

# Medieval Craftsmen at Castle Waldenfels

## Historical Construction Work as Serious Game

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**Abstract**—Reliving the medieval past is an important economic factor in Europe, physically as well as digitally. The broad public interest in the Middle Ages is still continuing, including all aspects of medieval life and culture, in media and as events on historical sites. Also the gaming community has a strong affinity towards medieval contents which is clearly visible in numerous popular titles and an ever-growing market. There is probably a substantial overlap between those two communities. Our approach envisions a serious game for both communities, to provide education on historical construction techniques and foster motivation for preservation of built heritage. Thereby we put a focus on the conceptual game design based on historical research and a reference to a heritage site. The implementation was done as a proof of concept. The idea has been realized with the listed heritage castle Waldenfels in Upper Austria. The context of the game is set by the medieval building phase of the castle which is only partially preserved. Its content focuses on medieval professions in construction, including their tools, materials and methods. The game's target audience are local people, tourists with an interest in castles, architecture students, as well as craftsmen and conservators. The benefit of using contemporary communication strategies like serious games for traditional construction techniques lies in the vitalisation of intangible heritage for an interested audience. Thus, the game aims to motivate and educate its audience to participate in preserving local tangible heritage as a community effort. We see our approach as a contribution to a sustainable living heritage that is supported by an involved community.

**Index Terms**—historical construction work, serious games, living heritage, architectural heritage, intangible heritage, castle Waldenfels.

### I. INTRODUCTION

One of the difficulties in cultural heritage conservation results from the construction history of the built heritage object, especially when it spans over several hundred years of changes and additions. The intention is not only to preserve the object in a state as close as possible to the original, but also to employ appropriate materials and technologies according to the different former traditions.

The regional craftsmen often lack the required expertise in historical building tradition. Fostering the understanding and appreciation of historical handicraft is one of the means to support heritage conservation.



Fig. 1. Photograph of Castle Waldenfels

The owner of the Austrian listed castle Waldenfels, Dominik Grundemann-Falkenberg has made this endeavour in cooperation with the regional Antiquities and Monuments Office. To this end, the castle has been partially opened up to the public, the local community has been invited to participate in some of the restoration activities, and more and more digital materials were produced.

The intention of a serious game on historical construction work follows the same line. In a playful approach, the construction of a medieval castle can be actively explored by local people, tourists with an interest in castles, architecture students, as well as craftsmen and conservators.

### II. MEDIEVAL CONSTRUCTION WORK

The first castles were made of wood, as it was the simplest material to be found ubiquitously. The wooden construction was gradually replaced by stones and rock due to their sturdiness. But building a castle in the Middle Ages was a costly and laborious endeavour, especially when the castle was to be made of stone. Suitable materials needed to be transported from the surrounding areas to the building site which made the whole process time-consuming and costly.

Not only was the transport of the material tedious, but also the handling of it was a challenge. The construction of such castles was very sophisticated, so that only specialists who had mastered the essential techniques could complete the task. At each step of the process, a specialist was required – from the master-workman (who also incorporated the nowadays role of an architect) making master plans and calculations, to the stonemason processing each and every stone, to the mortar maker preparing binding agent, and many more. On top of that,

numerous day-workers assisted in the process, under the supervision of skilled craftsmen.

The processing of materials relied heavily on man-made tools – from the Stone Age (e.g. bifaces), to Bronze and Iron Age, as well as in the Roman Age and until this day. Tools gradually improved despite their functionalities staying the same. With the discoveries of new materials, better expertise and knowledge would be gathered and applied on the tools which then made it possible to process hard materials such as rocks and stones.

For constructing wooden castles, scaffolds were not necessarily needed but for building a stone castle, they were a necessity. Different types of scaffolds were designed for each need. One of the biggest innovations in transportation was the development of hoists. They started with a very simple construction using a rope tied onto a cage that could be pulled upward. This progress to a more advanced construction of the hoist which involved the combination of a wire pay-off and the goods lift would be lifted with a pivotable crane. Those constructions made it possible to build grand buildings like churches, cathedrals and castles [1],[2].

For the design of this serious game, we focused on the involvement of professionals, tools, construction methods, and building materials. The professionals include a master-workman, bricklayer, stonemason, quarrier, mortar maker, carpenter, sawyer, blacksmith, and roofer. As for the tools, a collection of common medieval instruments used by the above mentioned skilled craftsmen have been selected. The game introduces the construction devices: scaffolding, ladder, slant, treadwheel, and crane. Essential medieval building materials for castles were stone, brick, wood, and mortar made of lime, sand, and water.

### III. CASTLE WALDENFELS

Waldenfels is a castle in Upper Austria with a fascinating and complex building history [3] encompassing roughly 500 years. Fig. 2 depicts on the left side a historical engraving from 1674 which displays the prominent castle keep in the centre, and on the right side the virtual reconstruction by [3].

A detailed diagram of the construction history is depicted in fig. 3. The initial fortified castle dates back to around 1330 – 1380 and features a simple five-edge layout. It was turned into a renaissance castle in 1580. Later some baroque additions were incorporated. In 1636, Waldenfels was acquired by Count Grundemann and has since remained a family property.

The presented game focuses on the founding of the 14<sup>th</sup> century castle Waldenfels. A rocky knoll in the centre of the castle area was used as the base of the initial fortified castle, a pentagonal castle keep. This part of the castle was largely



Fig. 2. Historical engraving from 1674 (left) [4] and reconstruction (right) [3] of castle Waldenfels

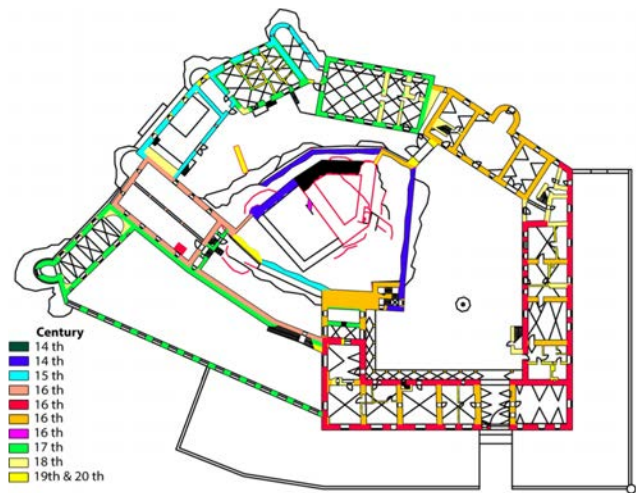


Fig. 3. Construction history of castle Waldenfels [3]

removed around 1809 and is only partly visible in its remains in the castle's present state.

A virtual reconstruction based on available documentation and on-site research was done by [3]. This reconstruction was selected as the setting for the serious game on medieval Waldenfels as an example for historical construction work.

## IV. MEDIEVAL SERIOUS GAME

### A. Serious Games for Architectural Heritage

Some educators believe that learning through play is natural and effective, and the game-based learning community argues along those lines [5],[6]. Even in digital heritage, serious games became a popular means to immerse interested audiences in past cultures and events [7],[8],[9],[10],[11],[12],[13],[14],[15],[16]. For the promotion of knowledge about the Middle Ages, digital games suggest themselves, especially because a substantial number of games are set in the style of this period of history.

From an educational point of view, storification for history learning has proven worthwhile [17]. A story helps to make sense of an experience [18]. One of the possibilities to realise a story, especially in a digital game, is to have it acted out. This proves particularly useful for learning scenarios [19], and enhances immersion. It also supports “learning by doing”, which can be integrated into the pedagogical framework for interactively realising the story that is being told. According to [20], learning by doing consists of the steps: define goals, set mission, present cover story, establish roles, operate scenarios, provide resources, and provide feedback – a recipe for digital games.

### B. General Game Concept for Medieval Construction Work

The didactical concept of the presented game can be summarized by „gaming objective equals learning objective“ [21]. This concept is based on and supplements the didactic concept of „learning by doing“. It describes a game design, which embeds the learning content in the game mechanics and task design. Players find information fragments in the game (theoretical background), and study them in order to be able to

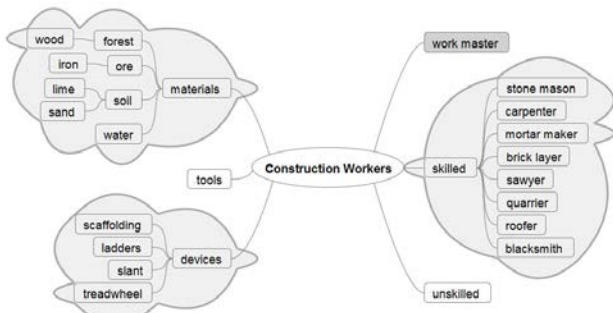


Fig. 4. Construction workers, materials and devices

solve the tasks and quests of the game (practical application). Any learning content integrated in the game therefore never ends in itself, but provides the theoretical basis to solve tasks and quests.

The general concept of the presented game is a narrative organisation based on a listed castle, realised as a “learning by doing” experience. A story-based digital game seems appropriate for communicating historical content, including construction work.

The content of the game is the intangible heritage of medieval construction work. It is exemplified by engaging the player to rebuild the 14<sup>th</sup> century fortified castle Waldenfels. In this instance, the player has to recruit construction workers, and together with them they learn about professions, materials, tools, and devices of the past (cf. fig. 4).

One of the requirements was to design the game to be included in the on-site guided tour at Waldenfels. This basically limits the initial game experience to a very short time period, implying that the game should convey the essential aspects of medieval castle construction within that time frame. For this purpose, the game experience has been divided into four stages (levels) which include (1) recruitment of construction workers, (2) collection and processing of materials, (3) operating construction devices, and (4) completing the medieval castle keep, as depicted in fig. 5.

The player is familiarized with medieval professions involved in construction work through conversation with people in the surrounding and villages. The game provides a conversation diary which registers those workers. Furthermore, the player can recruit workers for the castle keep to be built.

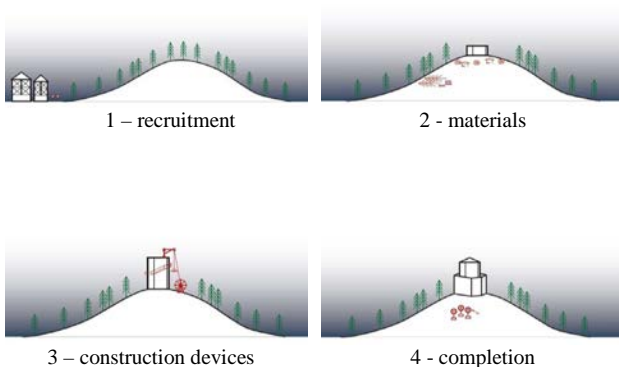


Fig. 5. Game timeline: four phases



Fig. 6. 3D models of some medieval tools

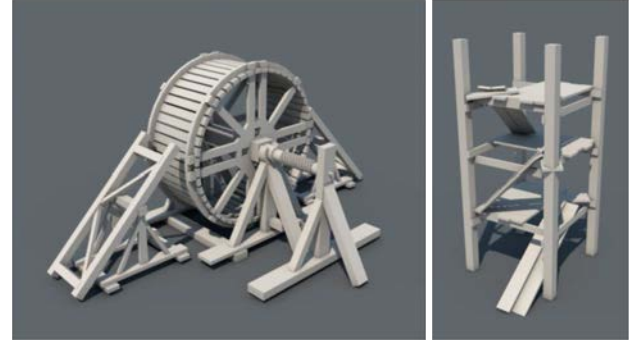


Fig. 7. 3D models of a running wheel (left) and a scaffolding (right)

The inventory registers the selected workers and registers collected materials and tools as well. A reference booklet provides valuable information on professions, materials and tools of medieval construction work. This booklet is for reference and in case the players prefer reading instead of talking to the workers. The tool chamber allows a 3D viewing of available tools and presents information on the displayed tools.

Like in many games, there is a minimap to aid the player with orientation in the virtual world, as well as a level indicator. Levels do not have to be completed in order.

A large effort has been put on the creation of 3D models of medieval tools and construction devices in accordance with corresponding literature. Some of them are depicted in figs. 6 and 7.

### C. Motivation, Achievements, and Community Building

As [22] argues convincingly, the motivational aspects of serious games are not overwhelming, and generally a difficult area as noted by many. One promising approach to overcome this issue might be in using achievements, especially in connection with real life coupons. This means intertwining game progress with business vouchers or activities (e.g. drinks at the castle, entry fee for the local archery tournament, participation in an on-site lime seminar). Vice versa, participation in castle-related activities could lead to vouchers for in-game items.

Another means to provide motivation lies in the community building aspect of this game. The game thus intends to actively link the castle and interested communities. This is partially approached via the achievement concept. Furthermore, as construction work is always a team effort, multi-user activities in the game could reflect this aspect as well. It could be tackled by having tools operated by several players. In single-user mode the other players are provided and controlled by the

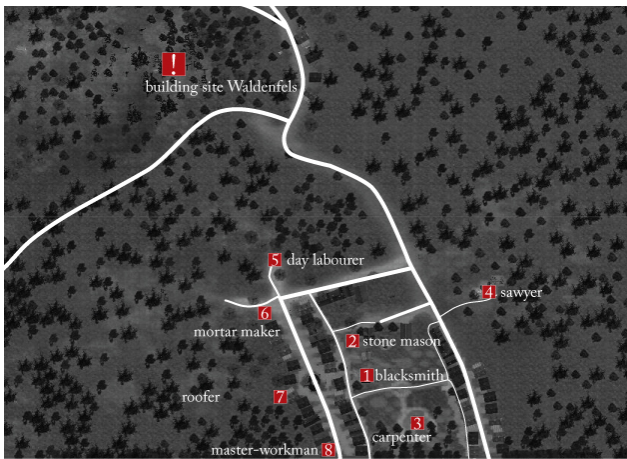


Fig. 8. Map of the building site and surrounding areas



Fig. 9. Medieval village in the area

game. Thereby, interested audience are encouraged to cooperate and may be rewarded vouchers as a group.

In a similar manner, the project Guedelon [23] is based on involving the community to “build a castle using the same techniques and materials used in the Middle Ages”. The presented game seeks participation of interested communities in the areas of restoration, and the castles activities as well as the appreciation of historical craftsmanship.

## V. RESULTS AND DISCUSSION

The game was partially implemented as a proof of concept with the Unity game engine. It starts in the area where the castle keep is to be built. Fig. 8 depicts a map of the building site and its surrounding areas. This area is inhabited by local villagers (see fig. 9).

So, the game establishes the setting (including the labourers and craftsmen of the neighbouring villages) and the goal to construct the medieval part of castle Waldenfels.

In stage 1, the player wanders about meeting local craftsmen, and can enjoy conversations about their craft. The game thereby introduces professions in medieval construction.

As craftsmen use a variety of tools, these are introduced separately in the tool chamber (see fig. 10) where they can be examined. The game provides interactive 3D models of tools along with information on its usage.

In stage 2, materials are gathered in the areas where they are found or produced (see fig. 11). The player can apply the acquired knowledge from stage 1 in this level by exploring a typical construction site of the Middle Ages.

He or she thereby finds out where the people were working, how they were using the tools, and how the mural of the castle had been constructed. The player can interact with the craftsmen by providing them with collected raw materials (like wood, sand, and rocks) or produced materials (like mortar (cf. fig. 12) or tools and devices).

In the third level, a part of the castle has already been built at the building site. The player’s task is now to aid the craftsmen to transport the materials upwards in order to complete the castle. The player will have to construct and utilise the needed devices like scaffolding, running wheels,



Fig. 10. Tool chamber



Fig. 11. Medieval craftsmen at work

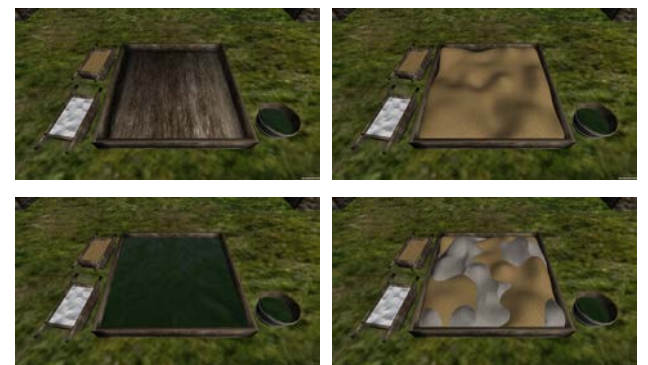


Fig. 12. Mixing mortar from the materials sand, lime and water

ladders, etc. to accomplish this assignment. Fig. 13 depicts scaffolding as it could have been used on the castle keep.



Fig. 14. Completed castle keep



Fig. 13. Scaffolding on the castle keep

The last level of the game is presented as a successfully built castle with its outer ward (see fig. 14). The player can admire what has been created through the application of knowledge that was acquired during the game.

Until the next tasks to be assigned (e.g. in a game extension), the player can practice virtual archery by shooting at targets that are placed in the area surrounding the castle keep to achieve bonuses.

In our approach with a serious game for medieval construction work, we aim to educate and motivate interested communities for the preservation of built heritage.

A focus was set on the founding of the 14<sup>th</sup> century castle Waldenfels which has been largely removed in the 19<sup>th</sup> century. Besides showing the virtually reconstructed 3D model, this part was made available as an interactive experience via the game where medieval construction work can be explored in its essential aspects. These include the introduction of professions and their tasks in the construction process, the material used in those times and how they were obtained and produced. Furthermore, the tools and construction devices in the game illustrate medieval construction techniques. A large effort was put into the creation of faithful 3D models which reflect literature on medieval craft.

After being presented with our serious game on castle Waldenfels, experts from the Antiquities and Monuments Office evaluated: "Scientific theories on the development of built heritage can only be tested and verified by virtual recreation of the historic environment with respect to cubature,

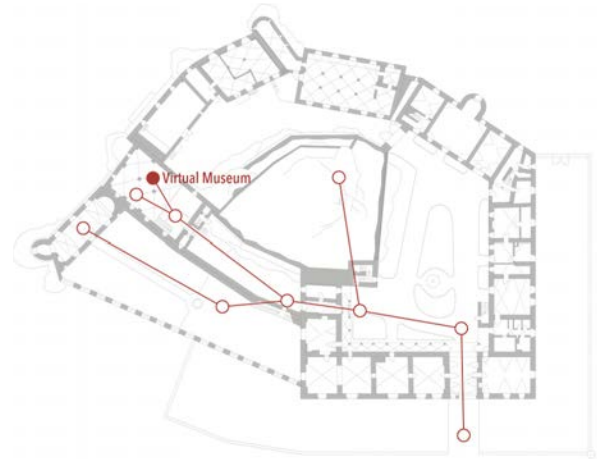


Fig. 15. Guided tour at castle Waldenfels

surrounding, and resources. Such a virtual reconstruction enables the correct fit of haptic architectural remains in terms of their position, construction and cubature, thus rendering the reconstruction scientifically comprehensible.

A scientifically grounded reconstruction facilitates a unique pedagogical combination of history education, architectural heritage, and current media reality of the younger generation. Working through the history of construction techniques through a game promotes the cultural empathy in regard to better understanding people, buildings, materials, and life in past times."

In his feedback, the owner of the castle stated that he has successfully involved the community in several activities, including the adaptation of castle areas for events like weddings, festivals, and themed dinners. Recently, a programme for unemployed young people started to help with regular maintenance. Additionally, cooperation in apprentice training with a local carpenter is planned for the restoration of the windows. In this spirit, the game represents an additional means to connect gamers with the castle and the local community and businesses.

The serious game is intended to serve as an educational simulation which could be part of the carpenter training. Furthermore, the serious game will be integrated into the on-site guided tour of the castle (see fig. 15), as an interactive installation for the visitors in the former court room which is still under restoration. This is a first step towards a virtual museum about castle Waldenfels. There are plans for cooperating with the local brewery to link community, businesses and the castle via the game's achievement system. Additionally, the archery association which resides at the castle is interested in virtual archery as part of the serious game.

## VI. CONCLUSIONS AND OUTLOOK

One of the key requirements for the game concept was to incorporate a listed castle in the game environment, with the intention to support its preservation and raise the public awareness about the castle in its present and historical form. Several discussions with the castle administration led to a game concept in accordance with their needs and interests.

It was also necessary to include researchers and experts from the Antiquities and Monuments Office in order to determine which technologies and knowledge about the preservation of medieval built heritage should be conveyed in a serious game.

The game concept is innovative in two aspects: it provides education on medieval construction techniques based on scientific publications. Furthermore, it fosters motivation for preservation of built heritage as a community effort.

For the dissemination of the game, several strategies have been envisioned. One of the intentions of the castle administration is the extension of the on-site guided tour with a virtual museum to visualize historical events and construction phases for the interested public. The presented game would be a first milestone in this direction. Recent developments in web technology make the game suitable for the castle's web presentation as well.

It is not intended to be a commercial game because the game's main intent lies in community building, education, and support of the castle's marketing. It might be reasonable, though, to include possibilities for advertisement of local businesses.

Another important dissemination route is social networks, as one of the game's set intent lies in community building. This can be achieved best by including current technologies like Facebook. But linking the castle and related communities should not only be done through online platforms, but also through possibilities of face-to-face events. Participation can take place in events on historical sites, like the famous medieval festivals which can be found all over Europe. Furthermore, it could also consist of letting the local community use parts of the castle for special occasions in exchange for assistance in the restoration work. For this purpose, the game would also provide education on medieval construction work. Also local craftsmen can be won over for cooperation in a mutual appreciation of traditional skills which then can be employed in actual businesses.

Several areas are open for further improvements like the real life bonuses and the web integration. An evaluation of a potential improvement with respect to motivational and educational aspects will then be possible.



Fig. 16. Renaissance garden areas at Waldenfels [24] from [25]



Fig. 17. Lime pit at Waldenfels

The game has been implemented as basic framework and could be extended in various directions. The most important extension would be to further develop the achievement system and fully realise the concept of vouchers for local businesses.

The historical garden areas in and around the castle are barely existent today. Fig. 16 depicts the castle as the central red structure. The outside garden was located east of the castle, a rectangular area with dividing and surrounding pathways, and a fountain in its centre. This garden could be reconstructed easily as an independent project in a community effort. A corresponding extension of the game should link the project and the community, thereby communicating historical gardening too.

It would be nice to enhance the operative aspects of the tools and devices, especially via tasks that require several people to simultaneously operate. This would require the implementation of multi-user aspects.

Geocaching [26] has a strong community, which also should be involved, because the area offers several interesting spots. An integration of geocaching in the game is a further potential extension with the benefit of getting people in contact with the castle and its history.

A further point of linking game content with restoration activities would be in the area of lime production and washing. The owner of the castle already transformed an existing pit for that purpose (cf. fig. 17) in coordination with the regional Antiquities and Monuments Office. For the interested communities, lime seminars could be organised there.

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