Twins, not double: the Doppelwendeltreppe in Graz



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Twins, not double: the Doppelwendeltreppe in Graz

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Ai miei nonni.

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Abstract

The main theme of this thesis is the Doppelwendeltreppe, an example of twin spiral staircase situated in the Grazer Burg (Graz's Castle) in the Austrian city of Graz. Through an historical research, typological analysis of the spiral staircases, constructive analysis of the case study and comparison with other example of spiral staircases both in Austria and in Italy, this thesis will try to analyse the object and understand it in its depth. Starting from the understanding of the urban layout of the city, going down to the scale of the historical city centre, passing to the Castle's scale and then focusing directly on the Doppelwendeltreppe, this thesis shows how this twin spiral staircase is strictly connected to the history and territory of the city. Comparing it then to four other examples of spiral staircases, one in Slovakia, one in Austria and two in Italy, this thesis tries to investigate how, and if, the model of the twin spiral staircase changed over the centuries.



Introduction



FIGURE 2, THE DOPPELWENDELTREPPE IN GRAZ (AUTHOR)

IN THE PREVIOUS PAGE: FIGURE 1, AERIAL VIEW OF GRAZ (HOLDING GRAZ/KERNASENKO N.D.)

Located in the south-east of Austria, Graz is the capital of the Styrian province; its position near the Slovenian border and at the intersection of western and Eastern Europe strongly shaped the city and its character throughout the centuries. The Doppelwendeltreppe, the object of this thesis, is situated in the Grazer Burg [Graz's Castle], and it is one of the best preserved twin double spiral staircase (Fig. 2).

Graz has existed since before the 14th century, when it was the residence and capital of Inner Austria. It developed starting from the Schlossberg ford, a fortification settled in the Bronze Age and built on a small mountain right by the Mur River, in the Middle Ages; however, it wasn't until the Renaissance period that the city properly started to get its shape.

Being near the border, Graz presented a lot of fortifications to defend the city from attacks; it was during the Turks invasions that these fortifications were enlarged and with it the city itself, following the style of Italian Renaissance artists. Another factor that influenced the buildings and expansion of the city was its role in the conflict between Catholics and Protestants, which shaped today's historic building fabric.

After the Capital was moved from Graz to Vienna and the Protestants were expelled from the city, Graz suffered a decline in its importance, which transformed the open-minded, multicultural identity of the city into a more conservative one.



FIGURE 3, MAP WITH THE RED ZONE AND THE BUFFER ZONE (IN BLUE) ('UNESCO WORLD HERITAGE LIST' N.D.)

In the 18th and 19th centuries, when the big fortified walls had to be destroyed to observe peace treaties, Graz changed its appearance once again, gaining the "green belt" around the city centre that is still visible today: where there were empty lands after the demolitions, a big park was realised, while the city expanded in the areas outside of the former glacis, leaving today's historical city centre untouched.

Being the second largest city in Austria and divided in 17 municipal districts, Graz's population reached almost 300000 people in 2020 (data.un.org n.d.); the city gained importance not only because of its renowned universities, but also because the historical city centre (with the addition of Schloss Eggenberg in 2010) was included in the UNESCO World Heritage List in 1999 ('UNESCO WORLD HERITAGE LIST' n.d.).

These different styles all co-exist in the city cen-As one can notice from the map of the red zone tre, creating a balanced mix with the presence and the buffer zone, the historical city centre is of the extended city park and the woods on the completely included in the World Heritage Site Schlossberg hill. (red zone); the boundaries of the red zone follow the old traces of the former fortifications Because of these characteristics, the city centhat were built starting from 1546 in the Eastern tre (and later on the Schloss Eggengerg) had side of the city, while it extends on the left bank been included in the UNESCO World Heritage of the Mur River, including the Mur village. List based on two Criteria(Bundesdenkmalamt 2010; 'UNESCO WORLD HERITAGE LIST' The buffer zone includes the city Park and buildn.d.):

The buffer zone includes the city Park and buildings created on the demolished sites in the 19th century on the eastern side of the city, while on the other bank of the Mur it includes the Andrä neighbourhood, the Burgher's Hospice Foundation and the Barmherzigenkirche and Barmherzigenkloster (the ecclesiastical precinct of the hospitallers' church and monastery). (Bundesdenkmalamt 2010)

the hospitallers' church and monastery). (Bundesdenkmalamt 2010)
The historical fabric of the city centre is made by a mix of buildings that represent different historical periods: traces of the Middle Ages are still present in cellars of various the burgher houses;
the Grazer Burg is an example of late Gothic architecture, while the Landhaus of the

Renaissance period; there are several build-Criterion (iv): The urban complex forming the City of ings made during the Baroque, some examples Graz – Historic Centre and Schloss Eggenberg is an excepare Palace Herbertstein, the Luegg Hauser, the tional example of a harmonious integration of architectural Burgerhaus in Kapaunplatz 2, the Wildenstein styles from successive periods. Each age is represented by Palace, the Attems Palace and the Gemaltes typical buildings, which are often masterpieces. The physiognomy of the city and of the castle faithfully tells the story Haus; Graz's City Hall is the perfect example of of their common historic and cultural development. Neoclassicism in the city, while the Schloßbergsteig of post-war architecture; the Murinsel and the Kunsthaus are, instead, examples of contemporary architecture.





	Examples of architecture			
	1 Grazer Burg, 1438-1952	4 Palace He		
	2 Schlossberg, 1125/1839	5 Luegg Hä		
	a Uhrturm b Glockenturm	6 Burgerha		
	c Kasemattenbühne	7 Palace W		
	3 Landhaus, 1527/1531	8 Palace Att		
	Historical fabric	Р		

gure 18, Kunst Haus (Au

re 17, Mur Insel (Author)

erbertstein, 1690 äuser, late 17th c. uus, beginning of 18th c. /ildenstein, 1702/1703 ttems, 1702/1705

Park

- 9 Gemaltes Haus, 1742
- 10 City Hall, 1893
- 11 Schloßbergsteig, 1914/1918
- 12 Murinsel, 2003
- **13** Kunsthaus, 2003

Water



The first step in approaching this thesis, was to first market street was built between nowadays understand the history of Graz's city centre and Hauptplatz and Schlossbergplatz, and Graz asits Burg; the two scales (old city and building) sumed the shape of a small settlement on the are strictly connected, the history and expansion south and west side of the hill. of the first extremely intertwined with the story In 1282 the Habsburgs arrived in the city, and and development of the Grazer Burg itself (and their domain over it would last for the following therefore of the Doppelwendeltreppe). 650 years (Fig. 20).

In the following chapter, we will try to briefly The first building expansion happened under investigate the changes that happened first in Emperor Frederick III, when Graz had become the administrative and cultural capital of Inner Austria. The Emperor built the first nucleus of Grazer Burg itself. (Bundesdenkmalamt 2010; the Grazer Burg, connecting it directly to the Kubinzky 2021) newly built St. Aegidius' Church, instituting it as the ecclesiastical centre in the city; a first background to the Doppelwendeltreppe. expansion happened towards South and the Mur river, where the old ghetto was: the Jews had been expelled from the city in 1438/39 by the Burghers, who bought their houses in the southern part of Herrengasse. This street, Herrengasse, was also the place where the farming 1.1 Urban layout town made of rows of long homestead buildings (stretched-out house farms, with a front building and a rear building) coexisted with the medieval market, showing both the rural and urban life of the city.

the old city, passing then to a smaller scale with the focus on the Stadtkrone until arriving to the All of this will give a full historical, and political, The name Graz dates back to the 12th century, from the Slavic name Gradec, which translates in "small fortress"; already from the beginning

the main characteristic of the medieval settle-During the reign of Emperor Maximilian I, the ment that would become the city of Graz was city did not expand but was adorned by some clear: the function was to protect and defend gothic buildings, including the Doppelwendelagainst the invasions. treppe in 1499.

As previously mentioned in the introduction, Starting from 1544 Ferdinand, brother of the the city stemmed from the fort that was built new Emperor Charles V, developed Graz into on the Schlossberg hill; from there in 1130 the a major fortified city of Inner Austria; the works

1. Historical framework

were given to Domenico dell'Aglio, who not During these years, settlements outside of the only built the fortifications around the city, but also a new part of the Grazer Burg and the most important Renaissance building of the city, the Landhaus in 1555, with its upper-Italian main façade and the courtyard with arcaded piers.

Inner Austria. During this time, under Archduke Charles II, new urban development took place while the city and its inhabitants had to face the Counter-Reform and the threats coming from the Turks. Because of this, the city expanded towards the North in the area above the Grazer Burg: the new city door, Paulus' Gate, was built together with its neighbourhood. A second expansion happened towards west, on the other side of the river Mur, where the stonemasons working in the building sites, coming from the areas of Como and Lugano, had their houses (today's Griesplatz area).

The extensive works of fortification continued, and Graz went through 40 years of almost uninterrupted buildings works. Among these, it's important to remember the expansion of the Grazer Burg, the creation of the Jesuit College and of the Old University (two buildings part of the Stadtkrone), and the construction of several galleried courtyards, that reminded people of Italian Renaissance towns. This was achieved through the use of facades with corner oriels, with decorations reminding of the ones from Lombardy, and the extensive use of the sgraffito (some examples are still present in some parts of the Grazer Burg).

city gates were already present, in particular the one on the western bank of the Mur river, called Murvorstadt (Fig. 21).

When the new Emperor Ferdinand moved the capital to Vienna in 1619, Graz still remained From 1564 until 1619, Graz was the Capital of the Capital of Inner Austria. Despite the change of location, Emperor Ferdinand still invested time in Graz, with the construction -prior to his coronation- of the biggest Habsburg Mausoleum together with the Church of St. Catherine in 1614 (for further details, see Chapter 1.2).

> The urban layout of this period was linked to the new Catholic orders that arrived in the city, all of this to assist with the Counter-Reform: the neighbourhood of Paulus' Gate gained new buildings, including the convents and monasteries from the Capuchins and the Carmelites; the Augustinians hermits settled in Sporgasse, right by the particular entrance of the Stiegenkirche; the Carmelites nuns obtained the Kalbernesviertel (a neighbourhood that nowadays has almost disappeared) right on the river Mur, next to the new Franciscan tower, built in 1636.

> This expansion involved both the north and the south of the city, regarding both religious buildings and palaces of noble families, with the exception of the Eggenberg Palace that was built on the other side of the Mur river (1625-1626); during this expansion, in 1642, the Styrian Armoury was also built next to the Landhaus, following the late Renaissance style with its monumental portal, while the statues remind of an early Baroque.



FIGURE 21, SCHEME OF THE EXPANSION TOWARDS MURVORSTADT (AUTHOR)



Fortified city walls

New expansio

17



FIGURE 22, COPPER ENGRAVING OF GRAZ FROM THE EAST, DESCRIBING THE URBAN LAYOUT IN 1699(TROST 1728)



FIGURE 23, COPPER ENGRAVING OF GRAZ FROM THE WEST, DESCRIBING THE URBAN LAYOUT IN 1699(TROST 1728)

pened to coincide with the advent (on a small- signalling the start of the merging between the er scale) of the Baroque in Graz. Since Graz historic centre and the surrounding villages. The was not the Capital of the empire anymore, the fortification on the Schlossberg hill were then Baroque arrived later than in Vienna and did demolished under the Treaty of Schönbrunn of not take over the majority of the town's facades. 1809, after the three Napoleonic occupations The first instance of a Baroque facade can be of the city, shaping the woods and buildings found in the arrangement of floor by floor pilasters in the palace on Raubergasse, realised from 1665 unitl 1674. After that, some of the existing facades of noble palaces were reshaped following the Baroque, bringing it also inside of the buildings (an example can be the Baroque staircase built in 1712 in the Jesuit College).

In 1663 the new threat coming from the Turks required the demolition of buildings outside of the city and the reinforcement of the fortifications; shortly after that the Plague hit Graz, aggravating the situation even more. In 1683, when the Turks were defeated, the citizens erected commemorative plague columns, placing them in the main squares (for example in front of the Iron Gate). The layout of the city as of 1699 was captured in two copper engravings city from East (Fig. 22) and West (Fig. 23).

Under the reign of Emperor Charles VI, Graz went through another expansion: the streets were newly paved and for the first time street lighting was installed; the mercantilist policy of the new Emperor placed Graz right on the Imperial Commercial road, which meant the advent of factories and the first banking houses on the east and south of the city, right outside of united and added to the old Graz of the 19th the fortified walls.

However, this division between old city inside the walls and new city outside of the walls started to fade when, from 1784, the fortified walls had to be destroyed: the Jakomini neighbour-

The last period of expansion of the old city hap- hood right outside of the Iron Gate was built, into today's layout. The rest of the old, fortified walls were then demolished in the 19th century: on the old military glacis there was the prohibition to build, so the new city park, a green belt around the historic centre, was created and the city expanded towards east, following a grid pattern of buildings and streets, while the old town remained untouched.

The old town ceased to exist with the demolition of the last fortified walls; after that it became the commercial and social centre of the city, with the new City Hall built on the site of the old, demolished one in Hauptplatz; around the same time, the Technical University (1811), the Karl-Franzens University (1827) and the new Opera Theatre (1899) were built. The people lived now mostly on the part of the city that was by Andreas Trost, describing the views of the old once outside of the walls: the noble families and the bourgeoisie were on the eastern bank of the Mur river, while the working class settled in the western one, where the main railroad system developed, connecting Graz to Vienna, Trieste and Budapest, and where factories and houses for the workers were built.

> Graz acquired today's shape starting form 1938, when the 17 neighbouring towns were century (Fig. 24).





1.2 The Stadtkrone

Stadtkrone, or City Crown, is a cluster of all the major buildings of the historical city centre: it includes the Grazer Burg, the Hofkirche (the Cathedral), the Mausoleum and the church of St. Catherine, the Old University, the Theatre, the Seminary, the Cathedral Manor and the Cathedral Parish; it evolved during the centuries, starting from the complex of the Grazer Burg with the Hofkirche, including then the others as the city expanded and developed, and it delimitates today's original core of the historical city. (Bundesdenkmalamt 2010)

Another characteristic of this cluster is the emphasis on how the power of the Emperor (temporal power) was strictly connected to the spiritual one: all of the buildings belonged to the Jesuits except for the Grazer Burg, that back when the Stadtkrone was first established was directly connected to the Cathedral by a passage used by the Emperor; this passage was created to establish the castle as a profane-sacral building group since Emperor Fredrich III (the one thatfirst established the Stadtkrone) had been crowned directly by the Pope Nicholas V, and therefore was believed to be a "ruler by the grace of God".

The scheme (Fig. 25) represents the position of the buildings that make the Stadtkrone, together with the original layout of the Grazer Burg; it was done following the cadastral map from the Franziszeischer Cadastre (Fig. 26): surveyed in order to calculate property taxes in the years between 1820 and 1841, it consisted of more

than 8600 hand-drawn individual sheets, that were later put together and digitalized in order to be used as the basis for the current cadastral map; the light red colour indicated the buildings that were built with stones, the yellow those built with wood, while the darker red indicated the public buildings. (Land Steiermark n.d.)

There is not a main, common architectural style for the buildings, since they were built in different centuries. The parts of the Grazer Burg built by the Emperor Frederik III and Maximilian I represent the Gothic, while the parts commissioned by Emperor Ferdinand to Domenico dell'Aglio represent the Renaissance. The Mausoleum and the church of St. Catherine have a façade whose structure is at the threshold from Renaissance to Baroque, while the inside is purely in the latter; the only building that is Baroque on the outside is the Cathedral Manor, Domherrhof. (Bundesdenkmalamt 2010)



FIGURE 25, SCHEME OF THE STADTKRONE, IMPLEMENTED BY THE AUTHOR (AUTHOR, ECHNER DENKMAL CONSULTING GMBH 2016B)



Places of worship

4 Hofkirche Cathedral

5a St. Catherine Church

5b Mausoleum of Emperor Ferdinand II

 \square

6 Seminary / former Jesuit Collegium 7 Cathedral Manor

8 Cathedral Parish



GRAZER BURG

While the history and functions of the Grazer Burg will properly be explored in chapter 1.3, it is still important in the context of the Stadtkrone to highlight some portions of the building, in order to properly appreciate the complex mix of styles present in it.

Of the original Gothic core only a small part survived until today, with the Doppelwendeltreppe tower and the private chapel as the main examples of the late Gothic architecture in the city; the Charles' wing, the Registry wing and the entrance portal, once the spiritual core of the castle, are the best examples of the Renaissance architecture, creating also a contrast with the old town's door from 1336-1339, known as Burgtor (literally, door of the castle)(Fig. 27). (Bundesdenkmalamt 2010)



FIGURE 27, THE BURGTOR (AUTHOR)

IN THE PREVIOUS PAGE: FIGURE 26, FRANZISZEISCHER CADASTRE MAP, 1820-1840 (LAND STEIERMARK N.D.)



FIGURE 28, ENTRANCE TO THE JESUIT COLLEGE (AUTHOR)

Jesuit College

Built in 1572 by Vinzenz de Verda, the old Jesuit College has kept almost all of its original characteristics and structure. The exterior of the building appears severe and plain, in line with the Renaissance, while the interior showcase the typical Baroque exuberance, in particular in the grand hall, the refectory and the staircase (Fig. 28 & 29).

OLD JESUIT UNIVERSITY

Founded by Archduke Charles II in 1585 and opened in 1609 by Archduke Ferdinand, this building is a manifestation of the transition from Rococo to Classicism. When the Jesuits were dissolved in 1773, the Empress Maria Teresa managed to save the precious book collection by transforming the former aula and theatre in a library, that then became nowadays Styrian archives. (Fig. 30)



FIGURE 29, THE BAROQUE STAIRCASE IN THE JESUIT COLLEGE ('JESUIT COLLEGE' N.D.)



FIGURE 30, ENTRANCE TO THE OLD UNIVERSITY (AUTHOR)



FIGURE 31, THE CATHEDRAL TODAY (AUTHOR)

CATHEDRAL

Today's Hofkirche is at the heart of the Stadtkrone. Built between 1438 and 1464 to replace the old church of St. Aegydius, it is another example of a building with Gothic façade, while the interior has been remodelled following the Baroque. The church became Cathedral in 1773, and it had been controlled by the Jesuits for more than 200 years (Fig. 31).

A unique element of the façade is the fresco on a portion of the southern-eastern wall. Realised by Thomas von Villach in 1480, it represents God's punishment to the citizes with the three plagues: the locusts, the Turks and the Black Death. In the lower part of the fresco, right above the Turks, there is the first aerial view of Graz.

Nowadays there is no trace left of the old passage that connected the Cathedral directly to the inside of the Emperor's palace; drawings and copper engravings can still help to visualise it, helping to describe the particular feature of the church of that time.

This copper engraving (Fig. 32) realised by Andras Trost, represents a view of the Grazer Burg from the Hofkirche, focused on the south facade and its state in 1699. Together with the drawings from 1728 (Fig. 33) and 1843 (Fig. 34), the layout and composition of the passage instantly become clear: it was made by three floors, plus a covered porch, and was connected directly to the Burg and the Church, allowing people to enter either of them without going outside. During the restoration works done in

1853 for the adaptation of rooms for the Emperor and the realisation of the governor's office, they had discovered that the passage was in a high state of decay (just like other parts of the castle), and even though they had tried to preserve it as much as they could, in the end the Viennese court architect Paul Sprenger (head of the Austrian state building department) decided that it could not be saved and allowed its demolition (together with the demolitions of several parts of the Grazer Burg).(Kubinzky 2021)



FIGURE 32, VIEW OF THE GRAZER BURG IN 1699 (LAND STEIERMARK N.D.)



FIGURE 33, CONNECTION BETWEEN THE GRAZER BURG AND THE HOFKIRCHE, 1728 (LAND STEIERMARK N.D.)



FIGURE 34, VIEW OF THE HOFKIRCHE, 1843 (LAND STEIERMARK N.D.)



FIGURE 35, THE DOMES OF THE MAUSOLEUM ('GRAZ MAUSOLEUM' N.D.)

Mausoleum and St. Catherine CHURCH

Built by Giovanni Pietro de Pomis between 1614 and 1687, these two buildings are the most important monument of the Counter Reformation, not to mention that the Mausoleum is the biggest one belonging to the Habsburg family.

The Mausoleum and the church are linked by a common part: the church raises above a cruciform plan, while the Mausoleum above an oval one; the main feature of this construction are the series of domes that rest on the walls, since already from further away one can easily spot them.

The planned visual impact of this building complex on the urban environment begins with the main façade: thought as a triumphal arch, it was made emulating and recalling the first Jesuit church in Rome, Chiesa del Gesù (Fig 36 & 37).



FIGURE 36, FACADE OF THE MAUSOLEUM (AUTHOR)



FIGURE 37, FACADE OF THE CHIESA DEL GESÙ ('CHIESA DEL GESÙ' N.D.)

1.3 Grazer Burg

The history of the Grazer Burg can be divided in 6 main moments, starting from the initial core of the Castle, and arriving to today's layout and appearance(Wagner and Walk 2019).



FIGURE 38, TIMELINE OF THE EVOLUTION OF THE GRAZER BURG, IMPLEMENTED BY THE AUTHOR (AUTHOR, LAND STEIERMARK N.D.)

this shape until the demolition works started 1438-1460 in 1853/54. The reason for the demolition The initial core of the castle was a previous me- works this is that when Archduke Ferdinand was dieval feudal court, which had the first enlarge- crowned Emperor in 1619, he moved the capiment with the Emperor Frederick III who start- tal of the Empire from Graz to Vienna, bringing ed building the town castle and the Hofkirche, with him not only the people of the court and connecting the two buildings and the two powthe objects of everyday life, but also the focus of ers (political and religious) from1438. the power, meaning that the Grazer Burg slowly lost its splendour.

Ca. 1500

1494, when Maximilian I, son of Emperor Frederick III, connected the two Frederick's buildings with a wing with a stair tower, where the Doppelwendeltreppe is located.

1550-1600

Next, Ferdinand I commissioned the addition of a wall and gate to give a monumental finish to the Gothic castle wings along Hofgasse, while on the other side of the wall a grand staircase (later demolished in 1853) was built following the Renaissance style. After Ferdinand I, Archduke Charles II added an extension to the courtyard wall (1570/71), plus the Registry wing along the northern medieval city wall (1580/85). At the same time, around 1571/72, the Archduchess Maria commissioned the realisation of a court chapel on the third floor of the Frederick's wing on the side of the courtyard.

1600-1852

After the death of Archduke Charles II, his son Archduke Ferdinand added some extensions to the castle around 1600, and the Burg kept

The watercolour by Joseph Kiwasseg (Fig. 39) (Land Steiermark n.d.) represents the first court-The second phase happened starting from yard of the Grazer Burg before the demolition works started. With the tower of the Doppelwendeltreppe in the background, it can be ob-



FIGURE 39, WATERCOLOUR OF THE GRAZER BURG BY JOSEPH KUWASSEG 1853 (LAND STEIFRMARK N.D.)

served how only 3 sides were facing towards works, and in 1949 the new wing of the Burg the outside; everything on the left of it will be was built, giving the Grazer Burg the shape it demolished, creating a 4th side facing towards has today (Fig. 40).(Österreichisches Bundesthe outside (today's layout).

1853-1949

In 1673 and 1728, coinciding with the marriage of Leopold I for the first date, and with the "hereditary tribute", oath of allegiance sworn to Emperor Charles VI by the Styrian estates, for the second one, some restoration works were carried out; in 1822/18223 some rooms of the Charles' Wing were renovated and adapted to become the apartment of Emperor Franz whenever he visited the city, changing the function of the whole Grazer Burg from that went from being the Emperor's Palace to an "inn" for the visits of the Emperor in Graz. During these works, wanted by the governor Count Ludwig Taaffe, they also realised the new governor's office; however, they also saw just how bad the state of decay of that portion of the Castle was.

This led, as we mentioned before, to the demolition of all the dilapidated parts, which included the Frederick's wing on the south, a part of the court end wall together with the grand staircase and the three-storey court alley crossing to the Hofkirche.

After that, the Grazer Burg didn't have any major changes in its function, until 1922 when it became the official residence of the Governor of Styria. Because of the damages endured during the bombing of 1 November 1944, in 1948 they started a series of repair and demolition

denkmalamt 1997)



1 Frederick's Wing,1447

2 Maximilian's Wing, 1499/1500 3 Charles' Wing, 1570/71 **4** Registry Wing, 1580/85 5 "New Castle", 1949

TWINS, NOT DOUBLE: THE DOPPELWENDELTREPPE IN GRAZ



FIGURE 41, CATALOGUE OF STAIR TYPES(KOOLHAAS 2018)

2. Spiral staircases

When dealing with the theme of stairs, it is impossible not to cross paths with the word "Scalalogy".

During his life, Friedrich Mielke surveyed around 2000 stairs and studied 10000, all while being on a wheelchair; his dedication and passion towards the topic brought him to write more than 30 books on the topic, and later to found in 2012 the Friedrich Mielke-Institut-für-Scalalogy (Friedrich-Mielke-Institut-für-Scalalogie) at the Eastern Bavarian Technical University of Regensburg.

"'the science of the properties and the effects of stairs' in short 'the science of stairs'. It emerged from stair research, which serves both practical stair construction, as well as architectural history in multiple ways. The subject of research is the type of negotiation of height differences through static constructions with steps." (Mielke 1986)

This new science emerged from the stairs research, and it's not limited to the study of the architectural object itself, but also to the stepping behaviours and to the people that had built them. It's a science that requires the use of different fields of knowledge in order to properly understand how a staircase works.

Mielke's interest towards stairs started right after WWII, during which he lost his leg: in 1951 he was working in Schwerin as an architect for the State Office for the Preservation of Historical Monuments and Buildings, and during a visit to the Schwerin Castel, one of his colleagues made a comment about the spiral staircases.

"A spiral staircase is the best kind in the world. Those with short legs can climb the stairs on the inside of the spiral, while those with long legs have enough space to climb on the outside of the spiral." (Koolhaas 2018)

From that comment, Mielke understood the close link between stairs and humans and his

interest for the later called Scalalogy was born.

In 1993, in his book "Handbook of Stairs" (Handbuch der Treppenkunde), Mielke did a classification of the different types of stairs, depending on their layout and characteristics:

- Straight stairs
 - Single flight of stairs
 - Multiple flight of stairs
- Partial spiral stairs
- Spiral stairs
 - Single-flight spiral staircases

- Multi-flight spiral staircases (with a further distinction between "Doppelwendeltreppe" and "Zwillingswendeltreppe")

- Winding stairs
- Centred stairs

This classification was then further developed with drawings in his book from 2003 "Handläufe und Geländer" (Fig. 41). (Koolhaas 2018; 'Scalalogie' n.d.; Mielke 2003)

2.1 Differences between the "Doppel" and "Zwillings" type

During the study of the types of spiral staircases (like palaces), since it requires more room to and of the Doppelwendeltreppe from Graz, at accommodate both of the parallel helixes. the beginning it wasn't clear that the object of this thesis has been known to everyone by the wrong name.

While visiting the staircase in Graz, it is called -and advertised- as "Doppelwendeltreppe", both in the signs that point towards its location and in the Austrian bibliography.

However, while examining the classification made by Mielke (Mielke 1993), one can observe how the description given for the "Doppelwendeltreppe" does not match the description of the Doppelwendeltreppe in Graz; instead, this objects falls under the definition of "Zwillingswendeltreppe".

To better clarify this, let's examine the differences between these two types of double spiral staircases. (Mielke 1993; n.d.; Koolhaas 2018)

The term "Doppelwendeltreppe" is often translated with "double spiral staircase" in English; this type of spiral staircase is made of two parallel helixes ascending side by side, never intertwining and keeping their paths separate, creating two separate staircases that are extremely close to one another. Because of its layout, this type of staircase is found mostly in large spaces

Zwillingswendeltreppe

The term "Zwillingswendeltreppe", instead, translates to "twin spiral staircase".

Its layout is made by two separate, mirrored, spirals that only have a few steps in common, and ascend around two centres; the centres can be spindles or hollow spindles (like for the Doppelwendeltreppe in Graz), and when climbing up people can chose to change spiral at any meeting point. The layout is therefore more "flexible" since it does not require the two spirals to be parallel to each other, and makes it possible to place this type of staircase in smaller places (like towers).

The main difference between these two types of spiral staircases is the fact that while the "Doppelwendeltreppe"'s spirals never meet, creating two separate paths, the spirals in the "Zwillingswendeltreppe" have some steps in common, and allow several ascension and descension paths. The visual impact is pretty similar between the two types, with the circular shapes, spindles and optical illusions creating almost an aura of awe to someone looking at them for the first time.

2.2 Diffusion of the "Zwillingswendeltreppe" type

A couple of examples from the 16th century During his life, Friedrich Mielke had surveyed, as we already said, an incredible number of can be found in Germany, but it isn't until the staircases throughout all of Europe, allowing middle of the 18th century, that another examhim to create a list of all the Zwillingswendelple based on the Doppelwendeltreppe, can be treppen. (Mielke 1993) found: we are talking about the metal "Zwillingswendeltreppe" found in the Styrian Augus-The first example that can be found of a spiral staircase that differs from the usual monocentric Augustiner-Chorherrenstifts. (Mielke 1993)

tinian monastery in Vorau, in the Bibliothek des helix principle was the staggered spiral staircase This brief excursus of the diffusion of the "Zwillingswendeltreppe" shows how this type of spiral staircase was mostly spread in the south of Austria, with some examples in Germany, and that they were mostly realised during the late Gothic period, since their architectural development was vertical while the Renaissance compositions – which formed the basis of Baroque creations - followed a horizontal one. (For a complete list of all the "Zwillingswendeltreppe" surveyed and studied by Mielke, check page 174 from the book Handbuch der Treppenkunde, written by F. Mielke)

in St. Vitus Cathedral in Prague, made by Peter Parler in 1371. Up until that moment, the monocentric helix principle had been the "rule" to build spiral staircases, while Parler's new approach broke from this tradition. After that, around 1440, an unnamed master builder constructed for the first time, in the Cathedral in Košice, Slovakia, a staircase with two spirals running in two opposite directions and meeting in the middle, or a "Zwillingswendeltreppe".

The next example of this type of stair is the object of this thesis, the Doppelwendeltreppe in Graz, built around 1499/1500; after this, two more "Zwillingswendeltreppen" were built in Austria, using the Doppelwendeltreppe as an example: a twin spiral staircase in the parish church of Eferding (Upper Austria), and the other at the Bürgerspital in Kirchberg am Walde (Lower Austria). Both of these staircases have been moved from their original location and have been relocated in their current location.

Examples of other double spiral staircases



Figure 42, Chambord Castle double spiral staircase (Sophie Lloyd N.D.)



Figure 43, Scala del Bramante in Vaticano, double staircase (Antonietta Bandelloni n.d.)



Figure 44, Double staircase in the Crédit Lyonnais headquarters (Unknown Figure 45, DNA Tower, Perth (Government of Western Australia n.d.) n.d.)





3. Doppelwendeltreppe

The Doppelwendeltreppe (Fig. 46) is one of the first examples of double spiral staircases in Europe and it is the second oldest remaining, with the first one being the stair of the choir in the Košice Cathedral built in 1440. (Österreichisches Bundesdenkmalamt 1997)

The first recorded documents about the con-According to the classification made by Friedrich struction of the Doppelwendeltreppe are dated Mielke in his Scalalogie, the Doppelwendelaround 1499/1500(Bundesdenkmalamt 2010; treppe is wrongly called by that name: instead, Österreichisches Bundesdenkmalamt 1997), it should be called Zwillingswendeltreppe, since making it easy to determine when the stair towthe two spirals have meeting points in the mider and the staircase were built. dle (for a more specific classification, see chap-As already mentioned in chapter 1.2.1, Emperter 2.1).

or Frederick III had been working on the expan-However, this particular case is addressed as sion of the Burg since 1438 and after his death Doppelwendeltreppe in various publications, in in 1493, his son Maximilian I continued with the literature (for example the poem by Erich Fried works, having the Doppelwendeltreppe and its Die treppen von Graz [The stairways of Graz] tower built. (Hubertus 2010)) and is commonly called that While it was easier to know the master buildway by the people of Graz, so it will be refers of the buildings realised by his father, in erenced with that name (while still keeping in the case of the Doppelwendeltreppe this task mind its correct definition). proved impossible, despite the vast amount of stonemason marks that are present inside the tower (further detailed in 3.2)(Schatz 2005).

3.1 Historical analysis

IN THE PREVIOUS PAGE: FIGURE 46, THE DOPPELWENDELTREPPE (AUTHOR)



FIGURE 47, ROMAN STONEWITH THE EAGLE (AUTHOR)

On the outer façade can be identified different stone elements that Emperor Maximilian I requested would be put there: on the southern-right corner, between the 3rd and 4th floor, there is a stone with the date "1499" engraved (Fig. 47); further down under the window of the 3rd floor, there is one of the two Roman gravestones (Fig. 48) placed there in 1506, with a pediment, an eagle in relief and the inscription:

"Bellatulo / Biraconis F. / Ann.LXX et Alte/ onate Malsonis/ F. Conj. Ann. / IX et Fevinae F. Ann. XXX/ Et Claudiae Ba/ nonae Ann. VIII/ H.F.C." (Österreichisches Bundesdenkmalamt 1997)



FIGURE 48, STONE WITH "1499" ENGRAVED ON (ECHNER DENKMAL CONSULT-ING GMBH 2016B)

The second gravestone is placed on the wall on the right from the previous one; it has also a pediment and a bust in relief of a couple (Fig. 49), as well as the inscription:

"C. Duronius / Martialis / V. F. sibi et/ Proculeias / Proclae Conj./ Ann. XXX et C. Duron. / suo F. Ann XX. "(Österreichisches Bundesdenkmalamt 1997).

The presence of these decorative elements further confirms the time period in which the Maximilian wing and the Doppelwendeltreppe were built.

Up until the first half of the XIX century, the Doppelwendeltreppe seems to have kept its original shape and purpose, connecting the two Frederick's wings and giving access to the private chapel on the second floor above ground.

However, some changes can be observed in the historical floorplans after that moment.



FIGURE 49, ROMAN STONE WITH THE COUPLE (AUTHOR)



The floorplan from 1819 (Fig. 50) describes the situation of the third floor for the Doppelwendeltreppe area, while the southern part of the Burg shows a project for the remodelling of that portion of the castle.

One can notice how the balcony connecting the Doppelwendeltreppe to the Karlstrakt was already present there, even though it seems like it was one floor lower compared to where it is today. This could be further proven by the presence of a walled-up opening (Fig. 51 & 52) right under today's balcony: this window was most likely closed during the renovation works done after WWII(Rohatsch 2004).



FIGURE 51, WALLED UP WINDOW DURING THE RENOVATION WORKS OF 2016 (ECHNER DENKMAL CONSULTING GMBH 2016B)



Figure 52, walled up window after the renovation works of 2016(Author)

IN THE PREVIOUS PAGE: FIGURE 50, FLOORPLAN FROM 1819, WITH THE DOPPELWENDELTREPPE HIGHLIGHTED (ECHNER DENKMAL CONSULTING GMBH 2016B)



FIGURE 53, 4TH FLOOR PLAN FROM 1825, WITH THE DOPPELWENDELTREPPE HIGHLIGHTED, OUT OF SCALE (ECHNER DENKMAL CONSULTING GMBH 2016B)

After the floorplan from 1819, it was possible to The floorplan of the 1st floor (Fig. 54) highlights find two floorplans from 1825, describing the layout of the 1st floor and of the 4th floor. (Fig. 53 and Fig. 54 respectively)

While observing the floorplan of the 4th floor (Fig. 53), one can notice how the aforementioned balcony on the 3rd floor is not drawn, scale of the drawing. Something else can also be observed on this floorplan: the Doppelwenthe Friedrich's wing on the left through a door; however, today there is no trace left of this door, and its existence cannot be further proven.

how the staircase was connected to the Friedrich's wing from this floor as well: in contrast with the situation on the 4th floor, the presence of a door on the 1st floor can still be seen today thanks to the stone frame placed where the walled-up door used to be (Fig. 55).

however, this was most likely omitted due to the After these changes, no further material could be found to identify any other kind of shift in the layout of the Doppelwendeltreppe, up until deltreppe's tower seemed to be connected to the construction works from 1949 already explained in 1.2.1 regarding the construction of the "New Castle".

> During this occasion, the Doppelwendeltreppe tower went through some renovation works in



FIGURE 54, 1ST FLOOR PLAN FROM 1825, WITH THE DOPPELWENDELTREPPE HIGHLIGHTED, OUT OF SCALE (ECHNER DENKMAL CONSULTING GMBH 20168)

order to repair the damages caused by WWII (further analysed in 3.4.3); as these works went on, the layout changed again: the balcony that connected the stair tower to the Karlstrakt had been moved from the 3^{rd} floor up to the 4^{th} floor, closing the original door and building a new balcony above it. (ECHNER Denkmal Consulting GmbH 2016b)

The next restoration works took place in 2016, when the Municipality of Graz decided to restore both the inside and outside of the Doppelwendeltreppe's tower and the southern façade of the Grazer Burg. (ECHNER Denkmal Consulting GmbH 2016b) However, this point will be analysied in Chapter 3.4.2.



FIGURE 55, PHOTOGRAPH OF THE STONE FRAME (AUTHOR)



This historical analysis can be summarised in the Tower's developed façade (Fig.56): starting form the analysis made by ECHNER Denkmal Consulting GmbH for the restoration works of 2016, it was possible to implement it with the latest findings regarding the upper part of the tower. In particular, the parts that have been repaired and replaced after WWII were added (the ones in green), helping to localize and understand better the areas that had suffered damage during the bombings.

FIGURE 56, HISTORICAL ANALYSIS ON THE FAÇADE (AUTHOR, ECHNER DENKMAL CONSULTING GMBH 2016B)

Twins, not double: the Doppelwendeltreppe in Graz



	DC	PPELWENDELT	REPPE		DOPPELWENDELTREPPE							
		А					В					
	Left	spiral, from ma	in door		Right spiral, from main door							
Average step		Step	depth	In common with		Average step	Step de					
N. of the step	height	inside	outside	spiral B?	N. of the step	height	inside	outside	In common wi spiral A?			
1	13	/	/	x	1	13	/	/	×			
2	14	/	/	x	2	14	/	/	x			
3	13	126	33	x	3	13	126	33	x			
4	20,00	16	42		4	20,67	16	40.5				
5	21,50	10.5	60		5	21,50	11	61				
6	23,00	10.5	64		6	22,67	9.5	60				
7	22,00	8.5	62		7	24,00	8.5	60				
8	22,50	8	59		8	22,00	9	60				
9	20,67	8.5	59.5		9	21,00	8	60				
10	22,50	8.5	59.5		10	21,00	8	63				
11	21,00	8.5	61		11	22,50	9	59				
12	21,33	9	59.5		12	22,33	11.5	60				
13	20,33	9	18 133	x	13	20,67	9	18 133	x			
14	21,50	11	14 78.5	x	14	21,00	11	14 78.5	x			
15	21,50	10	47	x	15	21,00	10	47	x			
16	22,00	10	48	x	16	22,00	10	48	x			
17	19,50	9.5	60	x	17	19,50	9.5	60	x			
18	22,00	10	41	x	18	20,00	10	41	x			
19	21,50	10	75		19	22,00	10	75				
20	22,00	10.5	79		20	22,00	9.5	81				
21	22,17	10.5	72.5		21	22,00	11.5	75.5				
22	21,00	10	61		22	22,33	15	61				
23	23,50	10	61		23	23,00	9.5	58				
24	23,00	10	60		24	23.16	10	58				
25	24,00	10	60		25	23,50	9.5	60				
26	23,00	9.5	63.5		20	21,67	9.5	62				
27	20,67	9.5	61 wall	X	27	23,67	9.5	61 wall	x			
28	24,00	9.5	14 50	X	20	22,00	9.5	14 50	x			
29	22,83	11	37.5	x	29	22,50	10	37.5	x			
21	21,00	10	40.5	X	30	21,00	10	40.5	x			
30	23,00	10	54	X	30	22,50	10	54	x			
32	23,00	10	46.5	X	32	22,33	10	46.5	×			
34	23,00	10.5	59		34	23,00	9.5	01				
35	22,50	10.5	60		35	23,00	9.5	01.0				
36	22,00	10.5	60.5		36	23,00	0.5	49.5				
37	23,00	10.5	60		37	22,00	0.5	50 5				
38	22,00	10	60.5		38	22,30	0.5	61				
39	21.83	9.5	59.5		39	22,30	9.5	50				
40	21.00	10	61		40	23,00	7.5	60				
41	23,00	9.5	65		41	24,00	9.5	65				
42	23,00	0	47	Y	42	23.50	0	47				
43	20,00	10	52.5	×	43	20,00	10	52.5	~			
44	21.50	9.5	.39	x	44	22,00	9.5	.39	×			
45	21,50	10.5	39	x	45	21 50	10.5	30	×			
46	20.00	9.5	62	x	46	20.50	9.5	62	× ×			
47	24,00	9.5	39.5	x	47	22,00	9.5	39.5	×			
48	24.33	10	.59	~	48	22,00	10	59	^			
49	24,00	9.5	58.5		49	23.50	9	54				
50	24.00	9.5	58.5		50	21.00	10	56				
51	23,00	18	59		51	20.50	11.5	56.5				
52	24.00	7.5	landing		52	20,00	24	landing				

3.2 Architectural the step deepness, ar with the other spiral. survey

Our survey of the Doppelwendeltreppe was floorplans (Fig. 46,49 & 50). These were not done over several months, trying to be as accudrawn in meters, but in Klafter: rate and precise as possible and trying to follow the guidelines given by Mielke on how to survey 1 Klafter = 1,896406 m ('Historical Measures' a spiral staircase (Koolhaas 2018). n.d.)

Using as a base the plans, sections and elevations done by the ECHNER Denkmal Consulting GmbH for the restoration works of 2016, the different documents have been implemented with more details, trying to go to a smaller scale and grasp the changes of shapes between the different areas of the Doppelwendeltreppe.

The survey was developed in different stages: starting with a general survey of the area of the castle, focusing on the main elements that compose it; then the survey got more detailed in the second level, focusing on the Doppelwendeltreppe area, and surveying the staircase in a general way; the third level was focused on the details, with a precise survey of the steps and heights, and of the windows, hypothesising how they work and how they could be attached to the walls.

The following charts contains the different measures surveyed, in centimeters.

The measurements were divided between the two spirals of the Doppelwendeltreppe; each tab, one per spiral, have 4 main columns: the number of the step, the average step height,

IN THE PREVIOUS PAGE: TABS OF THE MEASURES SURVEYED, IN CM the step deepness, and if the step is in common

Once all of the measurements were taken, they had been compared with both the ones from 2016, and also with the ones from the historical

THE DOPPELWENDELTREPPE'S STRUCTURE

The Doppelwendeltreppe is positioned in a tower in the first courtyard of the Grazer Burg, and is part of the Maximilian's wing, between the remaining portion of the Friedrich's wing and the "new castle". It develops for 11,78m through two spirals over a polygonal plan, with a total of 81 steps (plus 2 in the entrance door) and covering four floors above ground. From this moment on, these two spirals will be referenced as spiral A and spiral B, which indicate respectively the left and right spiral from the main door.

Each of the spirals forms its individual flight of stairs, with the exception of the steps that they have in common that serve as small landings: they develop in mirrored directions around a centre each which is formed, up to the 20th step, by a stone pillar; from that point, the steps have a hollow spindle in the middle. The landings do not coincide with the access doors to the 2nd and 3rd floor above ground, and instead are situated in the middle; the floors of the castle can be accessed through some steps that are situated in spiral B, while the wall of spiral A contains windows that overlook the first courtyard.

Following the first spiral lap made of 12 steps (9 single and 3 in common), one can reach the first landing zone; going up 7 steps and following spiral B along the second spiral lap, one can enter the 2nd floor. This second lap is made of 13 steps (8 single and 5 in common), while the third lap is made of 15 (9 single and 5 in common); still following spiral B as one climb up the third lap, they can reach the 3rd floor after 10 steps. The last lap, the fourth, is made

of 10 steps (5 single and 5 in common) and it finishes with the landing zone from which one can access the 4th floor or a small balcony.

The shape of the steps appears quite complicated at first glance, with the presence of decorations on the bottom part; these decorations have no structural role, and contribute to give to the Doppelwendeltreppe its characteristic gothic aesthetic.

The steps can be divided in two categories: with and without the central "pillar". From these two categories, it was possible to further classify each step: there are single steps that belong each to one of the two spirals, and shared steps between them. Some of the single steps in Spiral B also serve as access to the Burg's floors, as already previously mentioned.

A further distinction can be done for the shared steps, but it will be further discussed in the section 3.3.2 while talking about the constructional system.

The differences between spirals A and B are minimal, and they mostly concern the heights of the steps; because of this, the progression of the staircase in its entirety is regular and the aforementioned differences still ensure that the common steps are at the same level.

In the following drawings, the small dotted line represents what lies above the section plan; in the sections, while the areas that could not be surveyed are indicated with a bigger dotted line.

The floorplans, sections and elevations in scale can be found in the boards in the attachments.



FIGURE 57, KEYPLAN OF THE TWO SPIRALS(AUTHOR)

TYPE OF STEP

Single step with "pillar" Single step without "pillar Shared step with "pillar" Shared step without "pillar Step to access the floor Entrance steps

FIGURE 58, SCHEME OF THE TYPE OF STEPS (AUTHOR)



1 ST FLOOR PLAN, SCALE 1:50

°€.7 + 0.40 m ±0.00 m + 0.27 m <u>____</u> □ Not surveyed different material ™€́J

Figure 59A, Plan of the 1st floor (Author)



NAVIGATOR



2ND FLOOR PLAN, SCALE 1:50



NAVIGATOR







3rd Floor plan, scale 1:50

4th Floor plan, scale 1:50





Figure 59C, Plan of the 3rd floor (Author)





NAVIGATOR









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FIGURE 60B, SECTION B-B' (AUTHOR)



FIGURE 61B, ENTRANCE FACADE (AUTHOR)

FIGURE 61A, SOUTH FACADE (AUTHOR)



The windows

The Doppelwendeltreppe has a total of 6 windows, distributed on the southern and eastern walls, and have been named starting from the bottom one going up.

Their measures are slightly different and depend on which wall they are: the ones on the southern wall (window 1, 3, 5 and 6) are more than 1m high, while the ones on the eastern wall (window 2 and 4) measure respectively 0,94m and 0,98m.

This difference aside, they are all casement windows with a wooden structure, with one glass pane that is fixed to the mobile frame by metal mullions, screwed on the wooden structure.

The detailed drawings, made after the survey and a specific research(Paley 1846; Ungewitter and Ricker 1920; Tipografia del Genio Civile 1997), can be found in the boards in the attachments.



Figure 62, Elevation, plan and section of F1, out of scale (Author)





THE DECORATION

The pillars have stone cords as decoration, while the hollow spindles are decorated with fish-bladder blind tracery (Benítez Hernández and Valiente López 2015; Kavaler 2005) together with the stone cord that serves as handrail in the middle or each spiral (Fig. 63, 64, 65,66).

The steps have a cone decoration on the bottom part: the diameter of the cone goes from about ± 20 cm until ± 6 cm: this decoration does not have a static or structural purpose, because the "real" shape of the step inside the wall is a rectangular parallelepiped, which is recalled by the plaster decoration as well (Fig. 69).

On the second and third floor, the doors are decorated with barred pointed arch portals (Fig. 70 & 71), while on the last floor the door has a rectangular stone gate that is adorned with overlaps, covings, and round sticks (Fig. 72).

However, a further element that is present in the pointed arch on the second floor is the motif of tree branches, that stem from the portal and "break free" from it, recalling the ornamental motif of nature, typical of the Gothic.

The red marble entrance portal presents the same kind of decorations as the stone gate in the last floor (Fig 73). Similar examples can be found in the Church of Großreifling (Schatz 2005) (Fig. 74).

Another decoration present in the Doppelwen-

deltreppe are 36 stonemason signs (Fig. 75).

As Elisabeth Schatz (Schatz 2005) has widely described in her thesis "Über Steinmetzzeichen. Zur Bedeutung und Dokumentation eines mittelalterlichen "Markenzeichens" am Fallbeispiel der "Doppelwendeltreppe" der Grazer Burg ", 21 of these marks were placed not on the spindle of the stair, but instead on the surface of the underside of the steps. The position towards the spindle, or on the spindle itself, would have made the different steps easier to assemble on the site; however Schatz hypothesises that the position of the stonemason marks on the underside of the steps was probably chosen thinking that the people walking up the stairs would look up in admiration, and discover the signs.

It is true that the Doppelwendeltreppe evokes a sense of admiration while climbing it; all of the details, the flish-bladder tracery and cord on the spindle, the cones on the underside of the steps and the stonemason marks themselves, they all make the visitors try to grasp as many particulars as possible while climbing upstairs, with the light coming in from the windows that create several different shadows on the object.

"A violent stream of movement, also promoted by lively light-shadow effects, pulses through the powerfully sculpted complex"

(Description of the Doppelwendeltreppe given by G. Brucher, (Schatz 2005))





FIGURE 63. DECORATION AT THE BASE OF THE PILLAR (Author)

FIGURE 64. DECORATION AT THE CAPITAL OF THE PILLAR (AUTHOR)





FIGURE 66, DETAIL OF THE FISH BLADDER BLIND TRAC-ERY DECORATION (AUTHOR)

1849)





FIGURE 65, DETAIL OF THE STONE CORD ON THE spindle (Author)

FIGURE 67, FISH BLADDER TRACERY ORNAMENT (MEYER



FIGURE 68. EXAMPLE OF FISH BLADDER TRACERY, FROM Amien's Cathedral, 16th Century(Zairon N.D.)



FIGURE 69, FOCUS ON THE STONE CONES (AUTHOR)



Figure 70, Door on the 2nd floor (Author)



Figure 71, Door on the 3rd floor (Author)



Figure 72, Door on the last floor (Author)



Figure 73, Red marble entrance portal (Author)



Figure 75, one of the 21 stonemason marks, highlighted in red (Author)

Figure 74, portal in the Church of Grossreifling (Zengerer 2012)

3.3 Constructional analysis

3.3.1 Materials

is constructed, we must first focus on its materials.

Regarding the façade (Fig. 76), the main materials are the bricks and sandstone of the corner ashlars and window frames(ECHNER Denkmal All of the material have local origin, especially Consulting GmbH 2016a); on the ground floor the stone and marble that come from quarries the entrance portal is made of red marble, the that are, nowadays, not even 20 minutes away first step is made of granite, and the stone at the from Graz(Bednarik et al. 2014). basement level is limestone; the balcony on the last floor is made of concrete.

On the inside, the main material of the steps is the sandstone coming from the Afram quarry(Friedrichmielke Institut, n.d.). However, this material changes once we reach the last floor: in spiral A, the last three steps have a slightly different texture and colour, just like the decoration of the last step is completely different from the one in Spiral B (Fig. 77, 78, 79).

This stone is still a local sandstone, but comes from the quarry of Aflenz('Lithothek' n.d.; Kögler and Boulasikis 2021)(Fig.80 & 81).

This difference will be further explained in chapter 3.4.3, in which the hypothesis of a reconstruction in the last floor happened after WWI will be explained.

Before analysing how the Doppelwendeltreppe The plaster of the walls inside is made of pigmented lime putty sand, in different grain sizes, mixed with marble powder filler, which amount was adjusted based on the substrate (Schaunigg 2016)



FIGURE 76, MATERIAL MAPPING ON THE FACADE (AUTHOR, ECHNER DENKMAL CONSULTING GMBH 2016A)



FIGURE 77, LAST 3 STEPS IN SPIRAL A (AUTHOR)



Figure 78, Shape of the decoration of the landing in spiral A (author)



Figure 79, Shape of the decoration of the landing in spiral B (Author)



Figure 80, Afram stone('Lithothek' n.d.)

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Figure 81, Aflenz stone ('Lithothek' n.d.)

3.3.2 Constructional

system

tions and the history of the Doppelwendeltreppe, one of the main questions that still remain is how this magnificent example of late Gothic architecture was built. Despite the complicated appearance that the Doppelwendeltreppe presents itself with to the first-time visitors, its constructional system is actually quite linear.

Two options were possible: either the staircase had been built starting from the perimetral walls, erecting them and leaving the space void in which the stone steps would have been later inserted, ot the walls were built at the same time as the staircase was assembled.

According to the manual written by Formenti (Formenti 1909), both options were possible as long as the span of the step was no longer than 1.40m; the manual from Musso-Copperi instead states no limit in the length of the span, and it says that as long as the part of the step inside the wall is 1/5 of the total length, then the structure would have no problems. The manual also states that the staircases were usually built together with the walls; considering how small the space inside the Doppelwendeltreppe tower is, how big the steps are and the fact that they are usually monolithic, it is believed that the two spirals of the staircase were built together with the walls, following the procedure described by Musso-Copperi.

Having considered the materials, the decora- It's also important to mention that both manuals are talking about cantilevered stairs, and not double spiral staircases.

> To better explain the constructional system, let's imaginetobuildthestaircasestartingfromthebase.

The first thing to do would be to lay down the base itself and the walls in which the steps will be embedded in. The thickness of the wall, sectioning the first floor at +1,20m is of $\pm 1m$ for the northern wall, $\pm 1,44$ m for the western wall, and $\pm 0,44$ m for the southern wall.

The masonry of these walls is made with bricks and mortar positioned alternating, in the first three floors, rows of bricks and one row of roof tiles; on the 4th floor the masonry appears to be more regular, with no rooftiles or spolia.

As the wall is being built, the steps are embedded in it.





FIGURE 82, PLAN WITH THE MEASURES OF THE WALLS (AUTHOR



During the survey, it was observed how each between the steps has been highlighted in grey. step has its own height, that varies between 0,19m and 0,24m; the deepness also varies, while the width is approximately the same throughout both spirals.

These steps, as already observed in 3.2, have two main differences: the presence/absence of a central pillar in the spindle, and the layout of the step itself, single or shared.

No matter the type of the step, whether they are single or shared, with the pillar in the centre of the spindle or not, they are all hypothesised to be embedded in the wall for about \pm 0,28m(Musso and Copperi 1912). (Fig. 83 & 84A)

As previously mentioned, the shared steps can be further divided in three types: shared steps that are embedded in the wall, shared steps that are embedded in the wall and are resting on consoles(Fig. 84B&C), and shared steps not embedded in the wall.

The shared steps not embedded in the wall are made by a single block of stone that has been carved and modified until the desired shape was reached; the steps that are embedded in the wall, whether they are resting on a console or not, are made by two different blocks of stones, kept together by metal plagues.

Once the first part of the masonry has been made, the next thing to do would be to embed in it the first common step (Fig. 85). The following schemes of the constructional system will feature the common steps in green, the sin-

The first 7 steps are hypothesised to be laying completely on the masonry below; from that step up, they are resting for a portion of the step inside the wall, while towards the middle of each spindle they are resting one on top of the other, creating a pillar up to the 20th step; in the portion in the middle, the steps overlap for about 2cm, meaning that the main area in which they are actually on top of each other is the central pillar.

After the first shared step has been placed and embedded in the wall, each of the spirals develops in a mostly symmetrical way, with the wall being assembled and the steps embedded as they progress in height.

Next, 9 single steps are laid down (Fig. 86), each of them embedded in the wall and with the portion towards the middle of the spindle full, creating the a pillar.

The next steps to be placed are 6 shared ones, 4 of which are made of two stone blocks and are embedded in the walls (2 of these are also resting on a console), and 2 that are made by one block, and are not embedded in the wall (Fig. 87).

This process continues as each step is placed one on top of the other, also creating the different openings (windows and doors) present in the layout; It is a process that goes on simultaneously for both spirals, replacing from the 20th step, the steps with the pillar in the middle with the hollow ones (Fig. 88-90).

gle ones in pink, and the overlapping portion Step by step, the spirals proceed upwards until

shape is different between spiral A and B (Fig. 91).

Once the landing of the 4th floor has been The "pillar" in spiral A appears to have more placed and embedded in the wall, the rest of or a squared shape, with the absence of any the masonry and the roof structure are built, kind of decoration; the one in spiral B presents completing the Doppelwendeltreppe. (Fig. 92) the same shape as the previous ones, with the cord and the other decorations that are present throughout the whole staircase. Not only that, but the last 3 steps in spiral A also appear to be made with a different material, the same used



FIGURE 83, GENERAL DIMENSIONS OF THE STEP (AUTHOR)

the 4th floor is reached. Here the steps present for the landing on the 4th floor. And hypotheonce more the "pillar" in the middle, and their sis for this difference has been made in section 3.4.3.

> ±0,60m 0,20m +± 0,28m

> > ----- Part of the step inside the wall



TOP VIEW



BOTTOM VIEW

----- Part of the step inside the wall

Cone decoration

FIGURE 84A, SCHEME OF THE EMBEDDED STEPS IN THE WALLS (AUTHOR)



FIGURE 84B, PICTURE OF THE CONSOLE on the 1st floor (Author)



Figure 84C, View of the console on the 1st floor (Author)



Figure 85, Scheme of the constructional system, first common step (Author)



Figure 87, Scheme of the constructional system, Shared step (Author)



FIGURE 88, A (AUTHOR)



Figure 86, Scheme of the constructional system, first "single" steps (Author)



FIGURE 88, B (AUTHOR)



overlapping portion between the steps



Figure 89, A (author)



Figure 89, B (author)

overlapping portion between the steps





Figure 90, A (author)







overlapping portion between the steps

Figure 91, End of the constructional system, and Detail 8 + 6 of the landing of the 4th floor (Author)

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Twins, not double: the Doppelwendeltreppe in Graz







- Steps not embedded in the wall
 - Single step with "pillar"
- Single step without "pillar"
- Shared step with "pillar"
- Shared step without "pillar" Entrance steps

FIGURE 92, END OF THE CONSTRUCTIONAL SYSTEM OF THE STEPS, WITH THE DIFFERENT TYPES HIGHLIGHTED (AUTHOR)

3.4 Decays & Interventions

The Grazer Burg latest renovation works happened in 2018 (Kögler and Boulasikis 2021) while the Doppelwendeltreppe was restored in 2016; because of this, today the Doppelwen- and uses deltreppe does not show particular signs of decay, also thanks to the everyday maintenance case.

The survey explained in Chapter 3.2 was used works done on this incredible late-gothic stairas a base for the survey of the abrasion of each step. The following chart contains the measures However, there are some signs that are worth taken on the Doppelwendeltreppe the 18th of being investigated: the abrasion of the steps. January 2023 (Fig. 93).

Mielke (Koolhaas 2018) has always sustained Again we can find, reading the chart from left that Scalalogy also implies studying the stepping to right, the number of the steps in the first colbehaviour of the stairs' users, and to do that one umn, and three more main sections regarding needs to examine the abrasion that each step the left spiral (Spiral A), the steps in common presents; this way, especially on objects as old between the spirals, and the right spiral (Spiral and fascinating as the Doppelwendeltreppe, it B). Each of these three main sections contains will be possible to better understand the paths the heights of each step taken in three points: most frequently used by the users, connecting left side, middle and right side; for some of them to the functions of the castle as well. them further measurements were required, in particular in the cases in which the abrasion Both the abrasion of the steps and the restorawas quite evident.

tion works of 2016 will be further discussed in this chapter.

3.4.1 Steps' abrasion

Once all the heights had been measured, the green colour was applied to the lowest point in each step, in order to better understand where the abrasion was higher. This process allowed the representation of the abrasion in the 3D model (Fig. 94).

43 44 45 46 47 48 48 49 50 51 52	42 27 28 29 29 29 29 29 29 29 29 29 29	24 25 26	4 0 0 1 1 1 1 0 0 0 4 4 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	ω 22 -	N. of the ste		Scheme of the stee
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		22*	20* 19*		Lett sp		
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22 22.5 21.5 21.5 20.5	23 21.5 22.5 22.5 22.5 21 21 21 21 21	20.5 20.5	20		nalf of the step		
20* 22.5*		19*	21 5*	Inner spi 16 15 14			
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Following the trend of walking where the step- castle. During the years, as the Grazer Burg ping area is larger in spiral staircases, one can changed its function, the Doppelwendeltreppe observe how this happens as well in the Dop- still remained in its place, with little changes to pelwendeltreppe, but only when the spirals are its layout as already mentioned in Chapter 3.1. divided.

Having the wall to relay on while climbing or descending definitely played a role in the reason why that path was preferred when compared to the small stepping area of each step towards the centre of the spiral; however, the same cannot be said for the steps in common between the spirals: in those points people preferred to use the portion of the steps that are closer towards the spindles, despite them being smaller, and using the stone cords of the spindles as handrails.

This pattern is repeated throughout the entirety of the Doppelwendeltreppe, with small variations of the stepping areas.

What is also quite interesting about the stepping pattern is that despite having Spiral B directly connected to the rest of the Grazer Burg, the abrasion on the steps is still the same as the one in Spiral A. This means that people had always climbed and descended along the Doppelwendeltreppe in an equal way, with no "prefixed" path.

As for the users of this incredible gothic staircase, when it was built it used to connect directly to the private chapel of the Emperor; this "religious" use could explain the intricate decoration we find inside, and why the stonemasons dedicated a lot of time and attention to detail to a staircase that was not the main one in the

Restoration 3.4.2 works of 2016

In 2016, the municipality of Graz started the restoration works of the Doppelwendeltreppe and the southern façade of the Grazer Burg. Up until that moment, the state of the Doppelwendeltreppe had been slowly worsening, as no ordinary maintenance had been done since the restoration works of 1949

Several signs of decay were present both inside and outside, the big climbing plant being one of the most noticeable ones.

In order to remediate to these decays, the company ECHNER Denkmal Consulting GmbH, which was in charge of the restoration works, conducted an incredibly in-depth analysis of the facade of the stair-tower and of the southern façade of the Grazer Burg.

The main goal of their intervention was not only to rectify the damages and decays that had been caused by the weather and the passing of time, but also to try and bring back the Doppelwendeltreppe to its original state, both inside and outside of the stair-tower

INTERVENTIONS ON THE OUTSIDE

The objective of the restoration of the outside plaster, appeared recessed. (ECHNER Denkmal of the building was to bring back the plaster at Consulting GmbH 2016b) the same level as the stone elements, while also The ashlars made of sandstone (A) and the maexperiencing the corner ashlars as an essential sonry (C) were joined by a 1.5 cm thick layer of element of the design. mortar (B), made of a fat lime mortar with lime During the renovation works of 1949, the com-spikes (Fig. 95).

pany in charge of the works decided to change As the company ECHNER Denkmal Consulting the overall aesthetic of the outside of the GmbH started their restoration project, they stair-tower: the walls had been replastered with got the results from an inspection of the plaster a highly cementitious, two-layer plaster strucof the building, which stated that the historical ture which was quite thick, with a restorative plaster had been almost completely removed plaster layer of 1.3cm and then a 0.3 cm layer from the bricks. However, there was still enough of cement-based finishing plaster; under that, of it for them to identify its main materials and there was a highly hydraulic pre-spray layer, components, which would have been later used with a thickness of up to 0.5 cm, that served as to create a new plaster that would have been an adhesive base. Because of this, the windows, similar to the historical one. the Roman stones, and the marble portal that once rested on the same level as the historical



FIGURE 95, LAYERS OF THE FACADE BEFORE THE RENOVATION WORKS OF 2016(AUTHOR, ECHNER DENKMAL CONSULTING GMBH 2016A)



Once the façade was exposed, it was possible to notice the presence of 103 corner ashlars in the southeast corner of the tower (Fig. 96).

The ashlars up to the 3rd floor (the ones in pink) were made of lime-sandstone, they did not appear to be completely regularly cut and were positioned one on top of the other; their surface also appeared to be in extremely good condition, with signs of sharpening for later plastering. Something that caught the attention of the restorers was the presence of a thin layer of historical plaster that mimicked the design of stones that did not match the position of the ashlars. The ashlars of the 4th floor (the ones in green) however were different: not only were they positioned one apart from the other, with rows of bricks separating them, but the material also changed from lime-sandstone to soft sandstone, just as their surface appeared severely damaged.

Regarding the masonry, in the first three floors it is made of rows of bricks alternated by one row of roof tiles (Fig. 98); on the 4th floor the masonry appears to be more regular with no rooftiles. (Fig. 99)



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FIGURE 98, EXAMPLE OF MIXED MASONRY WITH ROOF TILES (ECHNER DENKMAL CONSULTING GMBH 2016B)



FIGURE 99, EXAMPLE OF MASONRY WITH NO ROOF TILES (ECHNER DENKMAL Consulting GMBH 2016B)



Figure 100, one of the windows before the restoration works of 2016 (ECHNER Denkmal Consulting GmbH 2016b)

FIGURE 101, THE SAME WINDOW AFTER THE RESTORATION WORKS OF 2016 (ECH-NER Denkmal Consulting GmbH 2016b)

These changes in materials happening in the 4th floor will be further detailed and analysed in section 3.4.2., in which a hypothesis for this change is made.

The restoration works of 2016, with the assistance and permission of the Bundesdenkmalamt (the Federal Monuments Office), managed to put emphasis on the crafted stones of the windows (Fig. 100 & 101), portals and spolia while also highlighting in a subtle way the presence of the corner ashlars.

The crafted stones were cleaned and repaired where parts were missing or cracks were present, the masonry was covered with one layer of white, lime plaster corresponding to the historical plaster residues; the damaged corner ashlars were supplemented with stone material, and then the surface was covered with a lime glaze, applied "a secco", leaving the stone perceptible (Fig. 102) (Wasmayer 2016).

Twins, not double: the Doppelwendeltreppe in Graz





FIGURE 102, THE FACADE AFTER THE RENOVATION WORKS OF 2016 (AUTHOR)

INTERVENTIONS ON THE INSIDE

The main goal of the restoration of the inside of the Doppelwendeltreppe was to emphasise the gothic character of the double spiral staircase while preserving the age value of the stone.

This was achieved, for the walls, by removing the cement additions from 1949, and by reducing the modern plaster to the historical surface which coincided with the stone level of the steps, creating flush connections. The walls were vacuumed and then cleaned with a damp cloth, only to then repair the cracks and holes present in the masonry. The finishing layer was made with a lime plaster, similar in composition to the historical one. (Schaunigg 2016)

The cement additions were also removed from the stone steps as much as possible; they were also cleaned and repaired wherever there were any missing parts. The stone frames of the doors were finally provided with a glaze.(Wasmayer 2016)



Figure 103, Window 5 before the restoration works of 2016 (ECHNER Denkmal Consulting GmbH 2016b)



FIGURE 104, WINDOW 5 AFTER THE RESTORATION WORKS OF 2016 (ECHNER DENKMAL CONSULTING GMBH 2016B)



FIGURE 105, LAST FLOOR BEFORE THE RESTORATION WORKS OF 2016 (ECHNER DENKMAL CONSULTING GMBH 2016B)



FIGURE 106, LAST FLOOR AFTER THE RESTORATION WORKS (ECHNER DENKMAL CONSULTING GMBH 2016B)

Hypothesis of 3.4.3 intervention on the 4th floor

Ever since the first site survey, the 4th floor of the Doppelwendeltreppe always showed evidences of interventions done on the area. While this object appears to be so cohesive and elegant, with the colours and surfaces so homogeneous throughout the entire staircase, when one reaches the last floor it is impossible not to notice the differences between spiral A and B.

Spiral B finishes following the same style and decoration that have been present in the entirety of the Doppelwendeltreppe (Fig. 107), while the centre of the spindle in spiral A appears quite different, just like the last three steps (Fig. 108)

As already mentioned in chapter 3.3.1, these steps are made of a different sandstone, coming from the quarry in Aflenz, which appears more compact and of a slightly darker colour. Another big difference between the last floor and the rest of the staircase is the landing platform: supported by two metal bars going inside the walls and another metal bar connecting the other two, the 7 cm thick platform clearly stands out, a stark contrast to the gothic style of the Doppelwendeltreppe; while having a moulding decoration on both spirals, the decoration towards spiral A stops before reaching the beginning of the spindle (Fig. 109-110).



GURE 107, Spindle decoration in spiral B (Author)



FIGURE 108, SPINDLE DECORATION IN SPIRAL A (AUTHOR)



Figure 109 A, Spiral B with the metal bars and moulding decoration (Author)



FIGURE 110 A, SPIRAL A WITH THE METAL BARS AND MOULDING DECORATION (Author)



FIGURE 109 B, SPIRAL B WITH THE METAL BARS AND MOULDING DECORATION (Author)



FIGURE 110 B, SPIRAL A WITH THE METAL BARS AND MOULDING DECORATION (Author)

While no official documentation could be found diffused in Austria of procuring the sandstone regarding the change of materials and steps on for the reconstruction of the monuments after the 4th floor, this thesis supports the idea that this intervention took place during the rebuilding works that happened after WWII.

subject to several bombing campaigns, with a total of 57 aerial raids (while Vienna had "only" 54)(Kubinzky 2021) that were mostly concentrated on the area of the Hauptbahnhof (the main train station); while the Grazer Burg was nowhere near the main objectives of the raids, it still suffered some damage and needed to be reconstructed in some parts (Österreichisches Bundesdenkmalamt 1997)(Fig. 111, 112, 113).

As previously mentioned in Chapter 3.1, 3.3.1 and 3.4.2, the masonry on the last floor of the Doppelwendeltreppe appears different in the area of the south-facing window(ECHNER Denkmal Consulting GmbH 2016b): the hypothesis is that this area had been reconstructed after the damage suffered during WWII. Because of this, the masonry appears to be more recent, with no spolia and made of regular bricks.

The damage most likely extended to the inside of the Doppelwendeltreppe, which resulted in the strengthening of some steps leading up to the 4th floor with the addition of metal clamps to keep the stones of the steps together (Fig. 114); in particular in Spiral A, the last 3 steps were replaced during the rebuilding works, using the stone coming from the Aflenz quarry, rather than the original sandstone from Afram, and the metal beams were inserted to further support the last floor.

This hypothesis is further supported by the article "Werksteinbeschaffung für die Baudenkmalpflege während der Zeit des Wiederaufbaus nach dem 2. Weltkrieg" (Rohatsch 2004), in which the author explained the phenomenon

WWII, indicating the quarry of Aflenz as the one used for the Grazer Burg.

The reasons why the landing step of Spiral A had During the Second World War, Graz had been not been decorated like the rest of the Doppelwendeltreppe is not known; perhaps the aim of the project was to show the difference between the reconstructed parts and the original steps, even though 2 steps out of 3 were decorated in the same style of the gothic staircase.

> In the end, the overall design of the Doppelwendeltreppe wasn't drastically changed, although the difference between the landing steps of the two spirals is pretty evident upon arriving on the 4th floor.



Aerial photograph of the area of the main train station after one of the bomb raids(Graz Museum n.d.)



FIGURE 112, VIEW FROM THE AKADEMISCHES GYMNASIUM AFTER A RAID, 400M FROM THE DOPPELWENDELTREPPE (AKADEMISCHES GYMNASIUM GRAZ 1994)

FIGURE 113, TUMMELPLATZ AFTER A RAID, 350M FROM THE DOPPELWENDELTREPPE (GRAZ ARCHIVES N.D.)



FIGURE 114, LANDING OF THE 4TH FLOOR, FROM WHICH ONE CAN SEE THE METAL CLAMP ON A STEP (AUTHOR)



FIGURE 115 A, LANDING AREA OD SPIRAL B (AUTHOR)



Figure 115 B, Landing area od spiral A (Author)

4. Comparison with other cases in Italy and Europe

The theme of the "Zwillingswendeltreppe" has one for the tower of Pietro Speciale in Ficarazzi; spread mostly in Austria and German speaking however, there is also an instance of a Zwillingcountries(Mielke 1985), as already mentioned swendeltreppe, that unfortunately was demolin Chapter 2.2, with the examples of the first ished (Nobile 2013b): this staircase, credited twin spiral staircase in Kosice(Juckes 2011), or most likely to Guarino Guarini (Nobile 2013b), of the extraordinary staircase of Vorau(Mielke was in the Teatini complex in Syracuse. 1988); however, while talking about the topy Another example of complex staircase credited of twin spiral staircases, it is impossible not to to Guarini, and demolished as well as the one think about the spread of the Vis de Saint-Gilles in Siracusa, is the one in the complex of I Santi in south Italy when the intricated forms of those Martiri in Turin. Always in Turin, there is a more spiral staircases with helicoidal barrel vaults recontemporary example of twin spiral staircase, call the intriguing forms of the Doppelwendelin the palace of the Fondazione Luigi Einaudi, treppe in Graz. Palazzo d'Azeglio.

There are several examples of Vis de Saint-Gilles in Sicily(Nobile 2013a), like the staircase for the Maniace Castle in Syracuse, or like the Swendeltreppen, and the complex staircase of I Santi Martiri, will be further described in this chapter.



FIGURE 116 A, SCHEMATIC FLOORPLAN OF KOSICE'S STAIRCASE (AUTHOR)









FIGURE 116 D, SCHEMATIC FLOORPLAN OF I SANTI MARTIRI'S STAIRCASE (AUTHOR)



FIGURE 117, KEYPLAN OF THE CITY OF KOSICE (AUTHOR)

Zwillingswendeltreppe in ST. ELISABETH'S CATHEDRAL, KOSICE

The twin spiral staircase situated in St. Elisabeth's Cathedral is the first one of its kind that was ever built in Europe (Juckes 2011; Mielke 1993); constructed around 1440, the master builder, just like for the Doppelwendeltreppe, is unknown.

The Zwillingswendeltreppe is situated in the main nave, and it connects the ground floor to the King's Oratory; while the easter spindle stops at the first floor, the western one continues upwards all the way to the attic of the Cathedral. Despite the several changes in the layout of the church (BERECZKI 2014), the Zwillingswendeltreppe has kept its place throughout the centuries.

Because of the extremely small space in which the staircase is situated (Fig. 118), the purpose of this Zwillingswendeltreppe is supposed to be purely decorative; while the outside of the structure of the staircase appears highly decorated (Fig. 120), the inside is quite bare and simple, a stark contrast to the highly decorated Doppelwendeltreppe in Graz (Fig. 119). The materials used are similar to the Graz' case study, with stone being the predominant one.





FIGURE 119, INSIDE OF THE ZWILLINGSWENDELTREPPE (UNKNOWN N.D.)

Figure 120, outside of the Zwillingswendeltreppe (Jiroušek n.d.)



FIGURE 121, KEYPLAN OF THE CITY OF SYRACUSE(AUTHOR)

FIGURE 122, PLAN OF THE DEMOLISHED STAIRCASE (NOBILE 2013B)

The demolished twin spiral staircase OF SYRACUSE

The demolished complex of the Teatini in Syracuse was situated in the Island of Ortigia, near the Cathedral and the Maniace Castle.

The Zwillingswendeltreppe of the complex, which most likely connected the 4 floors of the building, was made with white stone and had extremely sinuous and intriguing curves.

Presenting the typical layout of a twin spiral staircase (Fig. 122), the staircase was finished in 1691, and it is believed to have been built following the design of Guarino Guarini, because of its forms (reminding of the staircase in I Santi Martiri in Turin) and the fact that the architect was in Syracuse between 1657 and 1662, years in which the staircase was being built (Nobile 2013b).

This staircase is quite similar to the Doppelwendeltreppe, for the shape, layout, and the materials: the steps are embedded in the walls and lay, in both spirals, on a central pillar; the material of the steps was white stone, shaped so that the step appeared slightly curved (Nobile 2013b).

THE STAIRCASE IN THE COMPLEX OF I SANTI MARTIRI, TURIN

Situated in the Jesuit complex of I santi Martiri in Turin, near the refectory (Fig. 124), this particular staircase was unique in its kind; built during the XVIIth century, it was demolished in 1927 when the city of Turin transferred the municipal registry office in that lot (Signorelli 2000).

The architect that created this incredible staircase is unknow, although in 1969 it was hypothesised that Guarino Guarini might have been the mind behind it (Signorelli 2000).

Called in the plan of the San Paolo block as "Scaletta del refettorio" (Fig. 124) this particular staircase was accessed by 2 steps and a small FIGURE 123, KEYPLAN OF THE CITY OF TURIN (AUTHOR) landing area, from which one could access the In 1825, the architect Barabino described the corridor on the ground floor; The staircase was staircase as: then made by 2 twin winding runs (made by 10 steps each) that arrive to an intermediate landing, in common between them, from which an-...scala che monta alli piani superiori, costrutta con forma. other set of 2 twin winding runs (10 steps each bizzarra, ricavata da due elipsi, che si intersecano, in mezzo again) bring to the 1st floor; from that point, to di questa vi è uno stretto passaggio che va al corridoio."(reach the 2nd floor, one had to go up a straight Signorelli 2000) single exit run (made of 16 steps)(Fig. 125).

Particularly interesting is the fact that this staircase, with a particularly complex shape and structure, was completely made with bricks, with the steps having stone as a decoration on the steps, rather than in the structure.



["...staircase that brings to the upper floors, built in a bizarre way, obtained from two ellipses, which intersect, in the middle of this (staircase) there is a narrow passage that goes to the corridor."]

Despite not being a proper twin spiral staircase, this staircase was so extravagant and complicated in its forms, in a similar way to the Doppelwendeltreppe in Graz.



FIGURE 124, PLAN OF THE SAN PAOLO BLOCK, WITH THE STAIRCASE HIGHLIGHTED IN GREEN, 1722 (SIGNORELLI 2000)



FIGURE 125, PLAN AND SECTION OF THE STAIRCASE (VITTONE 1766)

THE ZWILLINGSWENDELTREPPE IN VORAU, AUSTRIA

The example of the twin spiral staircase from Vorau is dated back to the XVIIIth century(Mielke 1993; 1986); located in the Augustinian monastery library, the staircase connects the library to the former manuscript room, separated only by an opening with no doors (Fig. 127).

The staircase appears extremely light, almost transparent, since it is not enclosed by walls and instead is supported by 16 thin iron rods, that are connected to both the wooden steps and the iron handrail.

The layout of this Zwillingswendeltreppe follows the same one as the Doppelwendeltreppe in FIGURE 126, KEYPLAN OF THE CITY OF VORAU (AUTHOR) Graz: two twin spindles develop symmetrically and meet in two landing points, one between The overall appearance of this twin spiral stairthe floors, and one as landing zone for the upcase is quite elegant and light, a clear example per floor. It develops from a wooden base, decof how the Zwillingswendeltreppe has evolved orated with light maple wood and dark, walnut through the centuries as the technology prowood (Fig. 128); from there the two spindles, gressed(Mielke 1988). which have a diameter of 11,3 cm and 11,5 cm and are decorated with carved tendrils of Something that really stands out is the choice leaves, develop for a total height of 3,82 m and of the material for the steps themselves: as finish with an end knob that is not just decoraone observes this incredibly light structure, tive, but also acts as a screwnut to tighten the they might think that the steps are made of spindles (Fig. 129)(Mielke 1993; 1988).

metal, however that is not the case, since they are made of walnut wood. It's an interesting Each spiral is made by 19 wooden steps, with choice, since the steps are also guite thin, and heights that vary between 22 cm and 16,5 cm, one would think that the wood, over time, that have holes that allow the iron bars and the would end up bending: however, observing the handrail to be secured to them; they are also staircase, the steps show no trace of abrasion anchored inside the wall with bench irons (Fig. or bending. 130, 131, 132).





Figure 127, the Zwillingswendeltreppe in Vorau (Stift Vorau n.d.)



Figure 128, plan of the wooden base with the decoration (Mielke 1988)



FIGURE 129, DETAIL OF THE ENDING KNOB OF THE SPINDLES(MIELKE 1988)







FIGURE 131, PLAN OF THE STEPS 10-19(MIELKE 1988)



FIGURE 132, ELEVATION OF THE STAIRCASE WITH THE HEIGHT OF EACH STEP(MIELKE 1988)



FIGURE 133, KEYPLAN OF THE CITY OF TURIN (AUTHOR)

The Zwillingswendeltreppe in Palazzo d'Azeglio, Turin

Another example of twin spiral staircase is the one in Palazzo d'Azeglio in Turin, Italy. As already mentioned before, the Zwillingswendeltreppe spread mostly in Germany, Austria and Slovenia, while in Italy the instances of such staircase are rare. One of these it's the one located in Turin.

Built in 1953 by the architect Tommaso Buzzi as requested by Emanuele Nasi, this majestic staircase was built during the extensive renovation works done on Palazzo d'Azeglio in the years 1953-1956 (Fig. 134).

To create the space for the staircase, the southern wall that used to divide the old staircase, which was a traditional straight, single-run stair with two flights of stairs and a landing, from the apartment on the ground floor and 1st floor was demolished. The new staircase, made of reinforced concrete, material quite different from the stone of the Doppelwendeltreppe, or the walnut wood of the staircase in Vorau, has 2 twin spirals meeting in the middle and creating a landing before separating again; the shapes of the handrail, the stucco decoration and the shape of the steps themselves are extremely scenic, creating an extravagant and rich mix (Fig. 135).





The stuccos were created by venetian artisans, using the "trattamento pompeiano" with aged, slaked lime and marble powder.

Palazzo d'Azeglio stayed with the Nasi family until 1968, when it was sold to FIAT to host the Fondazione Agnelli; however in 1970 it was bought by the Fondazione Luigi Einaudi Onlus, and since then it has been the accommodation of the Fondazione, which made several restoration works in order to preserve the decorations, the remains of the past and the entire building(Converso and Firpo 1991).



5. Conclusions

type of staircase has easily adapted to the new technologies, showing how it was possible to create them not only with stone, but also with the combination of wood and metal (the Vorau case) or with more modern materials (the case of Palazzo D'Azeglio).

The "Zwillingswendeltreppe" type seemed to Over time the twins spiral staircase layout had resolve a wide-spread problem in the spiral remained the same, with a small technical staircases, having to use the smaller area of the novelty in the case of the stair in Schorndorf stair when meeting another person descending/ in Württemberg from 1579(Mielke 1985): the climbing at the same time: with two separate landing, common steps were enlarged, creatspirals, two people can easily climb together ing a bigger resting area; that case aside, this with no risks of having to step aside. This solution was not only practical and conciliatory, but also suited best the aristocrats that had this kind of staircase built in some of their palaces; together with the religious orders, nobel families were the only ones that would have been able to afford the high costs of such com- In the end, the Doppelwendeltreppe remains plicated and elegant stairs, and therefore the one of its kind, a testament to the incredible spread of the "Zwillingswendeltreppe" type was skills of the Gothic stonemasons, a symbol of strictly linked to that. elegance and power.

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