



# Colored Stories and Heavenly Light

The development of stained glass windows in Gothic cathedrals.



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The development of stained glass windows in Gothic cathedrals.

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*History Thesis, Everhard Korthals Altes*

**Subject:** The development of stained glass windows in Gothic Cathedrals.

**Case studies:** Chartres, Reims, and Bourges Cathedrals, and the Sint-Janskerk in Gouda.

**Research question:** How did stained glass windows evolve throughout the various phases of the Gothic period?

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**Abstract:** This thesis explores the evolution of stained glass windows throughout the various Gothic periods in Gothic cathedrals, focusing on Chartres Cathedral, Reims Cathedral, Bourges Cathedral, and Sint-Janskerk in Gouda. The research investigates developments in stained glass techniques, designs, and symbolism, and elaborates on the educational purpose and the link between architectural innovations and the windows. How these innovations enabled larger and more detailed stained glass windows. It also considers how perceptions and uses of stained glass shifted over time, from purely religious functions to more diverse artistic expression. And the importance of preserving the historical and social value of these windows.

By combining historical, visual, material, and comparative analyses, this research provides a comprehensive understanding of Gothic stained glass windows. It contributes to existing literature by focusing specifically on the value of these windows, in well-known cathedrals, rather than treating it as a minor aspect of Gothic architecture. The findings demonstrate how stained glass windows reflect broad changes throughout the Gothic period and beyond. This research enhances the appreciation for this art form and its everlasting historical significance.

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**Keywords:** stained glass, Gothic cathedrals, architecture, symbolism, religion, craftsmanship, development.

**Wordcount:** 5038 words, excluding sources.

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# Introduction

The 'heavenly' ambiance within the interiors of Gothic cathedrals is largely created by their colorful stained glass windows. These windows not only enhance the visual impact and ambiance of the cathedral but also tell stories. The windows had a didactic purpose, and let the divine light into the cathedrals. Stained glass evolved over the years due to various influences, mainly the development of the Gothic architectural phases, but this development also connects other themes and influences. This thesis will elaborate on the subject of stained glass with the main focus on the question: How did stained glass windows evolve throughout the various phases of the Gothic period?

This question will be answered with research and four supportive case studies, the cathedrals of Chartres, Reims, Bourges, and the Sint-Janskerk in Gouda, which allow me to apply and contextualize the information collected. The case studies can also illustrate findings and ideas, and are essential for making comparisons. The case studies are well-known examples in research papers, particularly on Gothic architecture in its entirety. Less research, however, has been conducted on the stained glass windows within these cathedrals, which is often introduced as a small part of the research. By comparing these four cathedrals and specifically focusing on the stained glass windows, I hope to contribute more knowledge and appreciation for this particular aspect of Gothic architecture.

Throughout the research process, I will practice various methods of analysis. The most prominent will be the historical and visual analysis. Historical analysis is crucial for understanding and contextualizing the subject and situating it within its historical framework. The visual analysis complements this by facilitating an examination of stained glass, which cannot be captured through text alone. Additionally, material, thematic, symbolic, architectural, and comparative analyses will play significant roles. Each detail of the topic requires a different critical perspective, and no single method can contain the subject.

This thesis will consist of four chapters. After reading this introduction, we will dive into the subject. These chapters will progressively build from a broader context to detailed analyses, allowing the subject to be explored at various scales. The first chapter describes the architectural context of stained glass in the various phases of Gothic architecture. The second chapter will explore the symbolism and iconography behind the windows, and focus on the narratives. The third chapter will explain the visual language of the glass and its purpose and placement within the Gothic Cathedrals. The last chapter will dive into the details of the craftsmanship and techniques of stained glass. At the end of this thesis, the research question will be answered and criticized in the conclusion.



# Chapter 1 | The Architectural Context of Stained Glass in Gothic Architecture

*Stained glass is one of the most beautiful key features of Gothic cathedrals. The rise of stained glass during the Gothic period was closely tied to architectural innovations, new structural elements like pointed arches and flying buttresses allowed cathedrals to have taller structures, thinner walls, and more window space (Reynolds, 2013)<sup>1</sup>. This provided an ideal canvas for the art of stained glass and contributed to the concept of dematerialization and transcendence reflected in Gothic cathedrals. Throughout the Gothic era, glass techniques evolved, resulting in larger panels and more complex designs. Innovations arose and created new patterns such as the famous rose windows<sup>2</sup>.*

## 1.1 Stained glass in the Early Gothic period (1140-1200)

During the Early Gothic period, stained glass became a focal point in cathedrals due to larger and higher window openings. Improved glass-making techniques enabled the production of flat glass sheets, resulting in deep, rich colors. These colored windows depicted biblical stories and saints, serving an educational purpose as well<sup>3</sup>.

### 1.1.1 Chartres Cathedral (1194-1260)

The windows in Chartres Cathedral provide an excellent example of the early Gothic period and demonstrate a lot of the first innovations in stained glass in architecture. The Cathedral is suited for both the early- and high Gothic periods. As seen in Figure 1, the high, small, and arched windows of the Choir of Chartres follow the structure of the cathedral perfectly. These windows have a blue/purple appearance, which characterizes the deep colors of the early Gothic period: blue, red, yellow, and white. The blue color became 'Chartres blue' and represented new technological advancements. Simple and orthogonal divisions in the glass windows are also mostly seen within the early Gothic phase<sup>4</sup>.

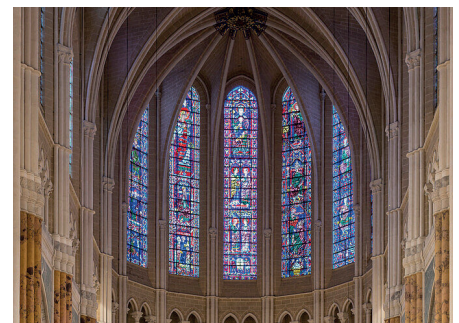


Figure 1. Stained Glass in the Choir, by Image Professionals

### 1.1.2 Bourges Cathedral (1195-1230)

Just as Chartres Cathedral, Bourges Cathedral's construction began at the end of the early Gothic period, but dates mostly back to the high Gothic period. As seen in Figure 2, these windows have the same simple and orthogonal composition as the first windows of Chartres. Religious stories are depicted with deep, bright primary colors and have thick steel separations between the glass panels<sup>5</sup>. Looking at the story told in the windows of Figure 2, and also the early windows of Chartres Cathedral, there is a single figure depicted with a border of glass decoration around it. The depiction of single figures was common in the Early Gothic period when windows were still smaller<sup>6</sup>.

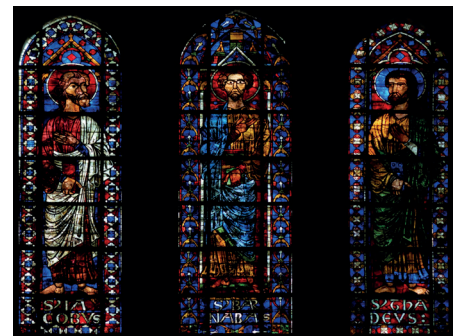


Figure 2. Stained glass window from Bourges Cathedral, by U.H. Archive

## 1.2 Stained glass in the High Gothic period (1200-1280)

During the High Gothic period, stained glass windows became more intricate due to advancements in glass production and color techniques, allowing for thinner glass and more vibrant palettes. Windows featured complex shapes, including rose windows, and storytelling became more detailed with enhanced painting techniques that added depth to figures<sup>7</sup>.

1 The Development of Stained Glass in Gothic Cathedrals by Elizabeth (Aislin) Reynolds (2013) Johnson County Community College

2 Why Stained Glass Windows Are Vital to Gothic Architecture by Bryan Lerew (2018) <https://www.cumberlandstainedglass.com/why-stained-glass-windows-are-vital-to-gothic-architecture/>

3 The Development of Stained Glass in Gothic Cathedrals by Elizabeth (Aislin) Reynolds (2013) Johnson County Community College

4 Ibid.

5 The Cathedral of Bourges and its place in Gothic architecture by Robert Branner (1989), Koninklijke Bibliotheek Den Haag

6 Grisaille Panel | French | The Metropolitan Museum of Art. (2001). The Metropolitan Museum of Art. <https://www.metmuseum.org/art/collection/search/469997>

7 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library



### 1.2.1 Reims Cathedral (1211-1299)

Stained glass windows in Reims Cathedral represent the High Gothic period beautifully. As seen in Figure 3, windows became even larger and allowed more light to enter. Stone tracery makes it possible to realize these measurements. High Gothic glass has finer details and a more diverse color palette<sup>8</sup>. Not only are primary colors and 'Chartres blue' recognizable, but the window in Figure 3 covers the whole spectrum. The use of color patterns is also a new feature representing this period in Gothic stained glass. The rose window is a typical advancement for this time, but has way fewer biblical figures than the windows beneath it and the previous windows showed. They used a more geometric design and simpler features compared to the Early Gothic period<sup>9</sup>. The orthogonal and arched windows do depict biblical figures; compared to the Early Gothic period, these windows do depict more figures in one window<sup>10</sup>.

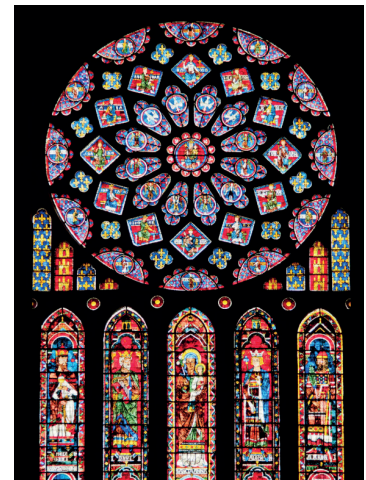


Figure 3. Rose Window, by Encyclopedia Britannica

### 1.3 Stained glass in the Late Gothic period (1280-1500)

Stained glass evolved significantly during the late Gothic period, with larger windows often covering entire walls. Various techniques led to the emergence of different styles. The focus shifted from the traditional Gothic religious themes to more naturalistic figures and elaborate storytelling, marking the transition to the Renaissance style. New styles also emerged as more countries began to use stained glass<sup>11 12</sup>.

#### 1.3.1 Sint-Janskerk Gouda (1404-1593)

The stained glass windows of the Sint-Janskerk are significant because they represent a large part of all the 16th-century glass in the Netherlands. The earliest windows of the church date from 1555<sup>13</sup>. The windows have a larger width than other windows shown, which is typical for Late Gothic windows and their function of maximizing light<sup>14</sup>. As seen in Figure 4, colors are lighter and depict more detailed scenes. The combination of these colors and scenes shows the finer details of the Late Gothic evolution in stained glass. As mentioned, most of the Late Gothic windows show the transition from Gothic to Renaissance style<sup>15</sup>.

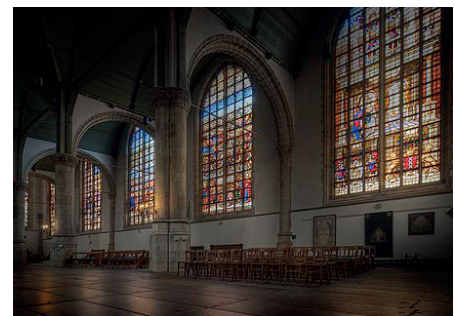


Figure 4. Gebrandschilderde glazen in de Grote Sint-Janskerk in Gouda, by Wikipedia-bijdragers

<sup>8</sup> The Development of Stained Glass in Gothic Cathedrals by Elizabeth (Aislin) Reynolds (2013) Johnson County Community College

<sup>9</sup> Wikipedia contributors. (2020). Reims Cathedral. Wikipedia. [https://en.wikipedia.org/wiki/Reims\\_Cathedral](https://en.wikipedia.org/wiki/Reims_Cathedral)

<sup>10</sup> Grisaille Panel | French | The Metropolitan Museum of Art. (2001). The Metropolitan Museum of Art. <https://www.metmuseum.org/art/collection/search/469997>

<sup>11</sup> The Development of Stained Glass in Gothic Cathedrals by Elizabeth (Aislin) Reynolds (2013) Johnson County Community College

<sup>12</sup> Church of St John Gouda – Discover hidden treasures | Sint-Jan Gouda. (n.d.). <https://sintjan.com/english/>

<sup>13</sup> Ibid.

<sup>14</sup> The stained-glass window in the Sint Janskerk at Gouda: the glazing of the clerestory of the choir and the former monastic church of the Regulars by Henri van Harten-Boers (1997) TU Delft Library

<sup>15</sup> Church of St John Gouda – Discover hidden treasures | Sint-Jan Gouda. (n.d.). <https://sintjan.com/english/>



## Chapter 2 | Glass Stories: Medieval Symbolism

*Stained glass windows in Gothic Cathedrals can be seen as pieces of art, but were primarily created for a religious and didactic purpose. The imagery and iconography were based on biblical stories, saints, patronates, and historical religious devotions. Throughout the centuries, the purpose of these stained glass windows got a bit lost. There was less focus on religion, which led to different, more modern perceptions of these windows. According to Abt. Suger physical beauty and light in stained glass windows can elevate the human mind to understand higher spiritual truths. Stained glass serves as a bridge to invisible realities, making the spiritual world accessible to all believers regarding their background and educational level. This chapter explores the symbolism of stained glass in Gothic cathedrals and how its perception has evolved<sup>16</sup>.*

*“The dull mind rises to truth through that which is material; seeing this light, it is resurrected from its former submersion.” - Abt. Suger.*

### 2.1 Historic symbolism

Stained glass windows were called the “Bible of the Poor” because they visualized the bible for many who could not read. The images, figures, and colors carried layered religious meanings, both direct and symbolic<sup>17</sup>. Especially in the early Gothic period, windows featured primary colors due to limited techniques and the impact of light, and these colors symbolized something within religious themes<sup>18</sup>.

| Color  | Common, sacred meaning      | Earthly meaning     | Ambiguous meaning   |
|--------|-----------------------------|---------------------|---------------------|
| Blue   | Heaven, Virgin Mary         | Loyalty, nobility   | Coldness, distance  |
| Red    | Christ's blood, Holy Spirit | Fire, passion, love | Sin, violence       |
| Yellow | Divine light, holiness      | Wealth, power       | Decay               |
| Green  | Renewal, paradise           | Nature, earth       | Instability         |
| Black  | Mystery, death, humility    | Mourning            | Hell, sin, darkness |
| White  | Sanctity, resurrection      | Innocence           | Sterility           |

Figure 5. Examples Symbolization of colors in Gothic Stained Glass. (Demaison, 1913) (Gage, 1999).

As shown in Figure 5, color symbolism can vary significantly due to difference in theological interpretation, local tradition, or biblical context. Historical authors provided an early framework for understanding these references, but interpretations are always influenced by their time and place<sup>19</sup>. The significance of a color shifts depending on the biblical event, region, century, or political factors. But colors were also selected for practical reasons; for instance, blue often symbolizes heaven and the Virgin Mary but is also a bright color in low light<sup>20</sup>. Therefore, single sources explaining the exact definition of this color symbolism cannot always be completely trusted. It is important that the colors must always be analyzed in their situation, the interpretation should always be accurate on multiple factors such as the visual composition and its context.

Besides the symbolism of color, iconography has a central role in the visuals of Gothic Cathedrals. As explained, the windows functioned as visual interpretation of biblical theology. The composition of figures was chosen carefully for each scenario, scenes were thoughtfully placed within the floorplans of the cathedrals. Important figures were depicted larger, placement on the bottom or top of the window showed the importance of figures, and the division in the window mattered. Smaller symbols, such as halos for holy figures, the cross or a lamb for Christ, a flame or dove for the Holy Spirit, reflect the level of detail in these windows<sup>21</sup>.

16 Radiance and Symbolism in Modern Stained Glass: European and American Innovations and Aesthetic Interrelations in Material Culture by Liana De Girolami Cheney (2016). Google Books

17 Cumberlandstainedglass\_Admin. (2015). Stained Glass More than Just Windows- Cumberland Stained Glass. Cumberland Stained Glass. <https://www.cumberlandstainedglass.com/stained-glass-more-than-just-windows/>

18 La Cathédrale de Reims by Louis Demaison (1913) Open Library

19 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

20 Color and Meaning: Art, Science, and Symbolism by Gage, John. (1999). Google Books

21 Cumberlandstainedglass\_Admin. (2015). Stained Glass More than Just Windows- Cumberland Stained Glass. Cumberland Stained Glass. <https://www.cumberlandstainedglass.com/stained-glass-more-than-just-windows/>



### 2.1.1 Symbolism in Chartres Cathedral

The rose window on the west façade of Chartres Cathedral depicts the final judgement, which is commonly found on this façade because of the setting sun in the west, referring to the 'end' in the bible. In Figure 6, Christ is depicted at the axis mundi, the visual and theological center. He is showing his wounds, surrounded by angels, apostles, and symbols of salvation. This circle shape reflects eternity, while the blue symbolizes the presence of the divine and the red symbolizes his blood<sup>22</sup>. Besides Jesus being recognizable as a figure, his halo confirms his holiness.



Figure 6. Western Rose Window Chartres Cathedral, by Manuel Cohen

### 2.1.2 Symbolism in Bourges Cathedral

Figure 7 shows Jesus washing feet, symbolizing humility, leadership, and teaching greatness to others. The spatial composition of the window suggests the affection and intimacy within scene. Jesus is placed not entirely central, and bending to the surrounding figures, the act of kindness is more important than his presence in this scene. The Blue and red in his halo refer to sacrifice and heaven. The facial expression of the central figure shows a questioning emotion, questioning whether to accept the gesture Jesus is making<sup>23</sup>. The dominant blue background is a symbol of heaven, which lifts the scene into the heavenly sphere. The white accents can refer to purity and innocence<sup>24</sup>.



Figure 7. Jesus washing feet, Bourges Cathedral, by Manuel Cohen

### 2.1.3 Symbolism in Reims Cathedral

The stained glass window at Reims Cathedral (Figure 8) illustrates more earthly labor. Scenes such as grape harvesting and wine production are depicted, integrating the local identity of Reims within theological narratives<sup>25</sup>. The composition is vertically from earth to heaven, with toil at the bottom and heavenly figures at the top. The green accents, mainly present at the bottom, are associated with nature and earth. The red elements symbolize the suffering, but also the love and Christ's sacrifice; red has a contrast in symbolization in this case. Yellow is mostly seen in the workers' clothes, and can symbolize the power of labor, while blue increases towards the top, symbolizing heaven<sup>26</sup>.



Figure 8. Reims Cathedral stained glass window, by Wikimedia

22 Chartres Cathedral by Robert Branner (1969) Koninklijke Bibliotheek Den Haag & TU Delft Library

23 Catholica, V. (2024, October 30). Christ washing the feet of the disciples. Veritas Catholica. <https://www.veritascatholica.com/christ-washing-the-feet-of-the-disciples/>

24 La Cathédrale de Reims by Louis Demaison (1913) Open Library

25 Paroisse Notre-Dame Saint-Jacques de Reims. (n.d.). <https://www.cathedrale-reims.com/>

26 Cumberlandstainedglass\_Admin. (2015). Stained Glass More than Just Windows- Cumberland Stained Glass. Cumberland Stained Glass. <https://www.cumberlandstainedglass.com/stained-glass-more-than-just-windows/>



#### 2.1.4 Symbolism in Sint-Janskerk Gouda

The stained glass window in the Sint-Janskerk (Figure 9) differs significantly from the previous medieval iconographic and symbolic traditions. This composition consists of abstract circles in a vibrant, but more pastel color palette. The symbolism behind this window is not primarily didactic. The circles symbolize the cosmos and express themes of hope, freedom of belief, and tolerance. The peacock feathers in the largest circle are a traditional symbol of Christ's resurrection, linking this window to Christian ideas. Dark borders and figures represent evil, while the light fade of color towards the center and the top symbolize the triumph of good, which are way more abstract symbols compared to medieval scenes. Blue still represents heaven, and is especially at the top to give a glimpse of the divine<sup>27</sup>.



Figure 9. Erasmusglas, by Marc Mulders

## 2.2 New light, old art: the shifting value of symbolism

The perception of the symbolism in stained glass windows of Gothic cathedrals has undergone a significant shift over time. During the Gothic period and throughout the Middle Ages, every detail of stained glass had a specific symbolic meaning, often linked to the presence of God, and was used as a tool to educate and convert people to Christianity. Additionally, some symbols were associated with wealthy patrons who contributed to the construction of the cathedrals, giving many windows local significance<sup>28</sup>.

As centuries progressed, religion became less central to daily life, leading to a decline in the religious role of stained glass. This shift mirrors broader societal changes. Today, while stained glass is appreciated for its aesthetic appeal, the original symbolic meanings are often lost on contemporary audiences<sup>29</sup>. Although valued for its historical significance and beauty, modern stained glass is mostly created for decorative purposes rather than religious themes, with ongoing efforts to preserve the historic value of windows and their architectural context.

| Aspects Stained Glass | Gothic Cathedrals                             | Modern Period                               |
|-----------------------|---|---|
| Function              | <i>Religious stories, education</i>           | <i>Appreciation &amp; cultural heritage</i> |
| Audience              | <i>God's followers</i>                        | <i>Interested visitors &amp; historians</i> |
| Symbolism             | <i>Divine Light &amp; biblical stories</i>    | <i>Historic Significance</i>                |
| Type of symbolism     | <i>Biblical figures &amp; specific colors</i> | <i>Aesthetic choices</i>                    |

Figure 10. The shifting value of stained glass symbolism. (Laura Jansen, 2025)

<sup>27</sup> Canon van Nederland. (n.d.). Erasmusglas. Canon van Nederland. <https://www.canonvannederland.nl/nl/page/105961/erasmusglas>

<sup>28</sup> Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

<sup>29</sup> Ibid.



## Chapter 3 | The visual language: painting with light

*Stained glass is a permanent object but with ever-changing language. The window stays in the same place, but the sunlight changing throughout the day creates a dynamic and spiritual experience. The giant and colorful artistic windows let lots of light into the cathedrals, typical of Gothic architecture's emphasis on maximizing light. Abt. Suger brought the concept of creating "heavenly light" to life, which brought god's presence into Gothic cathedrals. The interplay of light and color created this mystic and divine environment, and the specific placement of each of the different stained glass windows played a crucial role in this atmosphere. This provided practical illumination where needed and brought the symbolic messages to life<sup>30</sup>.*

### 3.1 Placement and Purpose

The placement of stained glass windows in Gothic cathedrals and the intensity of their colors were planned to enhance the divine atmosphere and convey symbolic messages. In the nave of the cathedral, the windows typically feature lighter and more translucent glass, allowing more natural light to fill the space where people gather<sup>31</sup>. As seen in Figure 11 in Reims Cathedral, this creates a light, natural, and friendly space, a transition from the earthly realm to the heavenly, approaching the direction of the altar<sup>32</sup>.

As you move toward the east end of the cathedral, where the choir or apse is located, the windows become darker and less translucent. This creates a more mystical atmosphere around the altar, and the richer colors symbolize the presence of God<sup>33</sup>. In this area, the windows serve a more educational purpose by depicting various narratives. The windows guide the way through the cathedral, and become more playful with colors, as seen in Bourges Cathedral (Figure 12)<sup>34</sup>.



Figure 11. 'Light' windows nave Reims Cathedrals, by Laura Jansen



Figure 12. Cathédrale Saint-Étienne de Bourges, déambulatoire extérieur, by P. Lemaître

30 Why Stained Glass Windows Are Vital to Gothic Architecture by Bryan Lerew (2018) <https://www.cumberlandstainedglass.com/why-stained-glass-windows-are-vital-to-gothic-architecture/>

31 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

32 La Cathédrale de Reims by Louis Demaison (1913) Open Library

33 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library



A window depicting the baptism of Jesus Christ is almost always placed in the western part of the cathedral, near the original baptistery, as seen in the Reims Cathedral<sup>35</sup>. This isn't the case in Gouda, which shows the difference of traditional placement of baptismal iconography, and post-medieval restructuring of the space<sup>36</sup>. The west façade, as explained, includes the famous rose window, often illustrating the Last Judgment (Figure 13). In contrast to the Last Judgement, the east end represents sunrise and the beginning of a new day, associated with the Virgin Mary, as light enters these windows at dawn and during services. Additionally, rose windows may also be found on the north and south façades, maximizing sunlight throughout the day<sup>37</sup>. This strategic placement creates a vibrant focal point that can be appreciated from both inside and outside the cathedral (Figure 14).

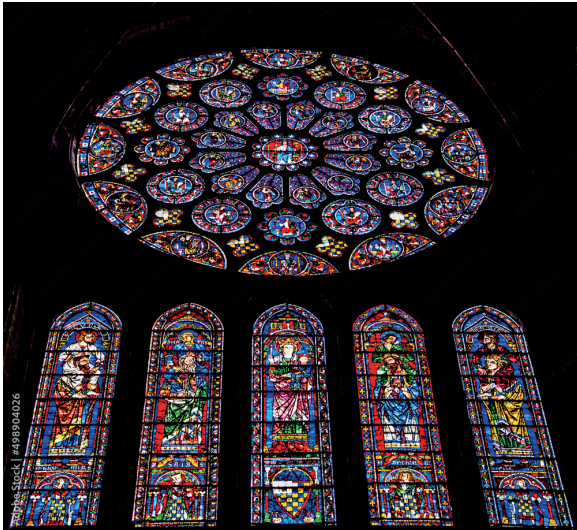


Figure 13. Stained glass rose window in Chartres Cathedral, by Stockfoto

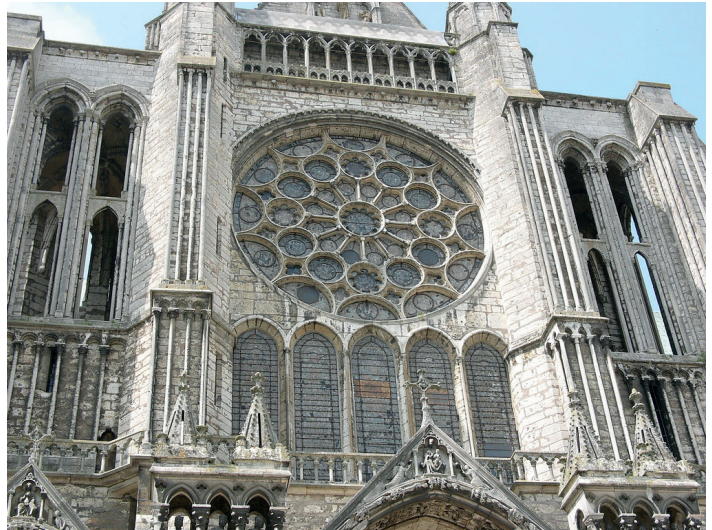


Figure 14. Chartres Cathedral South Façade Rose Window exterior, by S. Parry

35 Paroisse Notre-Dame Saint-Jacques de Reims. (n.d.). <https://www.cathedrale-reims.com/>

36 The 72 stained-glass windows of Saint Johns church in Gouda by R.A. Bosch (2008) Koninklijke Bibliotheek Den Haag

37 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library



## Chapter 4 | The Craft of Stained Glass

*Stained glass is a refined art form with a history dating back to the Romans and Egyptians, who created small glass objects rather than the large window panels that we recognize today<sup>38</sup>. By using metallic salts and oxides, craftsmen added luxurious colors to the glass, beautifully reflecting divine light in cathedrals<sup>39</sup>. The term “stained glass” encompasses both colored and painted glass that has been kiln-fired. Though techniques have evolved, they still connect to the methods used for Gothic cathedral windows<sup>40</sup>.*

### 4.1 Creating a Masterpiece

#### 4.1.1 Creating the Stained Glass

Glass is essentially melted sand, created by adding ingredients such as soda, lime, lead oxide, and various coloring or decoloring agents. The mixture of sand and these ingredients is melted at temperatures reaching up to 2000°C. Sodium can lower the melting point, and metal oxides are added to create colored glass. The resulting colors depend on the ingredients used and the melting temperature and duration<sup>41</sup>.

There are two main types of medieval glass: antique glass, which has uneven thickness and color variations and has a lot of imperfections, and sheet glass, which is rolled flat for uniformity (Figure 15). These imperfections of antique glass are desirable when creating textured colored glass. Bottle glass is made by blowing molten glass into a square shape, resulting in thinner sheets (Figure 16). Although the blow-pipe technique was invented by the Egyptians around 300 B.C., it wasn't widely used in Gothic cathedrals<sup>42</sup>.

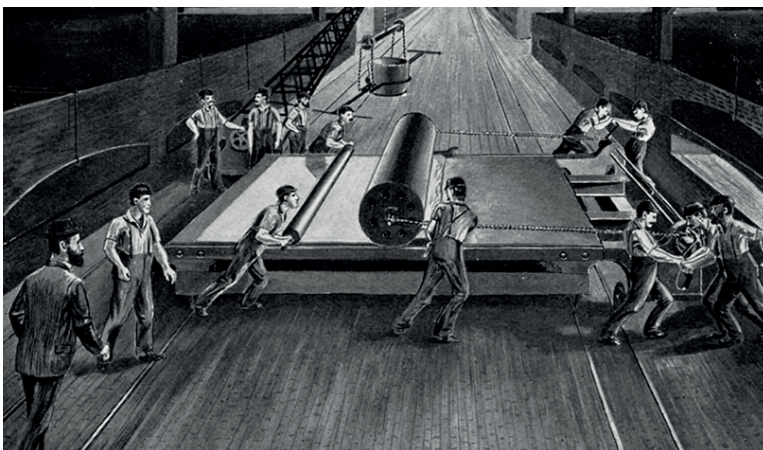


Figure 15. Antique & Wavy Glass Manufacturer, by Restoration Window glass

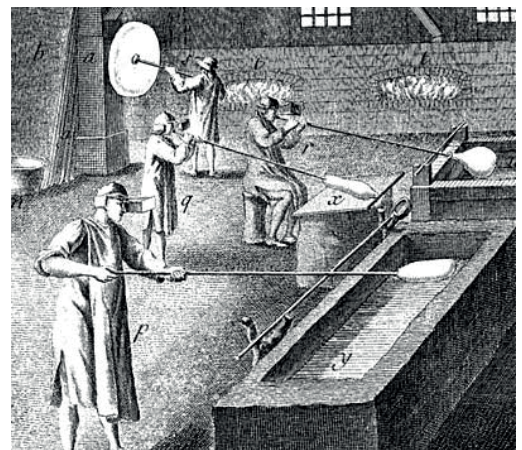


Figure 16. Glassmaking, by HHF Factpaper

#### 4.1.2 Designing the Window

The first step in designing a stained glass window is to sketch the ‘cartoon’ on large paper sheets, focusing on the placement of horizontal and vertical bars to ensure a cohesive design<sup>43</sup>. The bars are essential and should be placed where they are of most supporting value and do not interfere with the design of the cartoon.

After the cartoon is complete, glass sheets are laid over the pattern and cut into the right-sized pieces. Careful cutting ensures the pieces fit the design, and any excess glass is chipped away so the proportions of the design stay as intended<sup>44</sup>. Light cuts on the surface are made by hand, using diamonds for straight lines and cutting wheels for curves. A light tap breaks the glass along the cut.

38 The Evolution Of Stained Glass Windows Through History by Lead Windows (2023) <https://www.lead-windows.co.uk/news/the-evolution-of-stained-glass-windows-through-history>

39 Why Stained Glass Windows Are Vital to Gothic Architecture by Bryan Lerew (2018) <https://www.cumberlandstainedglass.com/why-stained-glass-windows-are-vital-to-gothic-architecture/>

40 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

41 Ibid.

42 Ibid.

43 Ibid.

44 The Development of Stained Glass in Gothic Cathedrals by Elizabeth (Aislin) Reynolds (2013) Johnson County Community College

To add detail to the cartoons, the Grisaille technique can be used, applying iron oxide pigment for shading and then firing it on, as seen in the face of Jesus Christ in Figure 17. Once the details are finalized, the glass pieces are assembled (Figure 18), each joint soldered together with lead and reinforced with larger bars for structural support<sup>45</sup>.



Figure 17. Stained glass window, Ambulatory, Bourges Cathedral, by Manuel Cohen

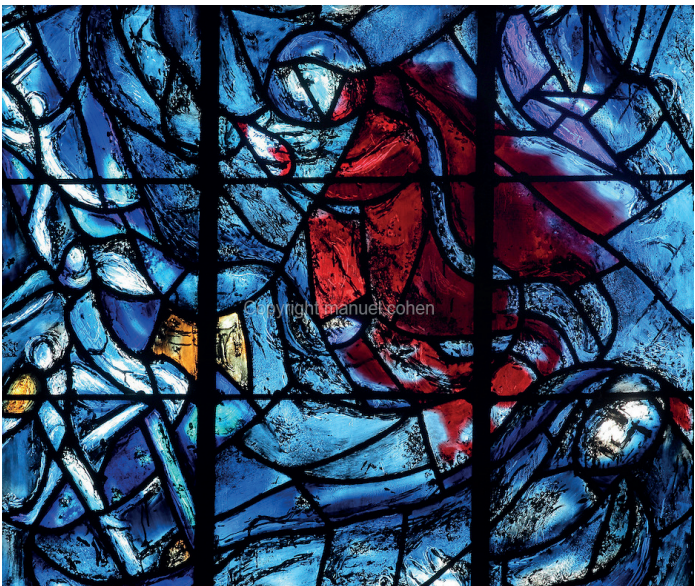


Figure 18. Marc Chagall Stained Glass Window, Cathedrale Notre-Dame de Reims, by Manuel Cohen

#### 4.1.3 Assembling the Window

Once the glass pieces are assembled, they fit into a larger iron frame, called an armature, which provides stability through vertical and horizontal bars<sup>46</sup>. An uneven number of windows is often preferred to create a central window, usually featuring a key figure like Jesus Christ<sup>47</sup>. The armature is secured in place within the masonry wall using steel bars, copper ties, and cement.

### 4.2 The art of coloring

#### 4.2.1 Coloring methods

Color in glass can be achieved through three methods. The first is color by absorption, where substances that absorb specific light frequencies are dissolved in the glass, which may include both metal oxides and metal ions. The second method involves submicroscopic metal oxide particles that are heated to the right temperature to produce color. The final method uses larger particles, which can be colored or colorless, that scatter light as it passes through<sup>48</sup>.

| Glass color | Metal oxide 1 | Metal oxide 2 | Metal oxide 3 | Metal oxide 4 |
|-------------|---------------|---------------|---------------|---------------|
| Blue        | Cobalt        |               |               |               |
| Green       | Uranium       |               |               |               |
| Copper      | Chromium      |               |               |               |
| Pink        | Selenium      |               |               |               |
| Yellow      | Cerium        | Titanium      |               |               |
| Amber       | Carbon        |               |               |               |
| Red         | Cadmium       | Selenium      | Copper        | Gold          |

Figure 20. Creation of Stained Glass with metal oxides. (source: Liddall Armitage, 1959)

An example is the production of Ruby colored glass. By adding a small amount of gold to the glass mixture, letting it melt together and gradually cooling it, the glass strikes a ruby color by heated to the right temperature. At first, you see nothing, but the heating process is essential to reach the desired color<sup>49</sup>.

45 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library  
46 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library  
47 The Development of Stained Glass in Gothic Cathedrals by Elizabeth (Aislin) Reynolds (2013) Johnson County Community College  
48 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library  
49 Ibid.



#### 4.2.2 Behavior of color

After the creation of the colors with the various methods, the glass can be used directly or painted and placed in the window panels. Combinations of colors in the windows can affect the appearance of the window. It's not just a flat color, it is also the variation of the tints and their behavior with the incoming light. The spreading of light can cause one color to mix or overlap with the other. The effect of the total vibrations of all the colors reacting simultaneously gives the sensation of white. For example, the Blue in Chartres Cathedral, placed next to Ruby colored glass, can give the effect of purple light. This can be intentional when the effect is desired, but can also be avoided by placing a narrow band of white glass between the two<sup>50</sup>. When you take a short glance at Figure 21, there is the illusion of the use of the color violet, but when you stare at the figure a bit longer, the detailed pieces of blue and red glass appear.

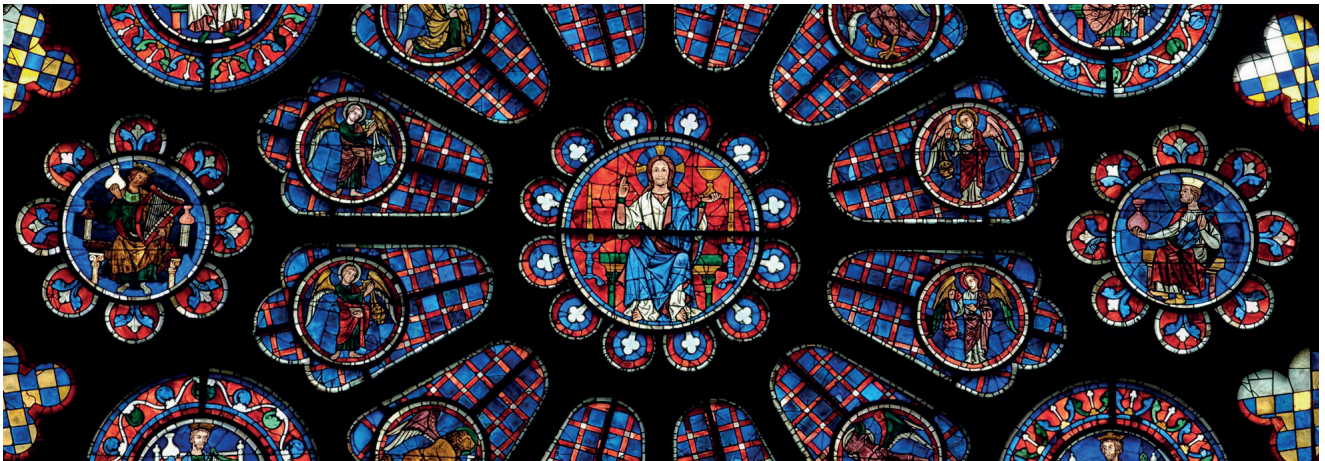


Figure 21. The Stained Glass Windows, by Cathédrale de Chartres

#### 4.3 Medieval mastery meets Modern innovation

In this chapter, the art of medieval stained glass was explained, but stained glass is still used today. In Chapter Two about symbolism, the switch from religious figures and symbolism was made to more modern interpretations, abstract shapes, and less religious themes. The more abstract style also led to the use of simpler and geometric shapes. Modern glass is produced thinner than medieval glass and catches light and expresses colors better<sup>51</sup>. Coloring methods are still used nowadays; the use of metal oxide is still a popular glass coloring method.

The differences and similarities between medieval mastery and modern innovations can be explained perfectly with the windows of Reims Cathedral. As seen in Figures 22 and 23, both later added windows in Reims Cathedral are more abstract. Figure 22 completely consists of abstract shapes, but does feature primary colors to fit into the historic cathedral. Figure 23 is more abstract than the medieval windows in the cathedral, but does still tell a religious story to honor the original purpose of stained glass. The coloring of the glass and its incorporation into the windows was carried out using traditional lead techniques, linking back to the tradition and respecting the cathedral<sup>52</sup>. The stained glass used in situations other than churches and cathedrals does use other techniques.

<sup>50</sup> Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

<sup>51</sup> Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

<sup>52</sup> Paroisse Notre-Dame Saint-Jacques de Reims. (n.d.). <https://www.cathedrale-reims.com/>



Figure 22. Stained glass windows Imi Knoebel, by Laura Jansen

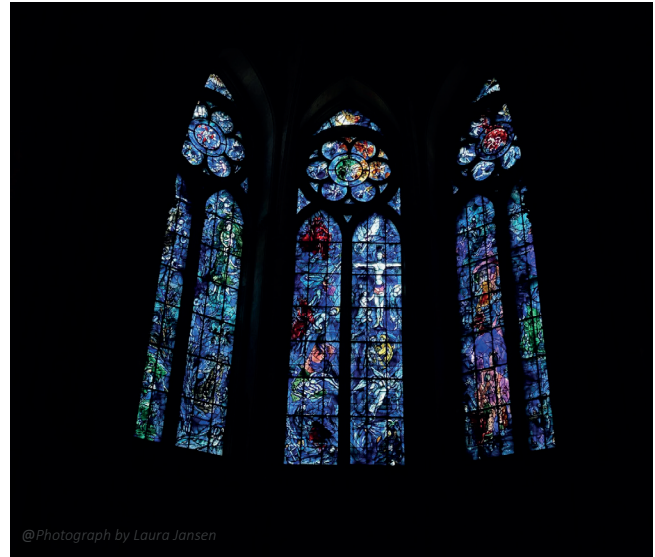


Figure 23. The Marc Chagall windows, by Laura Jansen

But as much as the windows honor the original tradition of glass making. Modern methods like digital design and precise measuring are used to make them perfect. The value of the craftsmanship did get a bit lost once the function of the glass faded after the medieval period<sup>53</sup>. It is still an art form, but the practice has evolved and has become less valuable.

<sup>53</sup> Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library



## Conclusion

This thesis examined stained glass windows and their evolution in Gothic cathedrals, with a central focus on the question: *How did stained glass windows evolve throughout the various phases of the Gothic period?* To address this question, four case studies were conducted, each providing examples and information for the chapters of the thesis. Stained glass windows were created for religious and didactic purposes, conveying biblical stories and serving as a bridge between the earthly and the spiritual realms, making it accessible to all believers<sup>54</sup>.

There is a nuanced relationship between architectural innovation and stained glass design, starting in the Early Gothic period. Technical advances in Gothic cathedrals enabled larger windows and fostered collaboration between the architect and glaziers<sup>55</sup>. Together with the improved glass techniques during the High Gothic period, this enhanced the visual atmosphere and artistic possibilities, enabling more detailed depictions of biblical scenes and figures. From single figures with borders of colored glass, to biblical scenes covering the larger window openings. Colors were created by adding metal oxides to the glass mixture, but later on, glass painting became a common technique<sup>56</sup>. The colors and narratives played crucial roles in symbolism and iconography, with blue and red often representing divine presence and sacrifice, though interpretations can vary. It is important that colors must always be read situationally; the interpretation should always be sensitive to multiple factors such as the visual composition, time and place, and the contextual background. The placement of figures, compositions, and the placement of the windows within the cathedral had a lot of influence on the interpretation of the stories. Important figures were depicted larger, placement on the bottom or top of the window showed the importance of figures, and the intervention of the circular-shaped rose window contributes to this iconography<sup>57</sup>.

During the Late Gothic period, techniques remained the same or improved a bit, but the focus switched from strict religious narratives to broader, more social themes, resulting in more abstract designs<sup>58</sup>. The case studies showed that the narratives were not only shaped through identical biblical theology, but differed in local traditions, theological priorities, patronage, and social factors<sup>59</sup>. This interdisciplinary dynamic played a crucial role, and is often not explained enough in previous analyses. The stained glass windows evolved highly throughout the various phases of Gothic architecture, addressing the technological and symbolic advances, but also addressing the difference in perspective and shift in themes. This thesis offers a new perspective on the importance of the value and collective memory of these windows, not only by conveying biblical stories, but their impact in a broader perspective to stay meaningful in the future.

54 Cumberlandstainedglass\_Admin. (2015). Stained Glass More than Just Windows- Cumberland Stained Glass. Cumberland Stained Glass. <https://www.cumberlandstainedglass.com/stained-glass-more-than-just-windows/>

55 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

56 Ibid.

57 La Cathédrale de Reims by Louis Demaison (1913) Open Library

58 Cumberlandstainedglass\_Admin. (2015). Stained Glass More than Just Windows- Cumberland Stained Glass. Cumberland Stained Glass. <https://www.cumberlandstainedglass.com/stained-glass-more-than-just-windows/>

59 Stained glass: history, technology and practice by E Liddall Armitage (1959) TU Delft Library

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