to create it. Yet, Sinhala letterforms are not mathematically symmetric or compared to an ideal geometric circle. By manipulating

the proposed grid we are able to ideate and create new Sinhala typeface designs. The manipulation includes the adjusting of the space between reference lines and/or changing the shape of the circle. This idea was tested on student work, where the circular grid was replaced with a manipulated shape within the reference lines. The shape was inspired from an existing logo for which the student wanted to design a new body text (figure 7.1). Taking the grid as the base for the new typeface design, it was further applied in generating the rest of the letterforms. A sample of the generated letterform for the new typeface is attached in figure 7.2. Such manipulation of the grid can be applied in creating new typefaces and provide several type design opportunities.

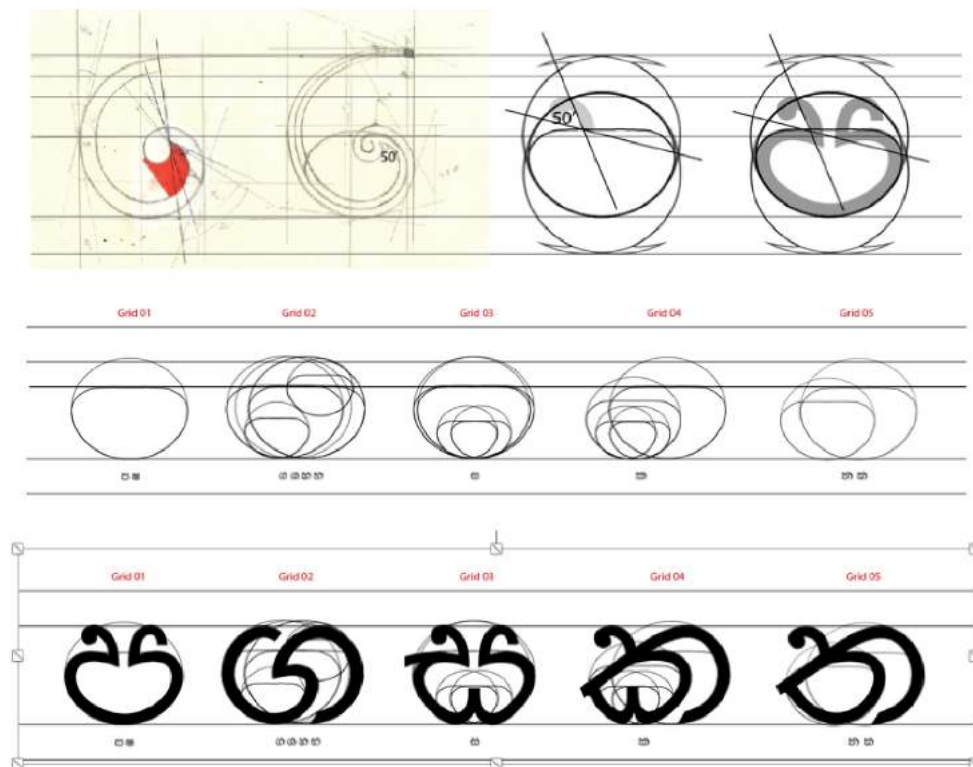


Figure 7.1: Manipulation of the proposed grid to create a new typeface

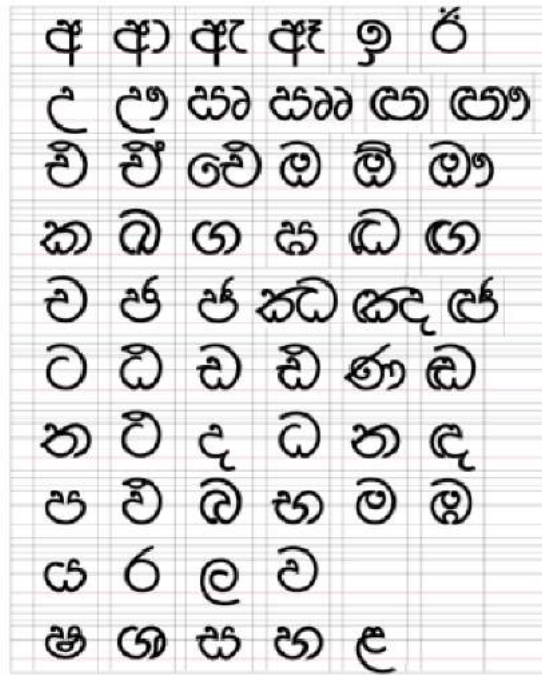


Figure 7.2 : Sample of the designed typeface

Application of letter-parts in understanding Sinhala calligraphy styles

There is a knowledge gap among the calligraphic forms of Sinhala, as there is no documentation or research conducted on the graphical development of Sinhala calligraphic forms. The study on the letter parts and the listing of similar letters identified in this thesis helps to analyze letterforms against similar letters and their distinct visual properties. A student research was conducted to test the practical application of this knowledge and to apply it in future work. The analysis of the calligraphic form focused mural calligraphy in selected temple shrine rooms, South of Sri Lanka. The grouping of similar visual property identified in this research was listed out for the analysis of calligraphic letterforms (figure 7.4). The observation was based on how one visual property is portrayed in different calligraphic styles. These are then further analyzed to present the formation of selected mural calligraphy. Classifying styles based on its visual character can expand the knowledge further study.

Each distinct visual property listed out recognize the behavior of the stroke, and this analysis contributes to the knowledge on the visual variation of Sinhala calligraphic forms. A sample of the analysis is found below.

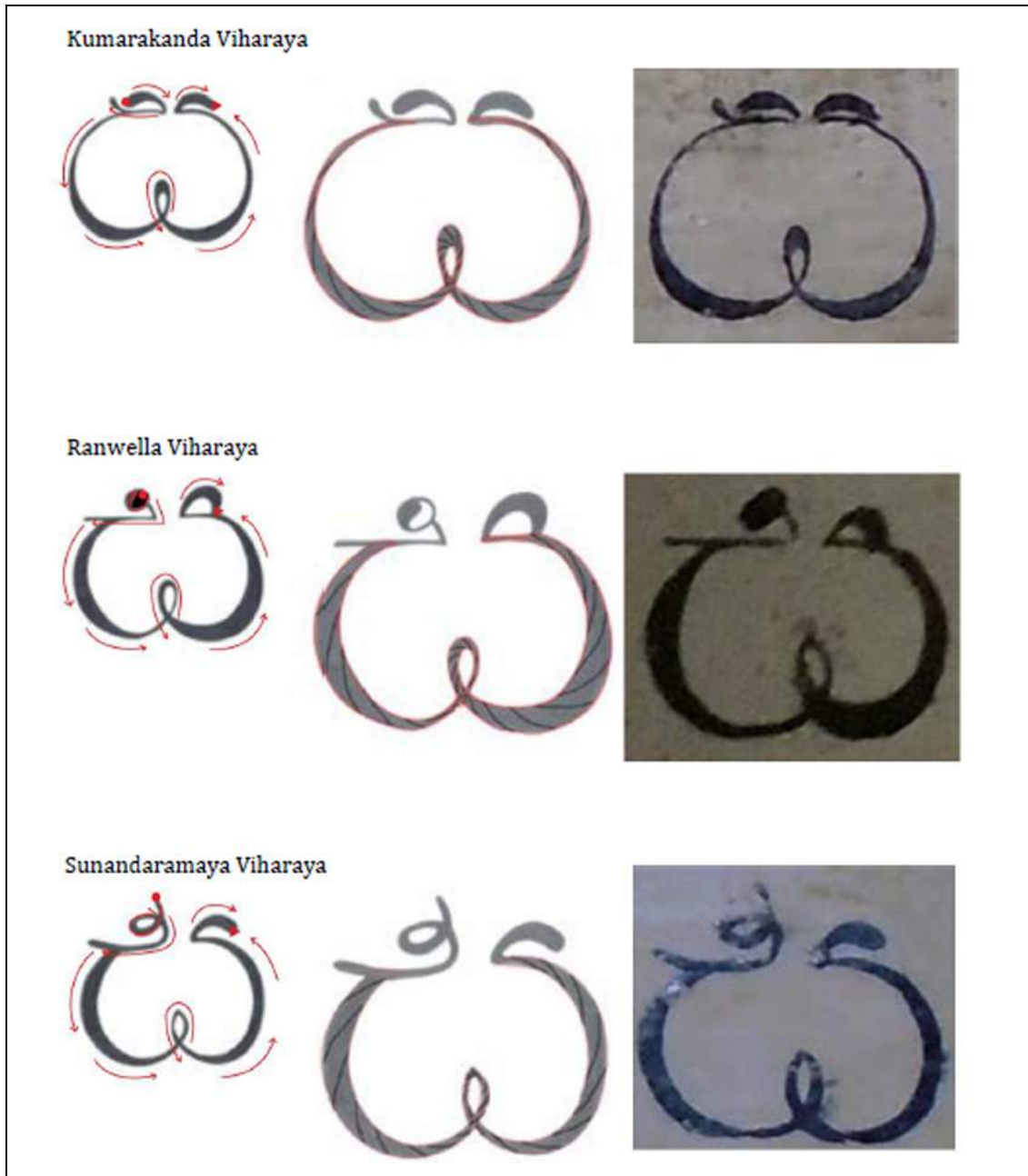


Figure 7.3 : Sample of the analysis of Sinhala calligraphic forms of three temples

Letter and typeface recognition software

The data on the distinct visual properties of each Sinhala letter provides the list of visual properties specific to each letter. Therefore, this data could be programmed to make software to construct a basic skeleton of a Sinhala typeface. This digitized data could also be used to build software on letters recognition.

Development of Legibility studies

The distinct nature of each Sinhala letter presented in the research spoke of how each letter becomes unique by itself due to the formation of these visual properties. Therefore, by manipulating the strokes that make these visual properties we are able to design new typefaces and yet, hold on to the legibility of the letterforms.

Reviving of early Sinhala typefaces and its historic data

At present we find very little evidence on the early typefaces and its precise meta-data. Since the documentation of the meta-data was established through this research, we are able to locate the original prints of the letterpress typefaces. As a result of this, earliest typefaces can be revived into digital typefaces for current day use.

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ANNEXURE 2.1

The development of the number of characters according to the chronological divisions of the Sinhala language time periods

3 BC -7/8AD Sinhala Prakrit stage	7/8AD –18 AD Sinhala Medieval stage	7/8AD –18 AD Sinhala Medieval stage	18 AD – today Sinhala current stage
<i>Prakrit hōdiya</i>	<i>miśra Sinhala hōdiya</i>	<i>Sidath Sangara hōdiya or Suddha Sinhala hōdiya</i>	<i>Modern / Contemporary Sinhala hōdiya</i>
අ අ ට අ අ ඉ ඊ උ ඌ ඍ ඎ ඏ ඐ	අ අ ට අ අ ඉ ඊ උ ඌ ඍ ඎ ඏ ඐ	අ අ - - ඉ ඊ උ ඌ - - - -	අ අ අ අ ඉ ඊ උ ඌ ඍ ඎ ඏ ඐ
උ උ - - - - ඌ ඌ - - - -	උ උ ඍ ඎ ඏ ඐ ඌ ඌ a ඍ ඎ ඏ ඐ	උ උ - - - - ඌ ඌ - - - -	උ උ ඍ ඎ ඏ ඐ ඌ ඌ a ඍ ඎ ඏ ඐ
එ ඒ - ඉ ඊ	එ ඒ ඉ ඊ උ ඌ	එ ඒ - ඉ ඊ	එ ඒ ඉ ඊ උ ඌ
ක - ග - - -	ක ඛ ග ඝ ඞ ඟ	ක - ග - - -	ක ඛ ග ඝ ඞ ඟ
- - ජ - - -	ච ඡ ජ ඣ ඤ ඦ	- - ජ - - -	ච ඡ ජ ඣ ඤ ඦ ට
ඊ - ඩ - ණ -	ඊ ඨ ඩ ඪ ණ ඬ	ඊ - ඩ - ණ -	ඊ ඨ ඩ ඪ ණ ඬ
ත - ඳ - න -	ත ඵ ඳ ධ න ඹ	ත - ඳ - න -	ත ඵ ඳ ධ න ඳ
ප - ඛ - ම -	ප ඵ ඛ න ම -	ප - ඛ - ම -	ප ඵ ඛ න ම ඹ
ය ර ල ව	ය ර ල ව	ය ර ල ව	ය ර ල ව
- - ස න ළ -	ශ ෂ ස න ළ -	- - ස න ළ -	ශ ෂ ස න ළ ට
අ - - - -	අ ෝ - - - -	අ ෝ - - - -	අ ෝ - - - -
ආ - - - -	ආ ෝ - - - -	ආ ෝ - - - -	ආ ෝ - - - -
V - 12 + C - 20 = characters 32	V - 18 + C - 36 = characters 30	V - 10 + C - 20 = characters 30	V - 18 + C - 42 = characters 60

ANNEXURE 2.3

Table of Existing vocabulary

Existing vocabulary				
	Variables	Expert one : Epigraphy	Expert two : language	Expert three : Standardization of language
vowel signs				
The sign for 'pure' consonant	<i>Hal kirima</i> - හල්කිරීම	y	-	y
	<i>Viramaya</i> - විරාමය	y	-	y
	<i>Kodiya</i> - කොඩිය	-	y	y
	<i>Hal Pilla</i> - හල් පිල්ල	-	y	-
	<i>Rahena</i> - රෑහැන	-	y	y
	<i>Al lakuna</i> - අල් ලකුණ	-	y	-
<i>ā</i> (ආ),	<i>ā pilla</i> - ආ පිල්ල	y	y	-
	<i>ā la pilla</i> - ආල පිල්ල	y	y	y
	<i>ā karanshaya</i> - ආකාරාංශය	y	-	-
<i>æ</i> (ඇ)	<i>æda pilla</i> - ඇද පිල්ල	y	y	y
	<i>Keti æda pilla</i> - කෙටි ඇද පිල්ල	-	-	y
	<i>ækaranshaya</i> - ඇකාරාංශය	y	-	-
	<i>Ædaya</i> - ඇදය	y	y	-
	<i>æ pilla</i> - ඇපිල්ල	-	y	-
<i>ǣ</i> (ඈ)	<i>deerga æda pilla</i> - දීර්ඝ ඇද පිල්ල	y	-	-
	<i>degu æda pilla</i> - දිගු ඇදපිල්ල	-	y	y
	<i>dik æda pilla</i> - දික් ඇදපිල්ල	-	-	y
	<i>ǣ pilla</i> - ඈපිල්ල	-	y	-
<i>i</i> (ඉ)	<i>is pilla</i> - ඉස්පිල්ල	y	y	y
	<i>Keti is pilla</i> - කෙටි ඉස්පිල්ල	-	-	y
	<i>i pilla</i> - ඉපිල්ල	-	y	-
<i>ī</i> (ඊ)	<i>deerge īs pilla</i> - දීර්ඝ ඉස්පිල්ල	y	-	-
	<i>degu īs pilla</i> - දිගු ඉස්පිල්ල	-	y	y
	<i>Dik īs pilla</i> - දික් ඉස්පිල්ල	-	-	y
	<i>ī pilla</i> - ඊපිල්ල	-	y	-
<i>u</i> (උ)	<i>Pa pilla</i> - පාපිල්ල	y	y	-
	<i>Keti pa pilla</i> - කෙටි පාපිල්ල	-	-	y
	<i>u pilla</i> - උ පාපිල්ල	-	y	-
	<i>Keti kon pa pilla</i> - කෙටි කොන් පාපිල්ල	-	-	y
	<i>Keti vak pa pilla</i> - කෙටි වක් පාපිල්ල	-	-	y
<i>ū</i> (ඌ)	<i>deerga pa pilla</i> - දීර්ඝ පාපිල්ල	y	-	-
	<i>degu pa pilla</i> - දිගු පාපිල්ල	-	y	y
	<i>ū pilla</i> - ඌ පාපිල්ල	-	y	-
	<i>Dik kon pa pilla</i> - දික් කොන් පාපිල්ල	-	-	y
	<i>Dik vak pa pilla</i> - දික් වක් පාපිල්ල	-	-	y
<i>e</i> (ඒ)	<i>e karaya</i> - ඒ කාරය	y	-	-
	<i>kombuwa</i> - කොම්බුව	y	-	y
	<i>e pilla</i> - ඒ පිල්ල	-	y	-
<i>ē</i> (ඒ)	<i>ē karaya</i> - ඒ කාරය	y	-	-
	<i>kombuva</i> - කොම්බුව	y	-	y
	+			
	<i>viramaya</i> - විරාමය	y	-	y

	<i>hal kirima</i> - හල්කිරීම	<i>y</i>	-	-
	<i>Us pilla</i> - උස් පිල්ල	-	<i>y</i>	<i>y</i>
	<i>Udu pilla</i> - උඩු පිල්ල	-	-	<i>y</i>
	<i>e pilla</i> - ඒ පිල්ල	-	<i>y</i>	-
o (ඔ)	<i>e karaya</i> - එ කාරය	<i>y</i>	-	-
	<i>kombuva</i> - කොම්බුව	<i>y</i>	-	<i>y</i>
	+			
	<i>ā pilla</i> - ආ පිල්ල	<i>y</i>	-	-
	<i>æla pilla</i> - ඇල පිල්ල	<i>y</i>	-	<i>y</i>
	<i>ākaranshaya</i> - ආකාරාංශය	<i>y</i>	-	-
	<i>o pilla</i> - ඔ පිල්ල	-	<i>y</i>	-
ō (ඔ)	NO TERM	<i>y</i>	-	-
	<i>kombuva</i> - කොම්බුව	<i>y</i>	<i>y</i>	<i>y</i>
	+			
	<i>dik ada pilla</i> - ඳික් ඇදපිල්ල	<i>y</i>	<i>y</i>	<i>y</i>
	<i>ō pilla</i> - ඔ පිල්ල	-	<i>y</i>	-
r(සා)	NO TERM	<i>y</i>	-	-
	<i>Gata Pilla</i> - ගැට පිල්ල	-	<i>y</i>	<i>y</i>
	<i>r Pilla</i> - සා පිල්ල	-	<i>y</i>	-
	<i>keti gata Pilla</i> - කෙටි ගැට පිල්ල	-	-	<i>y</i>
r(සා)		none	-	-
	<i>Degu gata Pilla</i> - ඳිගු ගැට පිල්ල	-	<i>y</i>	<i>y</i>
	<i>Degu r Pilla</i> - ඳිගු සා පිල්ල	-	<i>y</i>	
	<i>Dik gata Pilla</i> - ඳික් සා පිල්ල	-	-	<i>y</i>
au (ඔ)		none	-	-
	<i>Gayanu kiththa</i> - ගයනුකිත්ත	-	<i>y</i>	<i>y</i>
	<i>au Pilla</i> - ඔ පිල්ල	-	<i>y</i>	-
ai (ඔ)		none	-	-
	<i>Kombu deka</i> - කොම්බුව දෙක	-	-	<i>y</i>
	<i>ai Pilla</i> - ඔ පිල්ල	-	<i>y</i>	-
Combined consonant signs				
	<i>Yansaya</i> - යාංශය	<i>y</i>	<i>y</i>	<i>y</i>
	<i>Rakaranshaya</i> - රකාරාංශය	<i>y</i>	<i>y</i>	<i>y</i>
	<i>Repaya</i> - රෙපය	<i>y</i>	<i>y</i>	<i>y</i>
	<i>Takaranshaya</i> - ටකාරාංශය	-	<i>y</i>	-
	<i>Dakaranshaya</i> - ඳකාරාංශය	-	<i>y</i>	-

ANNEXURE 3.1

Calligraphic Style A	Selected Letter forms
a ഏ pl.no.05 pl.no.11	
ga ഊ pl.no.05 pl.no.11	
ma മ pl.no.05 pl.no.11	
ra ര pl.no.05 pl.no.11	
ba ബ pl.no.05 pl.no.11	
i ഇ pl.no.05 pl.no.11	
la ല pl.no.05 pl.no.11	
la ല pl.no.05 pl.no.11	
fa ഫ pl.no.05 pl.no.11	
na ണ pl.no.05 pl.no.05	

Calligraphic Style A	Selected Letter forms
va വ pl.no.05 pl.no.11	
na ണ pl.no.05 pl.no.11	
pa പ pl.no.05 pl.no.11	
e ഐ pl.no.05 pl.no.11	
da ഡ pl.no.05 pl.no.11	
ja ജ pl.no.05 pl.no.11	
u ഉ pl.no.05 pl.no.11	
i ഇ pl.no.05 pl.no.11	
sa ഷ pl.no.05 pl.no.11	
a ഏ pl.no.05 pl.no.11	

Annexure 3.2

Post related positions and persons related to the Government Printing office		
Date	Name	Position
1796 - 1815	Frans de Bruin	Head Printer
1815 - 1831	Nicholas Bergman	Head Printer
1831 - 1832	J. Wootler	Head Printer
1832 - 1833	P.M. Elders	Head Printer
1833 - 1835	George Lee	Superintendent
1835 - 1836	Lieutenant Colonel Gray	Superintendent
1836 - 1844	P.L.De Vos	Superintendent
1845 - 1849	A. Joseph	Superintendent
1849 - 1872	William Skeen	Government Printer
	A. de Kretser	Head Printer
1881 - 1904?	G. J. A. Skeen	Government Printer
1906 -	H.C. Cottle	Government Printer
1911 Relocation		

Annexure 3.3

List of the observed books - pre-newspaper era							
Date	Identification code no.	Name of typeface	Composing type	(est.) Size	Name of publication/ print	Name of Printing press or publisher	Location and search code
1708		N/I	Woodblock		Grammatica of Singaleeshche taalkunst, Ruell Joannes		491.485 RUE 000476 RAS
1737		1, 2	MType		Placard		15/H4NM
1737		1			Singaleesch Gebeede Boek		
1739		1, 2, 3			Apage Nayake galavumkara Yesus Christus vahansege Sudhavu Avum - mathewus Markus Lukas yohhnenes...	<i>Printed at the Government Press</i>	
1744			MType		Singaleesch formulier book (Sinhalese handbook of Prayers)- Colombo		242. Ref.R.B 004452 RAS
1744			MType		Kort ontwerp van de lhere den waarheid ... in de Sinhalese tale = short account of the teaching of truth in the Sinhalese Language - Colombo Wetjelius, Johannes Philippus		207 Ref. RB WET 001188 RAS
1771/ 1780		1, 2, 3	MType	small	<i>Hetheylige Evangelium onses Heeren en Zaligmakers. Jesu Christi NA DE BESCHREVVINGE Van De Mannen Gods En H. Evangelisten Matteus, Marcus, Lucas en Joannes</i>		15/ I-04 (good copy) 15/ I 09
1813		4	MType		The Cingalese Translation of the New Testament of O.L.A.S.J.C. part I- Gospel according to St. Matthew	<i>Printed at Church Mission Press CTTA</i>	15/ I-11 NM
1815		4			A Grammar of the Cingalese Language by James Charter	<i>Printed at the Government Press</i>	SJP 3471
1817			MType		<i>Sakala janayage Galvima pinisa prakasha karena ladha age Swami vu galavumkara yesus Christusvahansege abinava givisuma</i>	<i>Printed at Church Mission Press</i>	225.55 W514 1318 USJP Lib
1817			MType		<i>NT - Abhinawa Givisuma Sri lankadeepayehi vu colomba puravarayehi bible samagama venvuvata Wesleyan mishanarivarunen poth achchugasana eistanayadi achchugasanaaldi.</i>	<i>Printed at WMP</i>	15/I-10NM
1819					<i>Bible - Shudhavu bibalaya- colomba puravarayehi bible samagama venvuven Sinhala bashavata pitapathkota achchu gasana ladi</i>	<i>Printed at WMP for Colombo Bible society</i>	SJP 220.55
1820- 1823					Old Testament (Tolfri's reprint according to Arangala?)		15 I-03
1820				Small size 1817 size	The Sinhalese Translation of the book of Psalms + Book of Proverbs - <i>Hethopadeshaya</i> + Book of Sirach - <i>Upadeshakaya</i>	<i>Printed at WMP for CABS</i>	15 I-02
1923	Rafeal				A discourse on the Nativity of our Lord Jesus Christ	Wesleyan Mission Press	
1824					The Christian Institutes; or the Sincere word of God: being a plai and impartial	<i>Printed at WMP</i>	9/N-10

					account of the whole faith and duty of a Christian collected out of the writings of the old and New testatment; Digested under proper heads and Delivered in the word of scripture by the right reverend father in God, by the right reverend father in God, Francis, late LORD BISHOP of CHESTER and by sanction of the District committee of the society for promoting Christian Knowledge, translated into Sinhalese, by the Rev. Armour		
1826	Rafeal				The Gospel according to Mattew by Samuel Lambrick and Thomas Browning	Church Missionary Press - Kotte	
1846				Small size 1817 size	The New Testament of our Lord and Savior Jesus Christ translated into Sinhalese from the Original Greek	Printed at Church Mission Press CTTA	15 I-13NM
1846					Shuddhavu Baibalaya (Holy Bible)	Printed at Church Mission Press CTTA	15 H-23NM 15 H-24NM
1854					Bible, O.T. Pentateuch (WMP)	Printed at WMP for CABS	221 BIB Ref.RAS 002420
1857					Apage galavumkara suwamivu yesus christusvahansege Aluth givisuma	Printed at WMP for CABS?	15/H-20NM
1860	Rafeal				Holy Bible translated in Sinhala	Wesleyan Missionary Press	
1862					Aluth givisuma namvu Shudha Liyavilla	Baptist Mission ?	15/H19
1881	Rafeal				Sinhalese Grammar by Rev. S. Coles		
1888					Shuddhavu Baibalaya (Holy Bible) 1885 Old 1888 NT	Printed at WMP for Colombo Bible society	15/I-01
1888	Rafeal				Sabdamanjaria (Sinhalese First book)	Buddhist Press	
1881	Rafeal				Sinhalese Grammar by Rev. S. Coles	GP	
1890					Apage Galavumkara Swamivu Yesus Christus Vahansege Aluth Givisuma (NT)	Printed at WMP for CABS	15/H-21
1891					A Comprehensive Grammar of the Sinhalese Language by Abraham Mendis Gunasekara		

ANNEXURE 4.1

Selection of variables

Table 01

Identifying the features within the lines

TOP Lines : between line 1 and 2

Total number of letters : 23/48

අ	ආ	ඇ	ඈ	ඉ	ඊ	උ	ඌ	ඍ	ඎ	ඏ	ඐ
එ	ඒ	ඓ	ඔ	ඕ	ඖ						
(ක)	(ඛ)	(ග)	(ඝ)	(ඞ)	(ඟ)	(ච)	(ඡ)	(ජ)	(ඣ)	(ඤ)	(ඦ)
(ට)	(ඨ)	(ඩ)	(ඪ)	(ණ)	(ඬ)	(ත)	(ඵ)	(ද)	(ධ)	(න)	(ඳ)
(ප)	(ඵ)	(ඹ)	(භ)	(ම)	(ඹ)	(ය)	(ර)	(ල)	(ච)	(ශ)	(ෂ)
(ස)	(හ)	(ළ)	(ඟ)								
 	Letter not taken for the study										

Table 02

Identifying the features within the lines

INBTWEEN lines : between line 2 and 3

Total number of letters : 48/48

අ	ආ	ඇ	ඈ	ඉ	ඊ	උ	ඌ	ඍ	ඎ	ඏ	ඐ
එ	ඒ	ඓ	ඔ	ඕ	ඖ						
(ක)	(ඛ)	(ග)	(ඝ)	(ඞ)	(ඟ)	(ච)	(ඡ)	(ජ)	(ඣ)	(ඤ)	(ඦ)
(ට)	(ඨ)	(ඩ)	(ඪ)	(ණ)	(ඬ)	(ත)	(ඵ)	(ද)	(ධ)	(න)	(ඳ)
(ප)	(ඵ)	(ඹ)	(භ)	(ම)	(ඹ)	(ය)	(ර)	(ල)	(ච)	(ශ)	(ෂ)
(ස)	(හ)	(ළ)	(ඟ)								
 	Letter not taken for the study										

Table 03

Identifying the features within the lines

MIDDLE LINES : between line 3 and 4

Total number of letters : 48/48

අ	ආ	ඇ	ඈ	ඉ	ඊ	උ	ඌ	ඍ	ඎ	ඏ	ඐ
එ	ඒ	ඓ	ඔ	ඕ	ඖ						
(ක)	(ඛ)	(ග)	(ඝ)	(ඞ)	(ඟ)	(ච)	(ඡ)	(ජ)	(ඣ)	(ඤ)	(ඦ)
(ට)	(ඨ)	(ඩ)	(ඪ)	(ණ)	(ඬ)	(ත)	(ඵ)	(ද)	(ධ)	(න)	(ඳ)
(ප)	(ඵ)	(ඹ)	(භ)	(ම)	(ඹ)	(ය)	(ර)	(ල)	(ව)	(ශ)	(ෂ)
(ස)	(හ)	(ළ)	(ඟ)								
 	Letter not taken for the study										

Table 04

Identifying the features within the lines

BOTTOM LINES : between line 4 and 5

Total number of letters : 08/48

අ	ආ	ඇ	ඈ	ඉ	ඊ	උ	ඌ	ඍ	ඎ	ඏ	ඐ
එ	ඒ	ඓ	ඔ	ඕ	ඖ						
(ක)	(ඛ)	(ග)	(ඝ)	(ඞ)	(ඟ)	(ච)	(ඡ)	(ජ)	(ඣ)	(ඤ)	(ඦ)
(ට)	(ඨ)	(ඩ)	(ඪ)	(ණ)	(ඬ)	(ත)	(ඵ)	(ද)	(ධ)	(න)	(ඳ)
(ප)	(ඵ)	(ඹ)	(භ)	(ම)	(ඹ)	(ය)	(ර)	(ල)	(ව)	(ශ)	(ෂ)
(ස)	(හ)	(ළ)	(ඟ)								
 	Letter not taken for the study										

ANNEXURE 4.2

Table 01

Identifying the features within the lines

TOP Lines : between line 1 and 2

Total number of letters : 23/48


අ	ආ	ඇ	ඈ	ඉ	ඊ	උ	ඌ	ඍ	ඎ	ඏ	ඐ
එ	ඒ	ඓ	ඔ	ඕ	ඖ						
(ක)	(ඛ)	(ග)	(ඝ)	(ඞ)	(ඟ)	(ච)	(ඡ)	(ජ)	(ඣ)	(ඤ)	(ඦ)
(ට)	(ඨ)	(ඩ)	(ඪ)	(ණ)	(ඬ)	(ත)	(ඵ)	(ද)	(ධ)	(න)	(ඳ)
(ඵ)	(ඵ)	(ඛ)	(භ)	(ඹ)	(ඹ)	(ය)	(ර)	(ල)	(ඵ)	(ශ)	(ඹ)
(ස)	(හ)	(ළ)	(ඟ)								
 <p>Letter not taken for the study</p>											

Table 01a

Total number of features : 05

No. of Feature

02	Full circle as an ascender + end of diagonal line		
	ඊ		
01	End of ascending stroke		
	ඔ ඛ ඞ ච ඣ ඤ ට ඨ ඩ ඪ ණ ඬ ඵ		
01	End of Diagonal stroke		
	ඡ ජ ඣ ඤ		
01	Ascending end loop		
	ඵ ඨ ඩ ඵ ඵ		

ANNEXURE 4.3

Distinguished features of the Sinhala letter – Development table							
Action Research Spiral: One				Spiral: Two		Evaluated	Analyzed
By placing on the five guidelines				By visual construction		Creating a grid	Distinguished feature list
Draft list 02	DF 57	Initial DF LIST (Draft list 03)	DF 29		DF 20	12	12
Strokes (21) Full Circular stroke <ul style="list-style-type: none"> • Full circle as an ascender • Full circle on baseline • Cont. full circle as a descender • Cont. full circle on baseline Diagonal strokes <ul style="list-style-type: none"> • End of diagonal strokes • intersected diagonal strokes Ascending strokes <ul style="list-style-type: none"> • Start of ascending strokes • Cont. ascending stroke • End of ascending strokes • Ascending end loop Base stroke <ul style="list-style-type: none"> • Start of base stroke • Cont. base stroke • End of base stroke • Base stroke end loop • Base stroke joint Descending strokes <ul style="list-style-type: none"> • Start of descending curve • Cont. descending curve 		Strokes (6) <ul style="list-style-type: none"> • Full Circular stroke • Diagonal strokes • Ascending strokes • Base stroke • Descending strokes • Horizontal stroke 		Strokes (3) <ul style="list-style-type: none"> • Ascending strokes • Base stroke • Descending strokes • Eye stroke 		Strokes (3) <ul style="list-style-type: none"> • Ascending strokes • Base stroke • Descending strokes Loop (1) Eye (1) Joints (1) Other (7) <ul style="list-style-type: none"> • Hook • Nose • Hump • spiral • knot • stem • shoulder 	<ol style="list-style-type: none"> 1. Eye 2. Base stroke (strk) 3. Ascending strk. 4. Descending strk. 5. Knot 6. Hook 7. Nose 8. Hump 9. Stem 10. Spiral 11. Shoulder 12. Loop

<ul style="list-style-type: none"> • End of descending curve <p>Vertical stroke</p> <ul style="list-style-type: none"> • Vertical end loop <p>Horizontal stroke</p> <ul style="list-style-type: none"> • Horizontal mini stroke • Horizontal stroke <p>Loop (4)</p> <ul style="list-style-type: none"> • Ascending end loop • Base stroke loop • Horizontal end loop • Base stroke end loop <p>Eye (6)</p> <ul style="list-style-type: none"> • Eye with iris • Closed eye/s • Knotted eye • Eye with horizontal stroke • Reflected eyes • Reflected eyes with iris <p>Joints (7)</p> <ul style="list-style-type: none"> • Circle joint • Intersected joint/s • Ligature joint • Shoulder joint • Eye joint • Curve to curve joint/s • Neck joint/s 	<p>Loop (2)</p> <ul style="list-style-type: none"> • Ascending end loop • Base stroke loop <p>Eye (5)</p> <ul style="list-style-type: none"> • Eye with iris • Closed eye/s • Knotted eye • Eye with horizontal stroke • Reflected eyes <p>Joints (7)</p> <ul style="list-style-type: none"> • Circle joint • Intersected joint/s • Ligature joint • Shoulder joint • Eye joint • Curve to curve joint/s 	<p>Loop (2)</p> <ul style="list-style-type: none"> • Ascending end loop • Base stroke loop <p>Eye (1)</p> <ul style="list-style-type: none"> • Eye with iris • Closed eye/s • Knotted eye • Eye with horizontal stroke • Base stroke eye <p>Joints (7)</p> <ul style="list-style-type: none"> • Circle joint • Intersected joint/s • Ligature joint • Shoulder joint • Eye joint 				
--	---	--	--	--	--	--

<p>Hook (5)</p> <ul style="list-style-type: none"> • Hook • Expanded curved hook • Elevated hooked spear • Expanded hook • Cont. elevated hooked spear <p>Nose (2)</p> <ul style="list-style-type: none"> • Pointed up • Pointed down <p>Other (5)</p> <ul style="list-style-type: none"> • Hump • Hook • Spiral • Knot • Elevate circle <p>Knot (3)</p> <ul style="list-style-type: none"> • Inward knot • Outward knot • Knotted eye <p>Shoulders (2)</p> <ul style="list-style-type: none"> • Reflected shoulders • Expanded shoulder <p>Spiral (2)</p> <ul style="list-style-type: none"> • Intersection • Spiral 	<ul style="list-style-type: none"> • Neck joint/s <p>Hook (2)</p> <ul style="list-style-type: none"> • Hook • Expanded curved hook <p>Nose (2)</p> <ul style="list-style-type: none"> • Pointed up • Pointed down <p>Other (5)</p> <ul style="list-style-type: none"> • Hump • Hook • Spiral • Knot • Elevate circle 	<ul style="list-style-type: none"> • Curve to curve joint/s • Neck joint/s <p>Other (7)</p> <ul style="list-style-type: none"> • Hook • Expanded curved hook • Nose • Hump • Spiral • Knot • Elevate circle 				
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ANNEXURE 4.5




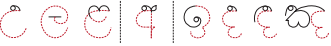

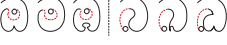






Definitions of the identified distinct visual properties

No.	Visual property	No. of variables (48)	Definition
01	Eye:01	08	<i>The way in which a curve stroke completes itself without creating a small counter space, but extends outward to form a semi-spiral parallel to the horizontal plane.</i>
	Eye:02	16	<i>The way in which a curve stroke completes itself to create a small counter space but extends outward to form a semi-spiral parallel to the horizontal plane.</i>
	Eye:03	08	<i>The way in which the outward edge of the semi-spiral continues along the horizontal plane.</i>
	Eye:04	05	<i>The way in which the curve stroke continues by overlapping each other</i>
	Eye:05, 06	03,05	<i>Eye ball/ An enclosed full circular stroke on the eye-line.</i>
02	Base Stroke: 01	03	<i>An enclosed full circular white space on the base-line.</i>
	Base Stroke: 02	05	<i>Two curve strokes that join to form two open counters on either direction.</i>
	Base Stroke: 03	05	<i>Two curve strokes that join to form a closed counter space at the centre.</i>
	Base Stroke: 04, 05	03, 02	<i>A stroke that completes itself to create a small counter space but extends outward to form a spiral parallel to the base line creating an overlap.</i>
03	Ascending stroke		
	Ascending stroke: 01	04	<i>A spiral that starts at the eye line and extends towards the ascending line.</i>
	Ascending stroke: 02	07	<i>A curved stroke that has a curve-to-curve joint parallel to the baseline, which starts at the eye line and ends at the ascending line.</i>
	Ascending stroke: 03	02	<i>The curve stroke that starts vertical to the base line and joints a hook and extends to form another semi-circle towards the ascending line.</i>
	Ascending stroke: 04	04	<i>A spiral that starts at the eye line and ends with a loop at the ascending line.</i>
	Ascending stroke: 05	01	<i>A curved stroke that has a curve-to-curve joint parallel to the baseline, which starts at the eye line and ends with a loop at the ascending line.</i>
	Ascending stroke: 06	06	<i>The diagonal stroke that starts at the eye line and extends towards the ascending line.</i>

04	Descending stroke: 01	03	<i>A spiral that starts at the eye line and extends towards the descending line.</i>
	Descending stroke: 02	01	<i>A semi-circle that starts at the eye line and joins a knot, vertical stem and ends with a loop at the ascending line.</i>
	Descending stroke: 03	04	<i>A curved stroke that has a curve to curve joint, which starts at the eye line and ends at the descending line.</i>
05	Knot	05	<i>The stroke, which overlap each other, and cross over each other.</i>
06	Hook/ Link	06	<i>A stroke that hooks/ links the eye to the preceding stroke.</i>
07	Nose/ point	07	<i>Connecting of two strokes from different directions parallel to the baseline.</i>
08	Hump	02	<i>The horizontal stroke that joints two halve circles parallel to the base line.</i>
09	Stem	08	<i>The stroke constructed straight, either vertically, horizontally or diagonally.</i>
10	Spiral	02	<i>The stroke that joins the eyeball at the base height to create a clockwise spiral.</i>
11	Shoulder	08	<i>A curve stroke that is composed parallel to the base stroke either as a joint or an adjacent stroke.</i>
12	Loop	11	<i>The way a stroke changes direction and overlaps each other without crossing over.</i>
13	Eye joint	45	<i>The way in which the eye joins the preceding strokes.</i>
14	Curve to curve joint	26	<i>The way in which two circular shapes join.</i>
15	Right angular joint	02	<i>The way in which two right angular strokes join two characters.</i>
16	Curve to stem joint	08	<i>The way the stem joins to a curve stroke.</i>
17	Curve angular joint	07	<i>The connecting point where a curve stroke joins an angular stroke parallel to the base line.</i>
18	Intersections	17	<i>The overlapping of two strokes.</i>
19	Terminals	48	<i>The way in which the letters terminate – ends.</i>

ANNEXURE 4.6

List of variables and the Visual Property of the Sinhala letterform

DF	Properties	Variables
1. Eye	Eye 01	06 
	Eye 02	
	Eye 03,04	
	Eye 05,06	
2. Base Stroke	BS 01, 02, 03	11 
	BS 04, 05	
3. Ascender Stroke	AS 01, 02, 03, 04	16 
	AS 05	
4. Descender Stroke	DS 01, 02, 03,	19 
5. Knot	01, 02, 03,	22 
6. Hook/ Link	01, 02,	24 
7. Nose/ Point	01, 02,	26 
8. Hump	01, 02,	28 
9. Stem	01, 02, 03	31 
10. Spiral	01, 02,	33 
11. Shoulder	01, 02, 03	36 
12. Loop	01, 02, 03	39 

ANNEXURE 4.7

List of each variable and its distinct Visual property

No.	Variable	Distinct Visual property of each variable
1	උ	Eye (02) + Descender Stroke (02) + knot (03) + Stem (02) + Loop (03) + [Eye joint (02) + Curve to Stem joint (01) + Intersection (03) + Terminal (10)]
2	ඌ	Eye (06) + Descender Stroke (03) + Spiral(0)+ [Eye joint (05) + Curve to Curve joint (04) + Terminal (08)]
3	ඍ	Ascender Stroke (05) + Stem (03)+ [Curve to Stem joint (02) + Terminal (08)]
4	ඎ	Eye (02) + Descender Stroke (01) + [Eye joint (02) + Terminal (09)]
5	ඏ	Eye (01) + Eye (02) + Base Stroke (03) + Shoulder(02) + Loop (01) + [Eye joint (01) + Eye joint (02) + Curve to Curve joint (02) + Terminal (01)]
6	ඐ	Eye (04) + Base Stroke (01) + Knot (01) + Shoulder(03) + Loop (01) + [Eye joint (04) + Intersection (01) + Intersection (03) + Terminal (02)]
7	එ	Eye (03) + Ascender Stroke (04) + Loop(02)+ [Eye joint (03) + Terminal (07)]
8	ඒ	Eye (05) + Ascender Stroke (02) + Hook (01)+ [Eye joint (05) + Curve to Curve joint (03) + Terminal (05)]
9	උ	Eye (02) + Base Stroke (04) + Nose (01)+ [Eye joint (02) + Curve to Curve joint (02) + Curve Angular joint (01) + Intersection (02) + Terminal (03)]
10	ඌ	Eye (06) + Ascender Stroke (03) + Hook(02)+ Nose (01) + [Eye joint (05) + Curve Angular Joint (01) + Terminal (05)]
11	ඍ	Base Stroke (02) + [Curve to Curve joint (01) + Terminal (03)]
12	ඎ	Eye (01) + Eye (03) + Base Stroke (03) + Hook(01) + [Eye joint (01) + Eye joint (03) + Terminal (01)]
13	ඏ	Eye (06) + Ascender Stroke (02) + Hook (02) + Loop (01) + [Eye joint (05) + Curve to Curve joint (03) + Terminal (05)]
14	ඐ	Base Stroke (02) + Shoulder(01) + [Curve to Curve joint (01) + Terminal (03)]
15	එ	Eye (03) + Ascender Stroke (01)+ [Eye joint (03) + Terminal (05)]
16	ඒ	Eye (01) + Eye (02) + Ascender Stroke (05) + Knot (02)+ Stem (03)+ [Eye joint (01) + Eye joint (02) + Curve to Stem joint (02) + Intersection (03) + Terminal (06)]
17	ඓ	Eye (02) + Ascender Stroke (05) + Knot (02)+ Stem (03)+ [Eye joint (02) + Curve to Stem joint (02) + Intersection (03) + Terminal (06)]
18	ඔ	Eye (02) + Base Stroke (04) + Ascender Stroke (02) + Nose (01)+ [Eye joint (02) + Curve to Curve joint (02) + Curve to Curve joint (03) + RightAngular joint (01) + CurveAngular joint (01) + Intersection (02) + Terminal (03)]

19	ஊ	Eye (04) + Base Stroke (04) + Descender Stroke (03) + Nose (01)+ Shoulder 03 + [Eye joint (04) + Curve to Curve joint (02) + Curve to Curve joint (04) + Right Angular joint (01) + Curve Angular joint (01) + Intersection (01) + Intersection (02) +Terminal (08)]
20	ர	Eye (02) +Eye (04) + Ascender Stroke (05) + Knot (02)+ Stem (03)+ Shoulder (03) + [Eye joint (02) + Eye joint (04) + Curve to Stem joint (02) + Intersection (01) +Intersection (03) +Terminal (06)]
21	டி	Ascender Stroke (01) + [Terminal (05)]
22	டி	Ascender Stroke (01) + Loop (02) + [Curve to Curve joint (03) + Terminal (07)]
23	பி	Eye (03) + Ascender Stroke (02) + [Eye joint (03) + Curve to Curve joint (03) + Terminal (05)]
24	பி	Eye (03) + Ascender Stroke (04) + Loop (02) + [Eye joint (03) + Curve to Curve joint (03) + Terminal (07)]
25	ஸு	Eye (05) + Ascender Stroke (05) + Nose (01)+ Stem (03)+ Shoulder (02) + Spiral (02) + [Eye joint (05) + Curve to Curve joint (03) + Curve to Stem joint (02) + CurveAngular joint (01) + Intersection (04) +Terminal (06)]
26	ஓ	Eye (03) +Eye (04) + Ascender Stroke (02) + Shoulder (03) [Eye joint (03) + Eye joint (04) + Curve to Curve joint (03) + Intersection (01) +Terminal (05)]
27	ந	Eye (02) + Base Stroke (05) + Nose(01)+ [Eye joint (02) + Curve Angular joint (01) + Intersection (02) +Terminal (03)]
28	டு	Ascender Stroke (04) + Loop (02) + [Terminal (07)]
29	டி	Eye (02) + Descender Stroke (03) + [Eye joint (02) + Curve to Curve joint (04)+Terminal (05)]
30	டி	Ascender Stroke (02) + [Curve to Curve joint (03) +Terminal (05)]
31	ஸு	Eye (02) + Base Stroke (05) + Nose(02)+ [Eye joint (02) + Curve Angular joint (02) + Intersection (02) +Terminal (03)]
32	ஓ	Eye (04) + Descender Stroke (03) + Shoulder (03) + [Eye joint (04) + Curve to Curve joint (04)+ Intersection (02) +Terminal (08)]
33	பி	Eye (01) +Eye (02) + Base Stroke (01)+ [Eye joint (01) + Terminal (01)]
34	பி	Eye (02) + Ascender Stroke (04) + Loop (02) + [Eye joint (02) + Terminal (07)]
35	ந	Eye (06) + Ascender Stroke (03) + Hook (02)+ [Eye joint (05) + Terminal (05)]
36	ந	Eye (03) + Base Stroke (02)+ [Eye joint (03) + Curve to Curve joint (01)+ Terminal (03)]
37	ஓ	Eye (05) + Ascender Stroke (01) + Hook (01)+ [Eye joint (05) + Terminal (05)]
38	ஓ	Eye (05) + Ascender Stroke (02) + Hook (01)+ Hump (01)+ [Eye joint (05) + Terminal (05)]

39	᳚	Eye (01) + Base Stroke (03)+ [Eye joint (01) + Curve to Curve joint (02)+ Terminal (01)]
40	᳛	Ascender Stroke (05) + Stem (03)+ [Curve to Stem joint (02) + Terminal (06)]
41	᳜	Descender Stroke (01) + Stem (01)+ [Curve to Stem joint (01) + Terminal (09)]
42	᳝	Eye (02) + Ascender Stroke (01) + [Eye joint (02) + Terminal (05)]
43	᳞	Base Stroke (02) + Loop (01) + [Curve to Curve joint (01) + Terminal (04)]
44	᳟	Eye (01) +Eye (02) + Base Stroke (01)+ Loop (01) + [Eye joint (01) + Eye joint (02) + Terminal (01)]
45	᳠	Eye (01) + Eye (03) + Base Stroke (03) + [Eye joint (01) + Eye joint (03) + Curve to Curve joint (02)+ Terminal (01)]
46	᳡	Eye (02) + Base Stroke (02)+ [Eye joint (02) + Curve to Curve joint (01)+ Terminal (03)]
47	᳢	Eye (01) + Descender Stroke (01)+ [Eye joint (01) + Curve to Curve joint (04)+ Intersection (05) + Terminal (09)]
48	᳣	Base Stroke (03)+ [Curve to Curve joint (02)+ Terminal (03)]

ANNEXURE 5.1

Survey 01 on letter properties

Name : _____ E-mail : _____


Age : 16-25 26-35 36-45 50-above

Interest : Don't know what is typography Learning typography in college/ university Learning typography by myself

: Like to learn how to design a font I have already designed/ created a font

PLEASE NAME THE LETTER PROPERTIES MARKED IN GRAY

1  Suggested name _____

2  Suggested name _____


3  Suggested name _____

4  Suggested name _____

5  Suggested name _____

6  Suggested name _____


7  Suggested name _____

8  Suggested name _____

9  Suggested name _____

10  Suggested name _____

11  Suggested name _____

12  Suggested name _____

13  Suggested name _____

ANNEXURE 5.2

List of the observed publications – pre-newspaper era					
	Date	Name of publication/ print	Name of Printing press or publisher	Location and search code	Identification code no.
1	1708	Grammatica of Singaleeshche taalkunst, Ruell Joannes		491.485 RUE 000476 RAS	N/A
2	1737	Placard	<i>Printed : Government Press (GP)</i>	Lot 01, r.n 2440 Dept. NA	Pre 01 Pre 02
3	1737	Singaleesch Gebeede Boek	<i>Printed at GP</i>	15/H4NM	Pre 03
4	1739	Apage Nayake galavumkara Yesus Christus vahansege Sudhavu Avum – mathewus Markus Lukas yohhnenes...	<i>Printed at GP</i>		Pre 04
5	1744	Singaleesch formulier book (Sinhalese handbook of Prayers)- Colombo	<i>Printed at GP</i>	242. Ref.R.B 004452 RAS	Pre 05
6	1744	Kort ontwerp van de llere den waarheid ... in de Sinhalese tale = short account of the teaching of truth in the Sinhalese Language – Colombo Wetjelius, Johannes Philippus	<i>Printed at GP</i>	207 Ref. RB WET 001188 RAS	Pre 06
7	1771/ 1780	<i>Hethylige Evangelium onses Heeren en Zaligmakers. Jesu Christi NA DE BESCHREVVINGE Van De Mannen Gods En H. Evangelisten Matteus, Marcus, Lucas en Joannes</i>	<i>Printed at GP</i>	15/ I-04 (good copy) 15/ I 09	Pre 07 Pre 08 Pre 09
8	1813	The Cingalese Translation of the New Testament of O.L.A.S.J.C. part I- Gospel according to St. Matthew	<i>Printed at Mission Press – Serampore, India</i>	15/ I-11 NM	Pre 10
9	1815	A Grammar of the Cingalese Language by James Charter	<i>Printed at GP</i>	SJP 3471	Pre 11
10	1817	<i>Abhinawa Givisuma - Sri lankadeepayehi vu colomba puravarayehi bible samagama venvvata Wesleyan mishanarivarunen poth achchugasana eistanayadi achchugasanaladi. (Sakala janayage Galvima pinisa prakasha karena ladha age Swami vu galavumkara yesus Christusvahansege abinava givisuma)</i>	<i>Printed at Wesleyan Mission Press (WMP) for Colombo Auxiliary Bible Society (CABS)</i>	225.55 W514 1318 USJP Lib 15/I-10NM	Pre 12 Pre 13
11	1819	Bible - Shudhavu bibalaya- colomba puravarayehi bible samagama venvven Sinhala bashavata pitapathkota achchu gasana ladi	<i>Printed at WMP for CABS</i>	SJP 220.55	Pre 14
12	1820- 1823	Old Testament	-	15 I-03 NM	Pre 15
13	1820	The Sinhalese Translation of the book of Psalms + Book of Proverbs - <i>Hethopadeshaya</i> + Book of Sirach - <i>Upadeshakaya</i>	<i>Printed at WMP for CABS</i>	15 I-02	Pre 16
14	1923	A discourse on the Nativity of our Lord Jesus Christ	<i>Printed at WMP</i>		Pre 17
15	1824	The Christian Institutes; or the Sincere word of God: being a plain and impartial account of the whole faith and duty of a Christian collected out of the writings of the old and New testament; Digested under proper heads and Delivered in the word of scripture by the right reverend father in God, by the right reverend father in God, Francis, late LORD BISHOP of CHESTER and by sanction of the District committee of the society for promoting Christian Knowledge, translated into Sinhalese, by the Rev. Armour	<i>Printed at WMP</i>	9/N-10	Pre 18
16	1826	The Gospel according to Mattew by Samuel Lambrick and Thomas Browning	<i>Printed at Church Missionary Press (CMP) – Kotte (CTTA)</i>		Pre 19
17	1846	The New Testament of our Lord and Savior Jesus Christ translated into Sinhalese from the Original Greek	<i>Printed at CMP -CTTA</i>	15 I-13NM	Pre 20
18	1846	Shuddhavu Baibalaya (Holy Bible)	<i>Printed at CMP -CTTA</i>	15 H-23NM 15 H-24NM	Pre 21

19	1854	Bible, O.T. Pentateuch (WMP)	<i>Printed at WMP for CABS</i>	221 BIB Ref.RAS 002420	Pre 22
20	1857	Apage galavumkara suwamivu yesus christusvahansege Aluth givisuma	-	15/H-20NM	Pre 23
21	1862	<i>Sudarshanya</i> - The True Light	<i>Printed at the Lankopakara press- Galle</i>	P. S. 147 NM	Pre 24

ANNEXURE 5.3

List of Newspaper observed – Early-newspaper era				
Date	Name of Newspaper	Location and search code	Observation code no.	Identification code no.
1860	Lankalokaya	*	113	01
1868	Sathya margaya	*	121	02
1883	Gnayanarthapredeepaya	B/05	125	03
1884	Sathyalankaraya	MS 518 - F12	012	07
1888	Hela Div Ruwana	*	114	06
1889	Kavata Duthaya	F-09	123	08
1889	Ruwanmaldama	MS/518 F12		04
1896	Lakrivi kirana	MS/518 F12	011	07
1897	Sri Lankodaya	MS/518 F12	009	09
1895	Dinapatha Pravurthi			10
1900	Baptist Pravurthi	F-09		11
1911	Hithavadee	*		15
1911	Dudana Bate	F-07	141	16
1916	Arya Sinha Vanshaya	F-07	142	17
1927	Peramuna	F-08		18
1928	Lanka Tharunaya	MS/503	020	19
1928	Mini Pahana	MS/503 F11	022	20
1931	Mini Kirula	MS/503	007	21
1931	Sinhala Kavataya	MS 507 F/11		22
1932	Punchi Hevaya	MS 507 F/11		23
1945	Hela Diva	MS 542		25
1949	Lanka deepa	MS 542	121	24
1949	Kavata kella	MSA 528	039	26
1957	Rata Jathiya Agama	MSA/ 15 F15	032	28
1958	Seya	MSA/ 15 F15	034	29
1960	Prabodhaya	MSA/ 15 F15	035	27
1967	Sinhala jathiya	MSA/29 F16	084	30
1968	Maharagama	MSA/29 F16	087	31
1969	Siri Anurapura	MSA/29 F16	088	32
1971	Dinamina			36
1976	Urumaya	MSA/48 F18	100	35
1977	Rathu Yathura	MSA/48	105	33
1978	Ada	MSA/48 F18	106	34

ANNEXURE 5.4

Titles of all the newspapers observed for the survey



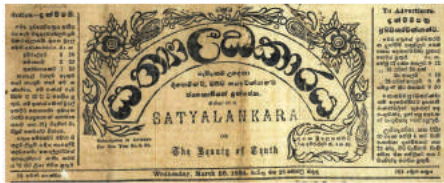
1860 Lankalokaya



1868 Sathya Margaya



1883 Gnyanarthapredeepaya



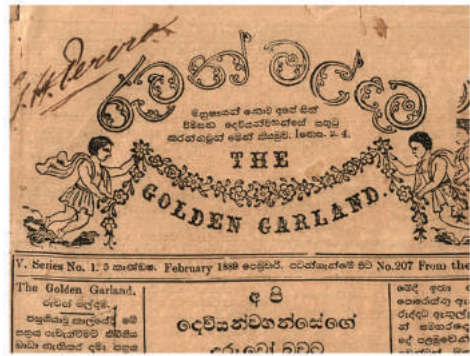
1884 Sathyalankaraya



1888 Hela Div Ruwana



1889 Kavata Duthaya



1889 Ruwanmaldama



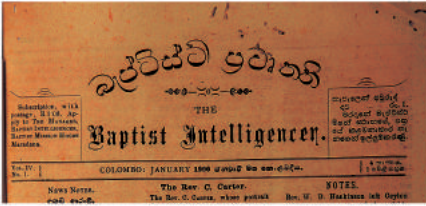
1896 Lakrivi kirana



1897 Sri Lankodaya



1895 Dinapatha Pravurthi



1900 Baptist Pravurthi



1911 Hithavadee



1911 Dudana Bate



1931 Mini Kirula



1931 Sinhala Kavataya



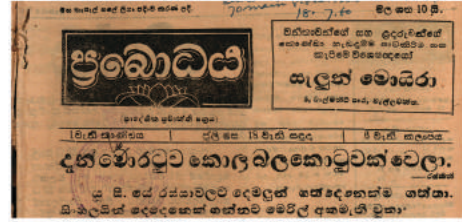
1932 Punchi Hevaya



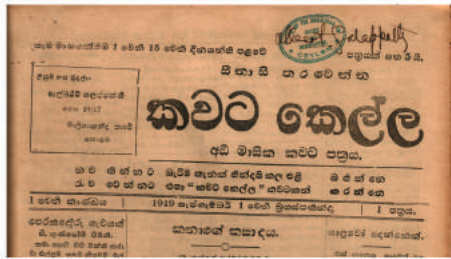
1945 Hela Diva



1949 Lanka deepa



1960 Prabodhaya



1949 Kavata kella



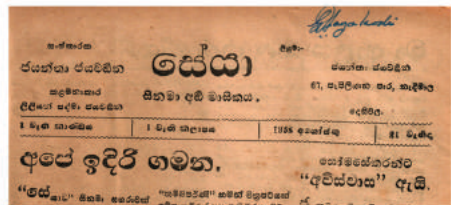
1967 Sinhala jathiya



1957 Rata Jathiya Agama



1968 Maharagama



1958 Seya



1969 Siri Anurapura



1971 Dinamina



1976 Urumaya





1977 Rathu Yathura



1978 Ada





ANNEXURE 5.5

36 selected sample cards

	01
	02
	03
	04
	05
	06
	07
	08

(computer)	0 1 2 3	ද්විතලපණලෙම්	09
(computer)	0 1 2 3	ද්විතලපණලෙම්	10
(computer)	0 1 2 3	ද්විතලපණලෙම්	11
(computer)	0 1 2 3	ද්විතලපණලෙම්	12
(computer)	0 1 2 3	ද්විතලපණලෙම්	13
(computer)	0 1 2 3	ද්විතලපණලෙම්	14
(computer)	0 1 2 3	ද්විතලපණලෙම්	15
(computer)	0 1 2 3	ද්විතලපණලෙම්	16

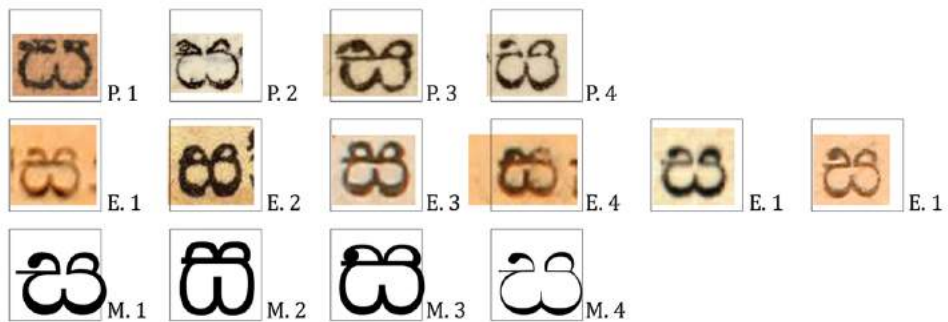
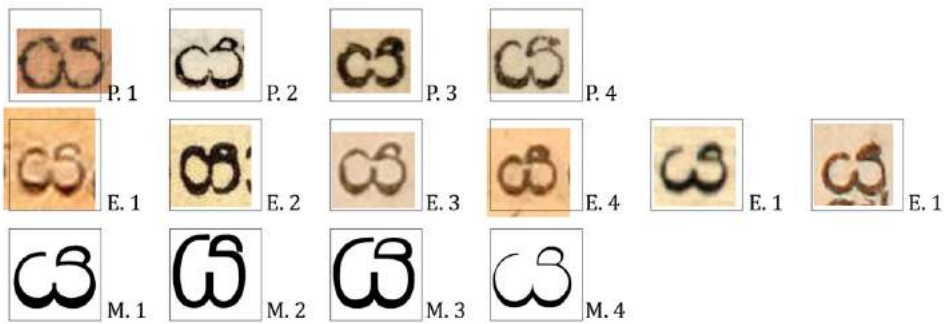
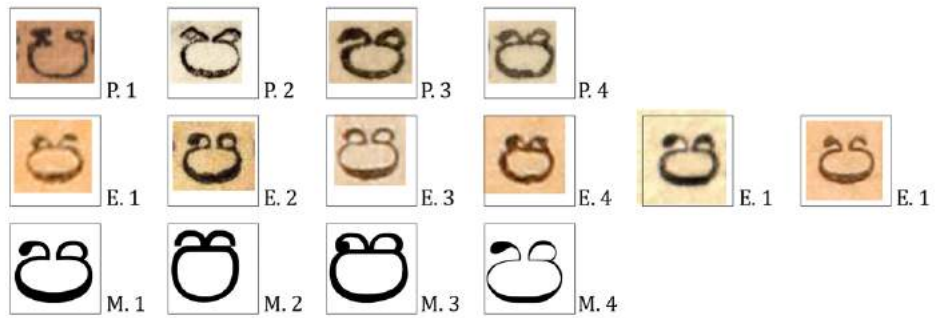
(computer)	0 1 2 3	କପାଳପତ୍ରଲେଖି	17
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	18
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	19
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	20
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	21
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	22
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	23
(computer)	0 1 2 3	କୃତକାଳପତ୍ରଲେଖି	24

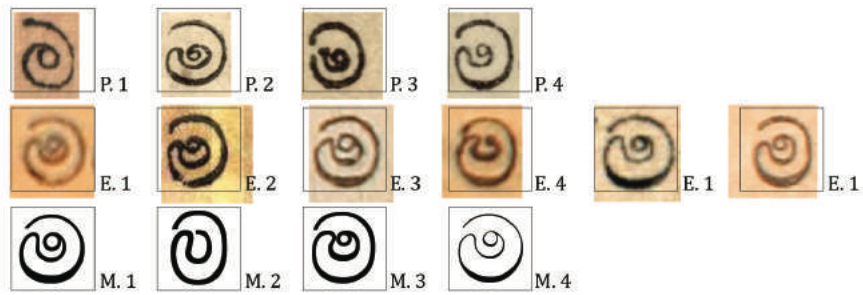
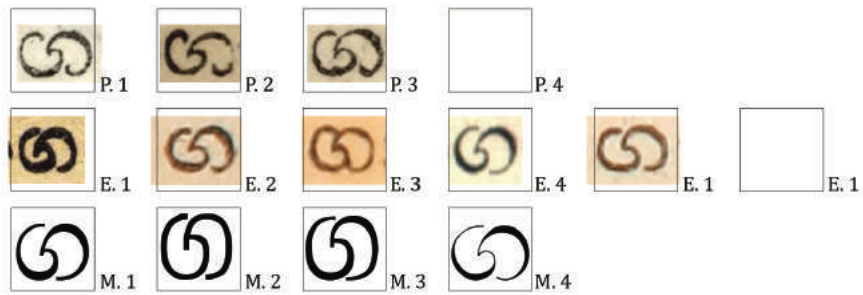
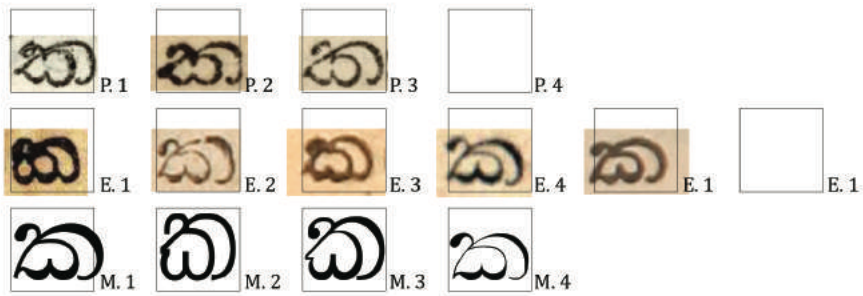
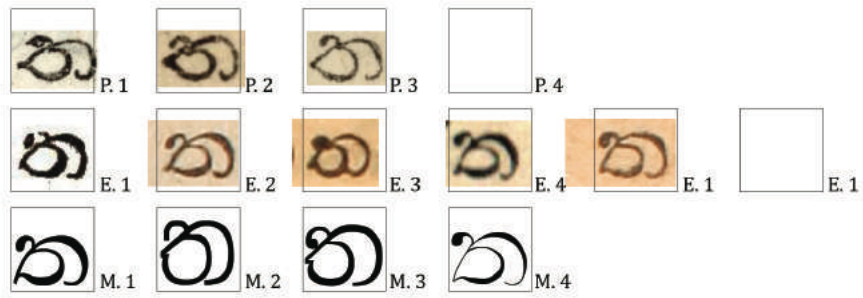
 0 1 2 3 (computer)	ද්විතලපණලෙම්	25
 0 1 2 3 (computer)	ද්විතලපණලෙම්	26
 0 1 2 3 (computer)	ද්විතලපණලෙම්	27
 0 1 2 3 (computer)	ද්විතලපණලෙම්	28
 0 1 2 3 (computer)	ද්විතලපණලෙම්	29
 0 1 2 3 (computer)	ද්විතලපණලෙම්	30
 0 1 2 3 (computer)	ද්විතලපණලෙම්	31
 0 1 2 3 (computer)	ද්විතලපණලෙම්	32

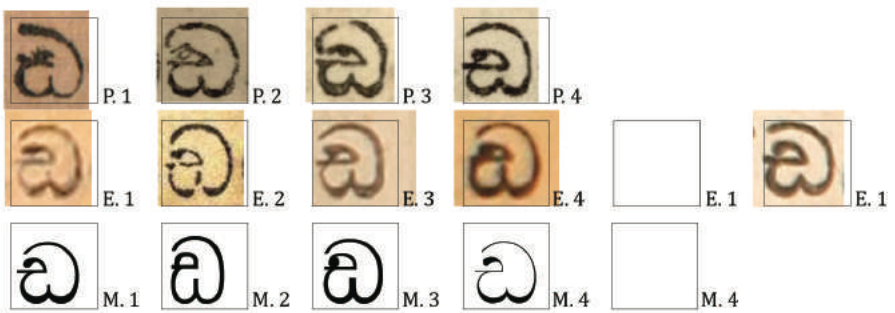
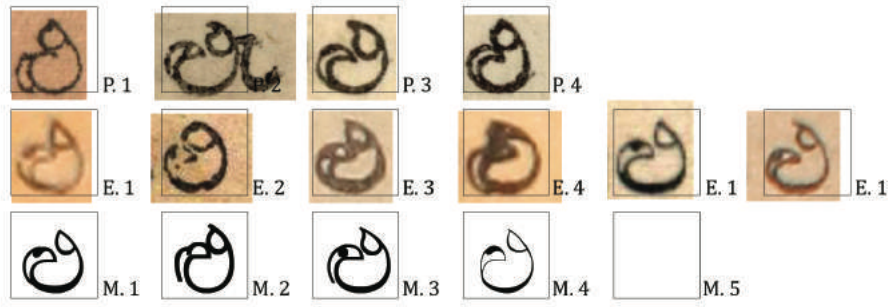
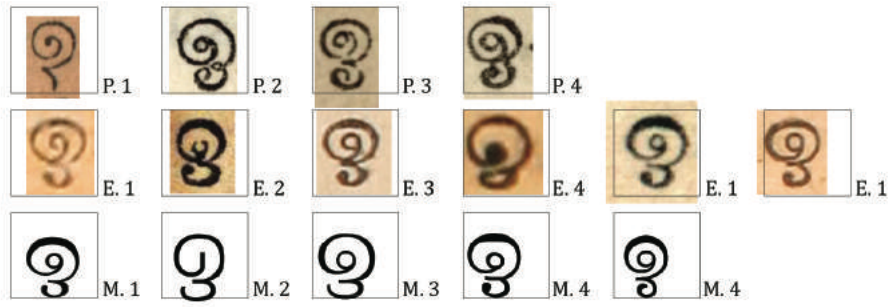
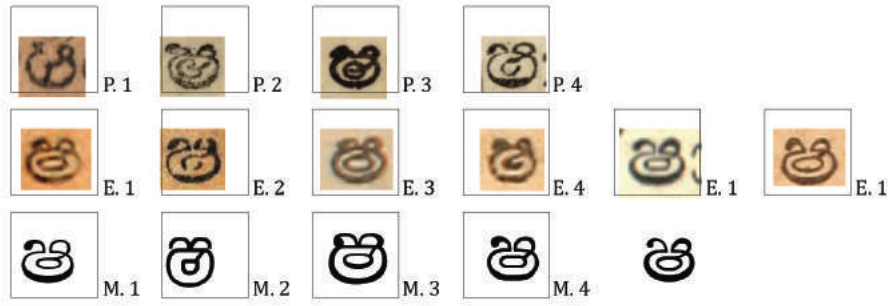
 0 1 2 3 (computer)	 ද්‍රව්‍යකළමනාකරණය	33
 0 1 2 3 (computer)	 ද්‍රව්‍යකළමනාකරණය	34
 0 1 2 3 (computer)	 ද්‍රව්‍යකළමනාකරණය	35
 0 1 2 3 (computer)	 ද්‍රව්‍යකළමනාකරණය	36

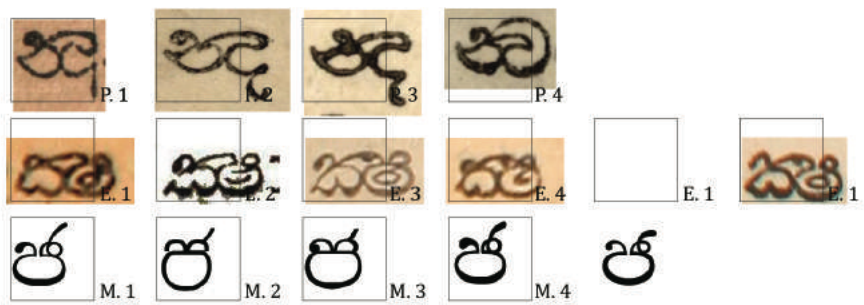
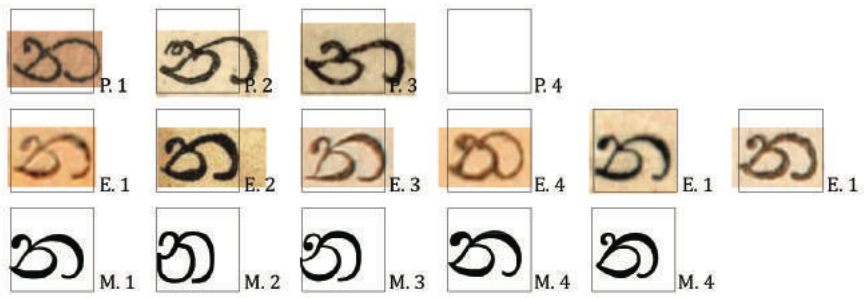
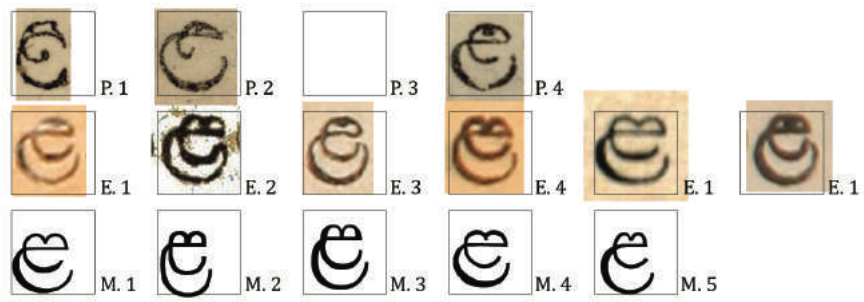
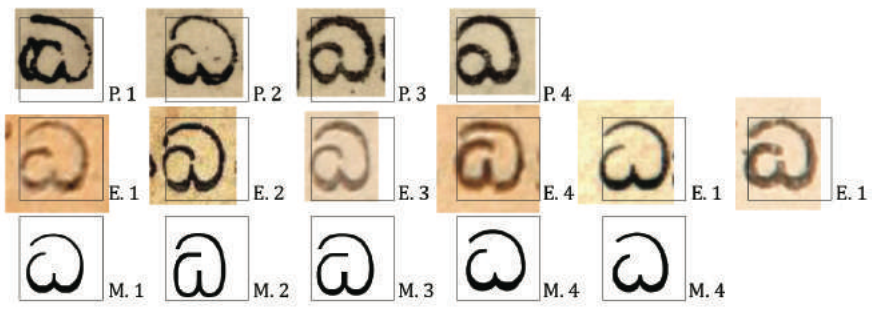
ANNEXURE 5.6

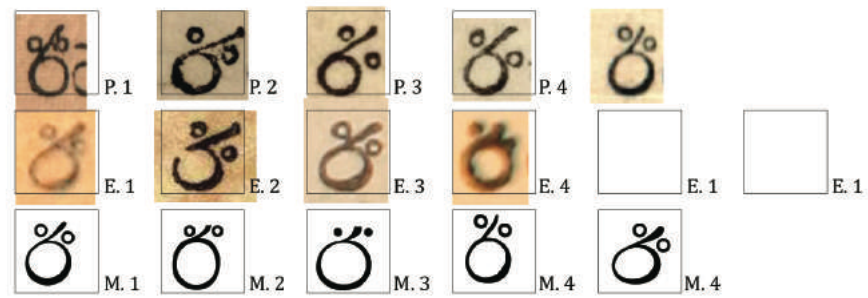
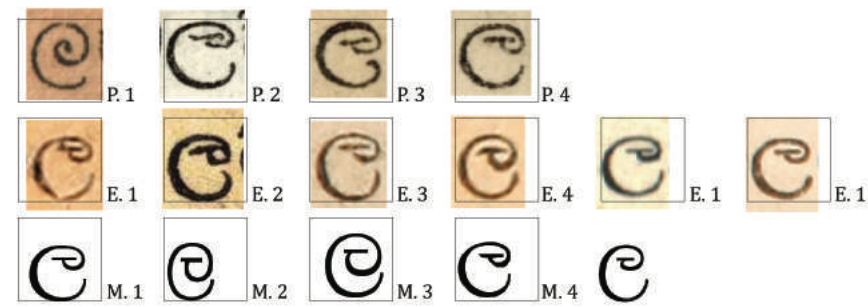
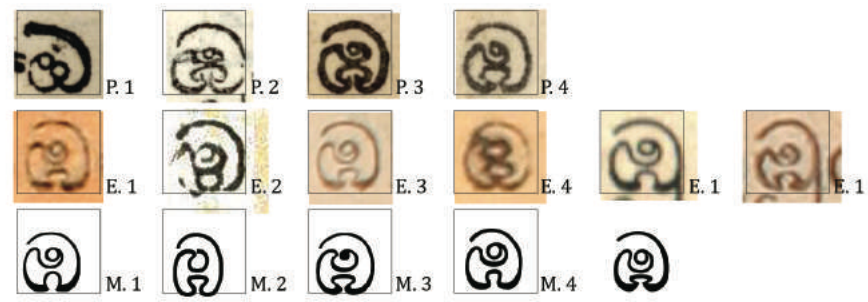
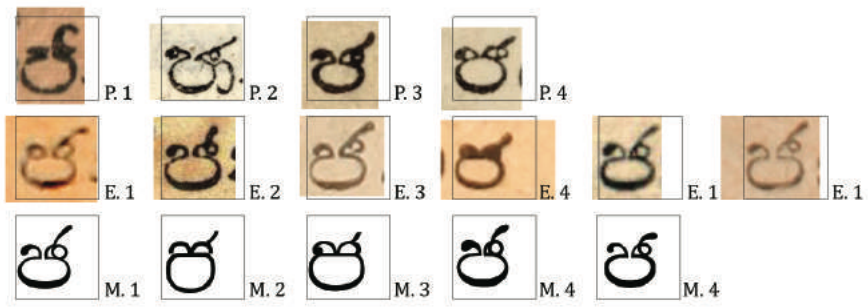
15 type specimen cards on selected letters

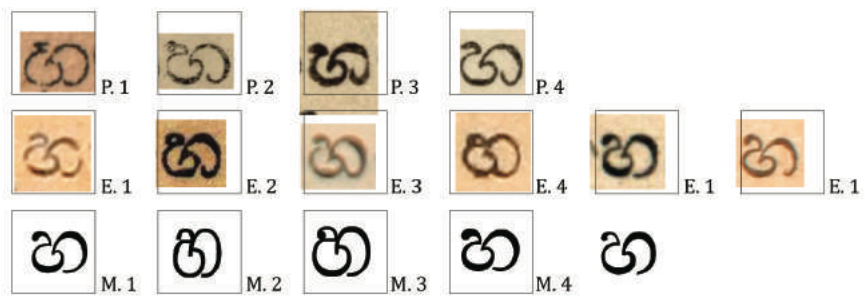
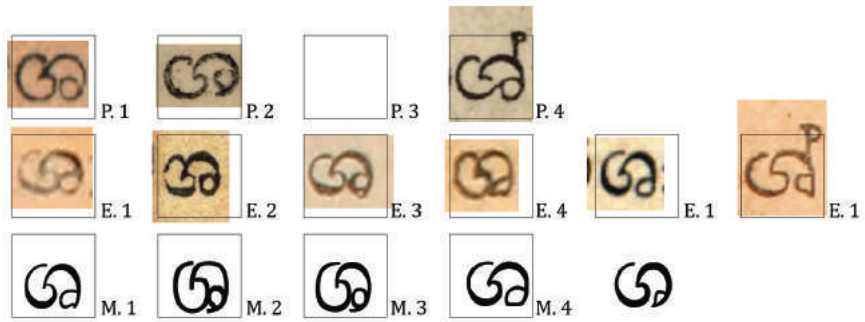
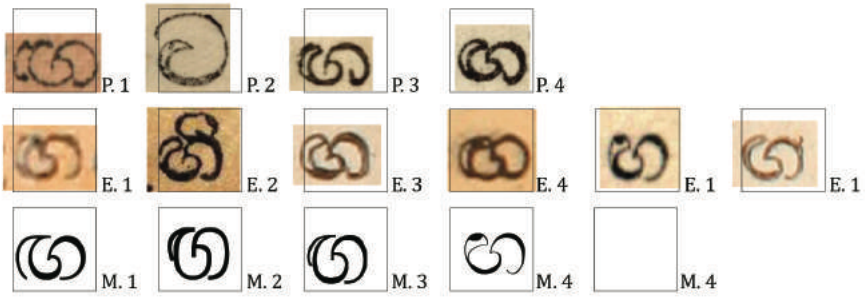
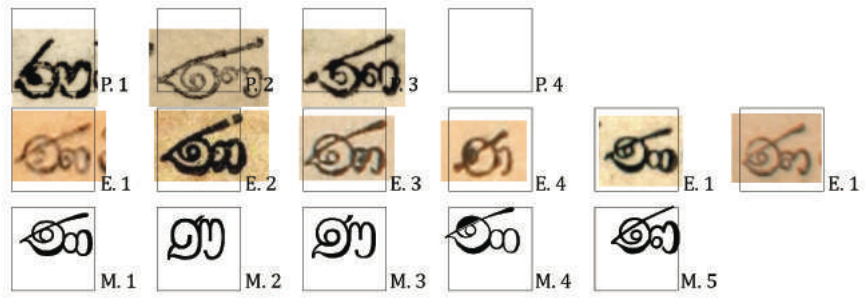


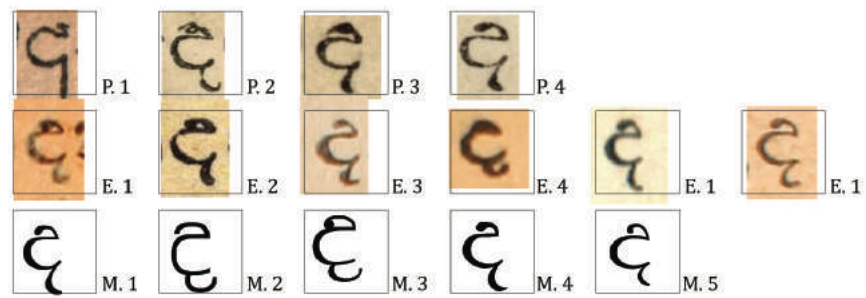
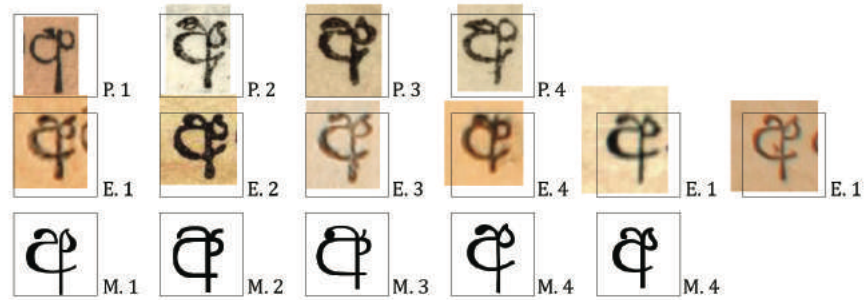
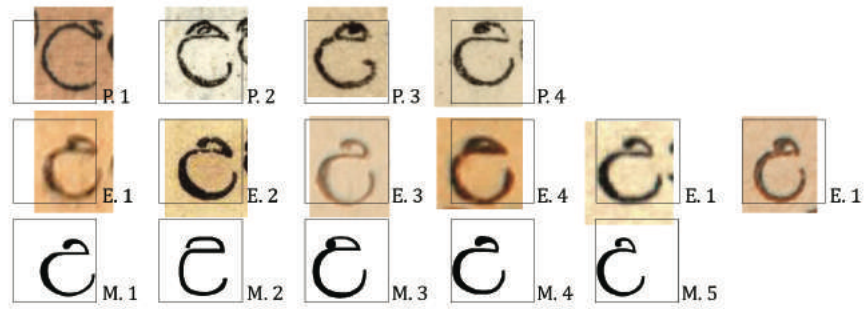
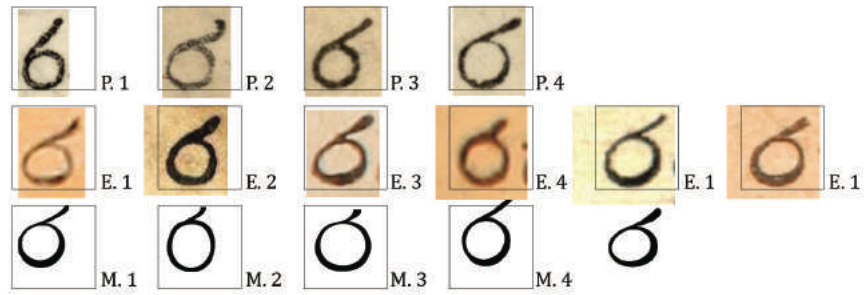












ANNEXURE 5.7

Modern Newspaper era typefaces with multiple names

Name of font	Sample
Mi_Lipi	ද්‍රවකලපණලෙඹි
AA Amali	ද්‍රවකලපණලෙඹි
OKDDESIE	ද්‍රවකලපණලෙඹි
Amalee	ද්‍රවකලපණලෙඹි
OKDSMAN	ද්‍රවකලපණලෙඹි
Chamara Normal	ද්‍රවකලපණලෙඹි
DS Satsara	ද්‍රවකලපණලෙඹි
Aradhana Bold	ද්‍රවකලපණලෙඹි
DL-Araliya	ද්‍රවකලපණලෙඹි
Aradana	ද්‍රවකලපණලෙඹි
AHBanti	ද්‍රවකලපණලෙඹි
Ranaviru-PC	ද්‍රවකලපණලෙඹි
AHerash	ද්‍රවකලපණලෙඹි
DS Dilini	ද්‍රවකලපණලෙඹි
DL Araliya Shatter	ද්‍රවකලපණලෙඹි
AHCow	ද්‍රවකලපණලෙඹි
DL- Manel	ද්‍රවකලපණලෙඹි
SinhManelAA	ද්‍රවකලපණලෙඹි
FS- Manel	ද්‍රවකලපණලෙඹි
Anupama Plain	ද්‍රවකලපණලෙඹි
AA- Sampath	ද්‍රවකලපණලෙඹි
Anuradha -PC	ද්‍රවකලපණලෙඹි
AHDuminda	ද්‍රවකලපණලෙඹි
DS- Anurada 2	ද්‍රවකලපණලෙඹි
Anuradha bold	ද්‍රවකලපණලෙඹි
DL Kusumi	ද්‍රවකලපණලෙඹි
DL Madu	ද්‍රවකලපණලෙඹි
DS MANO	ද්‍රවකලපණලෙඹි
OKDROSE	ද්‍රවකලපණලෙඹි

Name of font	Sample
DL-Dulackshi	ද්‍රව්‍යවිකල්පයකි
AHFan	ද්‍රව්‍යවිකල්පයකි
AHFox	ද්‍රව්‍යවිකල්පයකි
Ridhma Bold	ද්‍රව්‍යවිකල්පයකි
DL-Ridhma Li Bold	ද්‍රව්‍යවිකල්පයකි
OKAARALIYA	ද්‍රව්‍යවිකල්පයකි
AA-Menik	ද්‍රව්‍යවිකල්පයකි
AMILA NORMAL	ද්‍රව්‍යවිකල්පයකි
OKD NAMAL	ද්‍රව්‍යවිකල්පයකි
OSEVVANDI	ද්‍රව්‍යවිකල්පයකි
KELANI Plain	ද්‍රව්‍යවිකල්පයකි
A KELANI	ද්‍රව්‍යවිකල්පයකි
AA- Muthu	ද්‍රව්‍යවිකල්පයකි
AHGanga	ද්‍රව්‍යවිකල්පයකි
DI Hansika	ද්‍රව්‍යවිකල්පයකි
DL Paras	ද්‍රව්‍යවිකල්පයකි
OKDOLU	ද්‍රව්‍යවිකල්පයකි
Mi-Pathum	ද්‍රව්‍යවිකල්පයකි
DS Malan	ද්‍රව්‍යවිකල්පයකි
AHAshirwada	ද්‍රව්‍යවිකල්පයකි