Designing Devanagari type

The effect of technological restrictions on current practice

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BA degree final project
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Final project for a BA degree in graphic design
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Abstract

This thesis explores the current process of designing typefaces for Devanagari, a script used to write several languages in India and Nepal. The typographical needs of the script have been insufficiently met through history and many Devanagari typefaces are poorly designed. As the various printing technologies available through the centuries have had drastic effects on the design of Devanagari, the thesis begins with an exploration of the printing history of the script. Through this exploration it is possible to understand which design elements constitute the script, and which ones are simply legacies of older technologies. Following the historic overview, the character set and unique behavior of the script is introduced. The typographical anatomy is analyzed, while pointing out specific design elements of the script. Although recent years has seen a rise of interest on the subject of Devanagari type design, literature on the topic remains sparse. This thesis references books and articles from a wide scope, relying heavily on the works of Fiona Ross and her extensive research on non-Latin typography. To gain insight into the current type design process, an interview with a contemporary Devanagari type designer was conducted by the author. It is concluded that since the revolution of digital type design, the Devanagari script finally has the technology available to meet its typographical needs. The importance of research-based design is a constant throughout the thesis and with the combination of intensive research and the available technology of the digital age, designers will be able to produce high-quality Devanagari typefaces.
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Introduction

With the ongoing digitization of the world, the design and production of typefaces occupies a vital role in global communication. Although non-Latin scripts are used by most of the world, Latin typeface design dominates the market and non-Latin typefaces and typographical needs have been poorly served due to a very limited amount of typefaces, many of which are badly produced. Some non-Latin scripts were never rendered correctly in print until the digital era, although printing with letterforms dates back to the eleventh century. In the past few decades these typographical needs have been recognized with a rise in the production of non-Latin typefaces. This is in part due to globalization which has resulted in a rise in interest and need for multi-script and non-Latin typefaces. In addition to that, printing technology has perhaps only recently been able to correctly render the intricacies of many non-Latin scripts.

One of these scripts is Devanagari, a script used to write several languages of India and Nepal. These languages include Hindi, the most prominent language in India, Marathi and Nepali, as well as being used for Sanskrit manuscripts. Devanagari is a complex script and contains a large character set due to the behaviors of the script, and as Bapurao S. Naik describes in his introduction to the *Typography of Devanagari*, “[The] peculiar nature of the Devanagari characters and their combinations create many difficulties in type setting.” These difficulties have accompanied the script through the printing techniques of each age and influenced the design of its main characteristics up until the present.

The aim of this essay is to explore the design process of Devanagari typefaces today; part of this is achieved through historical research, as contemporary Devanagari typeface design has been greatly influenced by the various printing technologies through time. This essay will study the history of printing methods available in India, from the first foundries utilizing moveable type in the eighteenth century, to contemporary digital type design. From these studies it will be possible to discover the impact of technological restrictions on the current design of Devanagari.

Although there is not much literature on the subject, this essay will hopefully

contribute to the field as an introduction for designers interested in the Devanagari script, by providing a concise overview of the history of Devanagari type design and printing, and the current process of designing typefaces for this script.
1. A historic overview of Devanagari type design

1.1 The importance of research-based practice

Like most scripts, especially those that are non-Latin, the methods of reproduction and rendering Devanagari through its history have had a great effect on how it looks today, as the restrictions of each typesetting method leaves marks on the script. With each new technology comes the imitation of older typefaces, and these revivals carry the legacy of the marks. This imitation is due to many reasons including low funding, the habits of readers and reluctance to change designs which have previously been deemed ‘acceptable’.\(^5\)

The first printing press in India arrived in 1556 but due to the intricacies of the Devanagari script, books had to be printed in the Roman script for two centuries after its arrival. The *Christian Purana*, written by Fr. Stephens in Marathi in the beginning of the seventeenth century, was one of these books. Fr. Stephens describes the Devanagari script in a letter dated in 1608 as follows:

I very strongly desired to see in this Province some books printed in the language and alphabet of the land … this could not be achieved for two reasons: [sic] the first because it looked impossible to cast so many moulds [sic] amounting to six hundreds, whilst the characters are syllables and not alphabets as our twenty four in Europe.\(^6\)

It was not until 1796 that the first book in the Devanagari script was printed, when John Gilchrist printed the *Grammar of the Hindustanee Language*. The most significant complication of designing a typeface for Devanagari is due to the large character set. Various solutions to this complication have been employed through different printing technology eras, such as composing characters from shared components to save space. Some of these solutions have performed better than others but all of them have left their mark on the design.\(^7\)

\(^6\) Naik, *Typography of Devanagari*, vol. I, x.
\(^7\) Ross, “Non-Latin scripts: key issues in type design,” 131.
Just as Devanagari typeface design and typography needs have not been sufficiently served, the same goes for literature on the subject. The main resource on the history of Devanagari typeface design that was used for this research are the essays of Fiona Ross. These essays are a highly reliable source of information, and were used alongside some other articles and essays by various authors that have been listed in the bibliography section and referenced throughout the text.

Before designing type in any script, whether it is native to the designer or not, researching the script, the tools used to write it and printing methods is a necessity. Designers must study the script in many different applications, including contemporary samples and – just as importantly – historical samples of typefaces printed by different methods. Just as elements can be added to a script for stylistic purposes, the script could also be altered to suit the machines or technology available to print. Reviewing these samples will allow the designer to understand which elements of the script constitute its original structure. This must be done to avoid adopting elements that may seem aesthetically pleasing to a non-native but would have negative effects on the readability of the script.

Experiments can also be done with the original writing tools of the script. Practicing writing the characters and seeing how they relate and connect with each other with the reed pen, which was used to write manuscripts in Devanagari, is useful for building an understanding of the nature of the script. These experiments and studies not only help the designer to comprehend the structure of the script, but can also act as inspiration for new type designs that carry with them the richness of the script in its original form.

### 1.2 A concise look at printing technology

#### 1.2.1 Cold metal composition

The first type foundries in India were established in the late eighteenth century. The machines that these foundries operated used a printing method referred to as *cold metal* composing or typesetting. Also referred to as moveable type, this printing method is based on moveable components, arranged together by hand to create pages which are then

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8 Gerry Leonidas, “Beyond Latin,” in *Eye* 90, 2015, 81.
9 Ross, “Non-Latin scripts: key issues in type design,” 151.
10 Ibid., 150.
printed. These components, referred to as *sorts*, were cast out of metal and were reusable. Wooden type also existed but was mainly used for display typefaces at larger sizes.

Devanagari characters were composed in two different styles, the *Degree* system and the *Akhand* system. Both systems revolve around using components placed together to create the characters. The Degree system is a three-step system in which the main component of the character is cast in the center as half the height of the full character, then the diacritical marks are added to the top and bottom. The Akhand system utilizes kerning to fit components in the right places to form the characters. This method posed complications in the justification of lines, as diacritics were often skewed, resulting in incorrect placement. Having to compose the script in this way meant casting many different sorts for each character, and the earliest type foundries had to cast as many as one thousand sorts for a complete Devanagari typeface.11

These first type foundries were not operated by natives, but rather by Europeans who wanted to publish both religious and political documents. The purpose of these documents was to communicate “… between the Natives of Europe who [were] to rule and the Inhabitants of India who [were] to obey”.12 Due to this, the fonts developed by the foundries were not designed with the native reader in mind and did not show much respect to the Indian letterform. The missionaries had little interest in typography and their main objective was to produce the highest amount of material in the cheapest way. This resulted in simple westernized characters as well as the use of other traits of the Latin script, such as punctuation and inter-word spacing.13

In the second half of the nineteenth century, indigenous font foundries were opened and the standard of type design was raised in India. Although these native foundries have visible differences in their letter formations compared to the European ones, the early fonts had left their mark and many Latin characteristics remained in Indian typefaces.14

### 1.2.2 Hot metal composition

In the twentieth century, the implementation of Indian scripts on hot-metal composing machines was eagerly awaited. However, these composing machines turned out to have a

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13 Ibid., 67.
14 Ibid., 68.
negative effect on Devanagari type design, as Ross notes, “the restrictions of hot-metal machines, especially the line caster, had a profound impact (some would say devastating) on Indian type design.”\textsuperscript{15} The machines cast sorts out of hot metal and composed pages as the letters were typed, replacing the tedious work of arranging characters by hand and speeding up the printing process immensely. Two composing methods were used; the Monotype composing machine cast single characters and arranged them together, and the Linotype composing machine cast whole lines of type at once. These composing machines had been designed for handling Latin fonts and they operated fastest and most efficiently with 96 sorts. This meant complications arose when larger character sets needed to be used, such as in the case of Devanagari, as the script has no pre-determined character sets due to the fact that most characters are ligated consonants known as \textit{conjuncts}.\textsuperscript{16} The large character repertoire of the script remains one of its most difficult technical challenges and with the introduction of hot-metal type machines Devanagari was forced to discontinue hundreds of typeforms.\textsuperscript{17} Fonts designed by the European missionaries contained around 1000 sorts and Vincent Figgins\textsuperscript{18} standard Devanagari contained 608 sorts. To fit the script on the Linotype machine, it was possible to fit over 200 sorts in different compartments, this however had a drastic effect on composing speed.\textsuperscript{19}

Large character sets were not the only problem in implementing Devanagari into hot-metal type machines. The Linotype machine did not allow sub- or superscripted elements, which nearly eradicated the vertically stacked conjuncts of Devanagari. It was also not able to kern and position accents correctly which resulted in characters being distorted and vowel signs and diacritical marks separating from their host characters, making them distorted and unrecognizable from their handwritten counterparts. This not only had an obvious affect on readability, but ended up resulting in the formation of two different readerships; those who were familiar with the written letterforms found in manuscripts, and those who were unable to recognize traditional letterforms due to being confined to reading newspapers and other mass productions. This changed what was considered legible typography.\textsuperscript{20}

\textsuperscript{15} Ross, “An approach to non–Latin type design,” 69.
\textsuperscript{16} Ross, “From Metal Type to Digital Letterforms – a Straightforward Transition for Indian Scripts?,” 129.
\textsuperscript{17} Ross, “Non-Latin scripts: key issues in type design,” 134.
\textsuperscript{18} A punch-cutter from the United Kingdom who started producing fonts in 1782. He produced many non-Latin fonts and became one of the most important suppliers of “exotic type” to the East India Company.
\textsuperscript{20} Ross, “From Metal Type to Digital Letterforms – a Straightforward Transition for Indian Scripts?,” 129.
Although the Monotype machine was better suited for Devanagari typesetting due to its ability to kern, which allowed for correct placement of vowel accents, it was unsuitable for rotary printing. This meant it could not be used to print newspapers and was nearly only used for the printing of books. This resulted in typefaces produced by Linotype having a greater influence on Indian typography due to a higher output of printing material and therefore a larger readership.\textsuperscript{21}

\textbf{1.2.3 Photocomposition}

It was during the mid-twentieth century that the highly influential printing method of photocomposition was introduced which provided the opportunity to reverse the decline of quality of Devanagari type. Photocomposition used film negatives projected onto photographic paper by a machine called a phototypesetter. One negative could be reduced or magnified to the desired type size and the negatives took up far less space than the composed hot metal pages. The photocomposition machines could place accents very accurately, meaning it was possible again to recreate traditional letterforms. However, due to readers being accustomed to the distorted characters of the hot metal type machines, this was at first criticized as being retrogressive.\textsuperscript{22}

In 1978 Linotype developed a keyboard for the phototypesetters; this was a breakthrough in technology since up to this point no standard keyboard existed for Indian scripts. It was called the phonetic keyboard, and it marked the demise of the large keyboards previously used in the photocomposition era. The keyboard contained software that could select contextual forms, and was simple in design, allowing native speakers to easily operate it. Base characters, vowels, modifiers, numerals and punctuation were located on the keys, along with a conjunct key, which upon pressing would generate the correct ligature. For the first time the character set was not restricted by the hardware, but by the capacity of the typeface; the font repertoire could now contain up to 500 sorts. This allowed for the extension of many Devanagari typefaces and supported multi-language keyboards which before this was unthinkable.\textsuperscript{23}

\textsuperscript{21} Ross, “From Metal Type to Digital Letterforms – a Straightforward Transition for Indian Scripts?,” 132.
\textsuperscript{22} Ibid., 134.
\textsuperscript{23} Ross, “An approach to non–Latin type design,” 71.
1.2.4 Digital type design

With the introduction of digital type in the late twentieth century the production of typefaces has transformed. With relatively low-cost software built for typeface design being so readily available, type design has moved from a few large companies, whose main business was selling typesetting machines, into the hands of smaller publishers and independent designers.24 This has both been good and bad for Devanagari type design. On the one hand more typefaces are being produced, but the quality of these typefaces varies greatly. Typeface piracy has also risen, which causes investments in new non-Latin type designs to be less desirable.25

Although photocomposition machines allowed for large character sets, some regression took place in the end of the twentieth century as the standard digital font formats, Postscript and TrueType, could only store up to 256 characters. With the development of OpenType font files in the beginning of the twenty-first century, all character set constraints were removed, allowing a maximum number of 65,536 glyphs or symbols in a single font. OpenType specifications were also developed for contextual alternatives and other typographic behaviors crucial to Devanagari, allowing for these features to be easily coded into the typeface.26 Type design applications such as Glyphs27 even have many OpenType features pre-coded into the software, such as automatic conjunct formations. Currently these automatic features are not foolproof and often require the feature code to be edited, however in the future this will hopefully be unnecessary, making the creation of Devanagari typefaces a simpler task for the designer.28

Another big breakthrough of the digital age in regards to non-Latin type design is the development of Unicode. The Unicode standard is a universal map of characters, developed to specify the representation of characters in multilingual texts. Each character is mapped out and assigned a code. The Unicode standard allows computers to recognize different scripts without needing any specific software.29

But even digital typefaces still carry with them the legacy of the restrictions of older typesetting methods and remain as copies of unsatisfactory metal or film fonts.

27 https://glyphsapp.com/
28 Gunnar Vilhjálmsson in discussion with the author, 27/11/2015.
Newly published Devanagari OpenType fonts sometimes still only contain 254 glyphs, a limit set by previous technology. Since typeface design software is easily accessible, many fonts are designed without proper knowledge and research, resulting in badly designed fonts. One of the main issues with contemporary Devanagari typefaces is the lack of consistency in construction. Many typefaces contain poorly constructed glyphs, both in their design and the balance of stroke width, resulting in awkward fittings of characters within the same typeface, which in turn hinders the overall flow of the typeface. The same is true for diacritics, which are often inconsistent in appearance. An example of this is the use of two different designs within a single typeface to represent the same diacritic. Vowel marks are often misaligned, overlapping or in incorrect positions and conjuncts are also often disproportionate and composed out of badly fitting half forms, resulting in lack of readability of the typeface. Finally, many Devanagari typefaces are still being constructed based on the Latin script. This is done in two ways; One is by using Latin letters to construct Devanagari letterforms, such as re-using the letter s to create the letter ड. The other method is using calligraphic styles and features from the Latin script such as serifs, which do not fit with Devanagari letterforms.30 These issues with contemporary Devanagari typefaces accentuate the fact that designers must research and question earlier designs to be able to fully utilize the latest technology and produce quality designs.31

31 Ross, “Non-Latin scripts: key issues in type design,” 130.
2. The process of designing a Devanagari typeface

2.1 Introduction to the Devanagari script

After having researched the history of designing Devanagari typefaces, the next step is to get accustomed to the script, the character set and behaviors. The Devanagari script runs from left to right. One of the key visual aspects of the script at first glance is the *shiro-rekha*, or the head line, which the characters hang off of. The head line is a continuous horizontal stroke across the top of sequential consonants. Traditionally no word spaces existed in Devanagari and the headline ran the length of the script, but meanwhile they have made their way into the script through westernization. Another key visual is the use of vowel marks and diacritics, which act as a phonetic guide by showing correct pronunciation, and are placed both in the sub- and superscript positions.

The Devanagari script is based on syllables, rather than individual letters. The basic consonants carry with them the vowel *a*, for instance, क does not only represent the consonant *k* but the syllable *ka*. The vowel sound can then be altered with the placement of surrounding characters. Devanagari vowels have independent forms, which are used in the beginning of a syllable but when vowels immediately follow consonants they appear in their dependent forms. These dependent forms are referred to as *matras*, which are marks that attach to the consonants and alter their ‘inherent’ vowel *a*. An example is shown in fig. 1 (below), where the independent vowel उ (*u*) is shown in its dependent form, written with the sign उँ. The dependent form is then combined with the consonant क (*ka*), creating the character कु (*ku*).

Fig. 1. An example of the use of matras

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34 Snell, *Read and write Hindi script*, 10.
35 Ibid.
Another unique behavior of the Devanagari script is its ligated consonants or conjuncts. Conjuncts form when two or more consonants are written with no vowel between them. These conjuncts are formed in different ways, most commonly by dropping the right hand component of the first character and attaching it to the second one. Most Devanagari consonants contain a vertical stroke, which is then simply dropped when forming the conjunct. This is illustrated in fig. 2 (below): by removing the vertical stroke in the character स (sa) and joining it to the character क (ka), the conjunct झ (ska) is formed.

![Conjuncts in Devanagari](image)

**Fig. 2.** An explanation of horizontal conjuncts

The way consonants connect varies according to their shapes and not all consonants contain a vertical stroke. In these cases they either form stacked vertical conjuncts or the second character is changed to form the conjunct. *Half-forms* are consonants that have their vertical stroke or right side removed; these are then created into a component glyph from which conjuncts can be formed. This means that the typeface must contain not only glyphs for each consonant but also its half-form. There are no italics used in Devanagari, although some slanted Devanagari typefaces have been created. Bold typefaces are used for emphasis.

### 2.2 Defining a brief

A design brief serves as a guide for what the final outcome of the typeface will be. If the typeface is being designed for a specific client the brief is usually decided collaboratively between them. The brief is usually comprised of questions, which define the design of the typeface. The design brief has always been an important part of the type design process and perhaps even more since the breakthrough of digital type, as fonts can be designed to be used for a specific purpose, such as on screen or in specific sizes. Referring back to the brief throughout the design process is important to make sure the typeface fits the required

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36 Ross, “Non-Latin scripts: key issues in type design,” 134.
37 Snell, *Read and write Hindi script*, 55.
38 Naik, *Typography of Devanagari*, vol. 1, 327.
purpose. The brief also eases the task of making choices regarding changing specific elements of the design. The questions in the brief are similar to the ones designers may ask of themselves when selecting an existing typeface for a project. Defining the intended function, such as the target media and the dimensions in which the typeface will be displayed, is a key question of the brief. Other questions can include the language and script support of the typeface, as well as whether it should contain different weights. The brief also defines the personality and characteristics of the typeface, and what effects these traits will have on the communication of the typeface. The brief is then composed out of the answers to these questions, giving the designer a clearer view of the overall design objectives of the typeface.40

Using the answers as a guide, it is possible to determine which stylistic elements will suit the intended purpose of the typeface. For instance, a typeface intended for use in body text will ideally be easy to read in small point sizes while avoiding calling attention to the typeface itself, as this can distract the reader from the content of the text. However, for display typefaces intended for use at large point sizes, one can go into more details in the construction of the characters. Typefaces set the desired feel and mood of the communication and leave a subconscious impression on the reader so it is important to find a balance between aesthetics and functionality.41

2.3 Character set and language coverage

One very important thing to consider when designing a Devanagari typeface is the character set, as it has been one of the most problematic issues of the script. Due to the unique typographical behaviors of Devanagari, typefaces have no pre-determined character set and contemporary typefaces usually contain around 1000 glyphs. Although the character set charts can be accessed through the website of Unicode and may be helpful for determining the needed glyphs, in the case of Devanagari the majority of glyphs within the font are not listed in the chart as they consist of contextual forms such as half-forms and marks.42

42 Ross, “Non-Latin scripts: key issues in type design,” 134.
The Devanagari script contains fifty-four vowels and consonants, consisting of eleven independent vowel characters, ten dependent vowel signs and thirty-three consonants. There is no distinction between uppercase and lowercase characters in the script, making it a *unicase* alphabet. These characters are shown here in tables adapted from the matrix of Devanagari syllabary in the book *Read and write Hindi script*.43

### Independent vowel characters:

<table>
<thead>
<tr>
<th>अ</th>
<th>आ</th>
<th>इ</th>
<th>ई</th>
</tr>
</thead>
<tbody>
<tr>
<td>उ</td>
<td>ऊ</td>
<td>ऋ</td>
<td></td>
</tr>
<tr>
<td>ए</td>
<td>ऐ</td>
<td>ओ</td>
<td>औ</td>
</tr>
</tbody>
</table>

### Dependent vowel signs:

There is no dependent vowel sign for the character *a*, due to the fact that all consonants in their unaltered form contain it as an inherent vowel, as explained above.

<table>
<thead>
<tr>
<th>ऋ</th>
<th>ऌ</th>
<th>ऌ</th>
<th>ऌ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ऌ</td>
<td>ऌ</td>
<td>ऌ</td>
<td>ऌ</td>
</tr>
<tr>
<td>ऌ</td>
<td>ऌ</td>
<td>ऌ</td>
<td>ऌ</td>
</tr>
</tbody>
</table>

### Consonants:

<table>
<thead>
<tr>
<th>क</th>
<th>क</th>
<th>ग</th>
<th>ग</th>
<th>ङ</th>
</tr>
</thead>
<tbody>
<tr>
<td>छ</td>
<td>छ</td>
<td>ज</td>
<td>ज</td>
<td>ङ</td>
</tr>
<tr>
<td>ट</td>
<td>ट</td>
<td>ढ</td>
<td>ढ</td>
<td>ङ</td>
</tr>
<tr>
<td>ठ</td>
<td>ठ</td>
<td>ड</td>
<td>ड</td>
<td>ङ</td>
</tr>
<tr>
<td>प</td>
<td>प</td>
<td>ब</td>
<td>ब</td>
<td>ङ</td>
</tr>
<tr>
<td>य</td>
<td>य</td>
<td>र</td>
<td>र</td>
<td>ङ</td>
</tr>
<tr>
<td>श</td>
<td>श</td>
<td>स</td>
<td>स</td>
<td>ह</td>
</tr>
</tbody>
</table>

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43 Snell, *Read and write Hindi script*, 16.
The script also contains a few diacritical marks. Dots are placed below, beside or above characters to adjust their sounds. Other diacritics are the ं mark, referred to as the candarabindu (moon [and] dot), placed above characters, and the visarg which resembles a widely spaced colon. To remove the ‘inherent’ a vowel sound from consonants without the use of conjuncts, the अ mark, called viram or halant is used, usually in technical contexts such as in educational settings or when a typeface simply cannot handle a complex stacked vertical conjunct.

Punctuation in Devanagari has mostly been adapted from Latin scripts. A single punctuation sign is native to Devanagari, the character छ, danda (staff) or khari pai (upright line), which is used as a full stop or period. Since punctuation has mostly been adapted from Latin scripts, the vertical line and Latin period can both be found in print. Other punctuation in Devanagari includes inverted commas, ellipses and hyphens. The character ँ, the avagrah, is used to show that a character is being shouted and is used in combination with the Latin exclamation point. The sacred syllable om also has a special symbol in Devanagari, ☪. Devanagari also contains its own set of numerals which are used alongside Latin (roman) numerals in the script. The numerals have a few alternate variations, depending on the language being written. Shown here are the Hindi numerals, alongside the Latin ones.

<table>
<thead>
<tr>
<th>द</th>
<th>१</th>
<th>२</th>
<th>३</th>
<th>४</th>
<th>५</th>
<th>६</th>
<th>७</th>
<th>८</th>
<th>९</th>
<th>०</th>
</tr>
</thead>
</table>

Deciding on the character set does not only consist of determining the amount of conjuncts designed, but rather how they are formed; whether they are designed as separate glyphs or generated with the help of shared components and how the diacriticals are attached to the base glyphs. Determining which characters are included in the typeface and how they are composed should be decided by reviewing the purpose of the typeface, which is outlined in the design brief.

Since OpenType typefaces no longer restrict large character sets, regional languages and character variations can be combined into one typeface. The Devanagari script is used for over 120 languages and different languages contain variations of character shapes, as well as alternative conjunct constructions. Documents detailing these

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44 Snell, *Read and write Hindi script*, 46.
46 Ibid., 77.
exact linguistic variations to aid typeface designers can be found on the Internet, such as the *Devanagari script behavior for Hindi* on the website of the Technology Development for Indian Languages Programme.⁴⁸ Although this essay does not deal with the issues of Latin type design, it is important to consider from the beginning if the Devanagari typeface being designed should have a Latin counterpart. When designing a multi-script typeface, it is important that although the scripts should harmonize with each other, in addition to functioning well separately and staying true to their key visual elements.

2.4 Sketching: calligraphy and construction

The traditional tool for writing northern Indian manuscripts, including Devanagari, is the reed or bamboo pen. The reed pen is cut at an angle, which produces thick strokes where bowls join a vertical stem; this is the opposite of traditional western pen strokes. When writing in Devanagari, the pen is kept at a 45° angle which is not changed while writing the letterforms.⁴⁹ Familiarization with the strokes produced by the traditional writing tool results in a better understanding of the construction of the script, producing better designs. Sketching manually on paper provides an opportunity to quickly draw various character shapes, and can offer assistance during the design process.⁵⁰ The drawing order of constructing the letters is shown in fig. 3 (following page): first the characteristic part of the letter which is usually the left side, second the vertical bar, third the bottom elements and fourth the top elements such as *matras* or diacritical marks. Finally, the headline is drawn across the top.⁵¹

![Fig. 3. Drawing order of the vowel ओ](image)

Dr. Dalvi defines the anatomy of a typeface as “… a system which depicts the structural makeup of a letter; describing certain key parts within the letter for a given

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⁵⁰ Vilhjálmsdóttir in discussion with the author, 27/11/2015.
The typographic anatomy of the Latin script has been thoroughly analyzed and its different graphic elements are represented with terms including ascender, descender, serifs, loops and counters. Although a few people have studied the anatomy of the Devanagari characters and proposed terms for their different graphical details, no universal standard exists and many type designers use different terms for the same features. Dr. A. V. Bhagwat was the first to attempt a similar classification of the Devanagari script as is known in the Latin script. His classifications are based on handwritten Devanagari as opposed to type, and they are therefore obsolete in a certain sense, nonetheless they are still helpful insights on the graphic structure of the script according to Dr. Dalvi. Dr. Bhagwat began by sorting the characters into groups by specifications such as size, complexity, similarity and graphical elements such as strokes, angles, endings and flourishes. He then used the information collected to create a diagram showing the graphic elements of the Devanagari characters, shown in fig. 4 (following page). The diagram shows the headline from which Devanagari characters hang, comparable to the baseline in Latin scripts. Along with this headline, other guidelines shown are the upper mean line and lower mean line, which mark where the main part of many characters begin and end, the base line to determine where the complete letter ends and the matra line, which shows the top most point of the matras. The diagram also displays most elements usually used in the script, such as different diacritics and conjuncts.

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53 Ibid.
54 Naik, Typography of Devanagari, 205.
55 Ibid., 215.
Typefaces in the Devanagari script mostly fit into two categories; *modulated stroke* typefaces and *low-contrast* typefaces. Modulated stroke typefaces have strokes with difference in contrast; the stroke style descends from early manuscripts with characters being drawn with the traditional reed pen, and produces a typeface with a calligraphic style. Low contrast typefaces on the other hand contain little to no contrast. When choosing a stroke style it is again important to refer to the design brief to see which style suits the intended purpose of the typeface. Modulated stroke and low contrast typefaces share some similarities with Latin serif and sans-serif fonts, with modulated stroke typefaces often better-suiting for body text and low contrast fonts suiting for web applications. However, just as with Latin fonts, this is not always the case.\(^\text{56}\)

In his essay on the conceptual model of Devanagari typefaces, Dr. Dalvi defines a few more character features that are important to be taken into consideration when designing a typeface in the script. Examples of these features can be seen in fig. 5 (following page). In characters with a ‘neck’ joining them to the headline such as ट or ढ, the connecting stroke can either be drawn as an angular or horizontal stroke. The counters, which are defined as the enclosed negative space in letters such as क or ठ, can either be drawn fully closed or slightly open. The authentic way of writing Devanagari is with

\(^{56}\) Gholap, “Designing a Devanāgarī text font for newspaper use.”
closed counters, but some designers choose to keep them open to increase readability. Similarly to counters, characters containing loops such as भ or ध can be represented with either closed or open loops. 57

<table>
<thead>
<tr>
<th>necks</th>
<th>counters</th>
<th>loops</th>
</tr>
</thead>
<tbody>
<tr>
<td>ट</td>
<td>क</td>
<td>भ</td>
</tr>
<tr>
<td>Adobe Devanagari horizontal stroke</td>
<td>Adobe Devanagari closed counter</td>
<td>Devanagari MT closed loop</td>
</tr>
<tr>
<td>ट</td>
<td>क</td>
<td>भ</td>
</tr>
<tr>
<td>CDAC Surekh angular stroke</td>
<td>CDAC Yogesh open counter</td>
<td>Adobe Devanagari open loop</td>
</tr>
</tbody>
</table>

Fig. 5. Variations of Devanagari character features

Another important character feature is the knot, a part of a character where two strokes overlap each other, such as in the characters ढ and ण. When designing the knots, care should be taken to insure that they do not stand out and the typeface maintains an even grey color. 58

2.5 Digitizing: proof of concept

Starting the design with a small amount of characters makes it an easier task to figure out whether the design is successful or not. In the diagram shown above (fig. 1) a sentence is chosen which displays the characterizing elements of the script, such as vowel marks, consonants and conjuncts. When beginning to digitize the sketches it is important to choose a word or collection of characters that contains these key elements. Dr. Dalvi recommends starting with the letters अ इ ए ख त थ ध ध ध, which define features that many of the remaining characters can be derived from. McLaughlin further suggests adding conjuncts मोर्ं and ड्डू which contain height extremes; these are useful for being able to determine the vertical metrics of the typeface. 59 As always, the design brief should be kept in mind while choosing these initial characters. For instance, if the design is complex or in a very heavy weight, it is important to start designing the more complicated characters to

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57 Gholap, “Designing a Devanagari text font for newspaper use.”
58 Ibid.
see if they function in the typeface. These first characters designed are referred to as the proof of concept.\textsuperscript{60}

Once the designer is satisfied by the proof of concept it is important to start getting feedback. Feedback should be acquired both from type design specialists who are well acquainted with the script as well as native readers of the script with little to no type design knowledge, as these two people will see the design in different ways. Native readers can both comment on the readability of the script and recognize cultural associations the typeface might have with their surroundings. If the typeface is being designed for a client, their feedback should also be received at this stage. After receiving feedback the designer can progress with the rest of the character set, starting with the vowels and consonants and finally the conjuncts. If the typeface will contain more than one weight, they should be designed in the weight extremes, such as the thin and black versions, which can then be interpolated\textsuperscript{61} and edited. The feedback should remain a constant throughout the process, so that the designer will continue to receive regular reviews from their client and consultants.\textsuperscript{62}

Alongside designing the characters it is important to start spacing them correctly. When spacing Latin typefaces, usually the letters ‘n’ and ‘o’ are used to determine the space between round and flat side-bearings. The same method is used in spacing Devanagari; according to McLaughlin, an example of a good character for spacing tests in Devanagari is प. After filling pages with प to test that the character has an even grey color, the designer can start adding in other characters with round features such as ठ. Once these spacing tests are complete, other common characters can be added to the string of प and ठ, to compare their spacing next to flat and round side bearings. The spacing tests should be done in a long list so they can be compared effectively. It is important to do these tests in print, unless of course a screen font is being designed.\textsuperscript{63} The characters can then be categorized into groups referred to as metric classes depending on their shapes. For example, the characters प and ठ can be in the same metric class as they share the same side-

\textsuperscript{60} Vilhjálmsson in discussion with the author, 27/11/2015.
\textsuperscript{61} Interpolation refers to a computer application automatically producing font weights between two extreme values.
\textsuperscript{62} Vilhjálmsson in discussion with the author, 27/11/2015.
\textsuperscript{63} McLaughlin, “Designing Devanagari Typefaces.”
bearings. After spacing the first characters, the designer will then be able to form words out of them and begin testing with real text.  

Along with spacing tests, all other aspects of the typeface need to be repeatedly tested throughout the process, including all marks and conjuncts. Once the complete character set has been designed and tested repeatedly with constant feedback, the font engineer receives the design and performs various tests on different aspects such as outlines, curves and codes in information such as the metrics of the typeface and copyright information. Finally, the font files are exported; these are usually usually multiple files for different operating systems and programs.

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64 Vilhjálmsson in discussion with the author, 27/11/2015.
65 Ibid.
Conclusion

Although the Devanagari script has been poorly served in regard to type design in the past centuries, it is the belief of the author that the design of Devanagari typefaces has room for improvement. Through time, the script has been rendered awkwardly due to restrictive reproduction methods, from misplaced vowel marks to ill-fitting or inaccurate conjuncts. Although the marks of these restrictions have followed the script through centuries of print, since the revolution of digital type design the technology to completely eradicate these marks is now available.

Having finally entered an era with the proper technology to render complex scripts, the other necessary part of good typeface designs becomes even more important: the research. Thankfully, in the past few decades, and especially since the revolution of digital type design, there has been a rise in global awareness for the necessity to design better non-Latin typefaces and a rise in interest in the subject has created a higher demand for quality Devanagari typefaces. Due to this interest, typefaces in non-Latin scripts have been exhibited around the world, with new literature being published on the subject alongside these exhibitions, such as Language Culture Type edited by John D. Berry and Non-Latin scripts, containing essays by Fiona Ross and Graham Shaw, both cited throughout this essay.

The publication of this literature serves a key role in producing more information available to designers. Researching and gaining knowledge before designing a complex script is crucial for a successful design and the influx of information on Devanagari type design encourages this research. With the available technology of the digital age and committed research, designers are and will be able to produce high-quality Devanagari typefaces.

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Fig. 2. Lydon, Kinnat, *An explanation of horizontal conjuncts*, 8/12/2015.

Fig. 3. Snell, Rupert, untitled image, unknown date. In *Read and write Hindi script*, London: Hodder Education, 2010.


Fig. 5. Lydon, Kinnat, *Variations of Devanagari character features*, 25/11/2015.
Appendix

Interview with Gunnar Vilhjálmsson

To gain further insight into the process of designing Devanagari typefaces, an interview was conducted with Gunnar Vilhjálmsson, a contemporary typeface designer who amongst other things designs typefaces in the Devanagari script. The interview took place over Skype on the 27th of November, and has been translated into English.

**How much of the sketching process takes part physically on paper and how much takes place on the computer? Which do you find more helpful? Why?**

I do not usually use paper. I usually design straight into the computer and when I do not, it is usually to get a feel for the structure of a shape. There is a very strong calligraphic ‘flavor’ in the Devanagari text typefaces, so if I am having trouble with the stroke behavior, speed or a certain type of curve, I use a pen to figure it out. Otherwise I do everything on the computer. I know of a lot of people who draw a few characters manually, scan them in and trace them ... and further their design on the computer. I do not think there is anybody who designs a whole typeface on paper. But as I say, if you are having problems with a certain character, it can be a good idea to do some sketches with a broad nib pen. When you sketch you can work quicker than when you move pen points on a screen.

**When designing a font family with many different weights, which weight do you begin designing?**

Say you have a text typeface and are going to design five different weights. If the character construction does not change too much in the extreme weights of the typeface – such as ‘thin’ and ‘black’ – then you should start designing in these extremes, which can then be interpolated. However, a few characters are often designed first in the ‘regular’ weight to get the right thickness and ‘flavor’ of the typeface. This all depends on the the designer though, just as with the sketching preferences.

**Dr. Girish Dalvi recommends the letters ओ ख झ थ ध as a proof of concept as they define many features of the remaining letters. Do you have your own ‘favorite’ proof of concept? Does it differ depending on the typeface being designed?**

I do not have a ‘favorite,’ but the answer to the second part of this question is yes. For instance, are you designing a text or display typeface? When you are designing a
display font or something very bold, the most complex characters should be tested first before you continue. If these characters do not work out in your design then the concept is basically dead.

Who do you go to, to receive feedback? Do you mostly receive feedback from type specialists or also from the average native readers of the script? If either/both, why? How does the client participate in the feedback process?

It is necessary to have consultants who are knowledgeable: on one hand a typographer who is accustomed to Devanagari and on the other hand a native reader but not a typographer. I think it is crucial to have both. You get completely different feedback from the non-typographer. He might not be looking at specific shapes but can comment on the flow of the reading. They can as well make cultural associations; your typeface might remind a native of the latest diaper commercial, or a brand of soup everyone hates. Shapes are always connected to something specific, which is why I think it is very interesting to have someone from the culture offer feedback. You also receive client feedback, expectations connected to their brand, which tighten the boundaries of what you can do.

When it comes to spacing, besides printing and re-printing rows of characters such as पपकपपकपप, what other tools or methods can be used to assist spacing?

There are many theories on how it is best handle spacing … you take shapes that have similar left side bearings, such as o, d, e and c in lowercase, or O, C and G in uppercase. You categorize them into ‘metric classes’ and use the same spaces for these categories. You begin by spacing one of the letters, such as the o, and then assign those spacing values to the rest of the letters in the class. So when you change the o, the c, d and e update automatically. The idea of letters with similar shapes on the same side works for all scripts, including Devanagari.

Concerning contextual alternatives and conjuncts, are they coded into the typeface continuously or is this done in the finalization process?

Since you already know what contextual alternatives and OpenType features you want to include in your typeface, if you have done this before you can simply copy paste the features you used last time. It depends on what program you are using, for instance in Glyphs this is all built into the program itself.

What program do you use?
I use Glyphs.

**Is it the best at the moment for non-Latin type design?**

It is not completely perfect, I have bumped into a lot of things recently. They have a lot of things built into the program, such as character lists and contextual features but they might not all be completely correct. You really have to edit the feature file yourself a bit, although I believe it is not long until you will not have to anymore. I think they have gotten the furthest with Devanagari. I am hoping that soon you will be able to do all the basic stuff and just use automatic features, which would be a revolution. Then you would not have to be a technological wonder to be able to produce typefaces, you could just focus on the design.

**What does the finalization process consist of, what are the last tasks that are completed before the delivery of the final typeface?**

At some point you have a design that functions perfectly. After testing everything back and forth, such as curves, spacing, kerning, marks and conjuncts, the typeface is passed to the font engineer. He checks technical specifications such as if all the characters are in the character set, the quality of the drawings, the vertical metrics and something called a font header with all the copyright information. Finally he exports the font in the formats needed, which are usually more than one as fonts have different files for web and print, and different operating systems use different files.