RESTORING AND SAFEGUARDING KOLDINGHUS CASTLE

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For more than a century Koldinghus Castle, a former royal western residence in Kolding, South Jylland, from about 1550, was standing as a spectacular ruin following a disastrous fire in 1808, during the Napoleonic Wars. Two of the four wings of the castle, however, remained with major parts of walls in fairly good condition, and exterior repairs and restorations in 1884, in 1931-35 and in the early 1970s enabled successive interior restorations, allowing of creation of museum and exhibition rooms etc. and in particular restoration of the church hall. The remaining two wings, the southern and eastern ones, in contrast were severely damaged by the fire and the ravages of time, and a very novel approach to restoration was developed, incorporating many special architectural and engineering features. In this contribution the philosophy and concept of restoration as well as the architectural and engineering solutions, structural and fire-related, will be discussed.

SOME NOTABLE FEATURES OF THE CASTLE AND ITS HISTORY

Like many other castles in Europe Koldinghus was subjected to a number of alterations and rebuildings during the centuries. The oldest remains of the medieval fortress date from the 13th century; around 1475-80 two sizeable Gothic wings were added, and in a few years ar. 1550 the former fortress was transformed to a four-wing Renaissance castle, by King Christian III. Some 50 years later Master-builder-King Christian IV modified the castle in exterior and interior, also adding a large tower and creating a fine church-hall. Finally in 1720-1726 King Frederik IV rebuilt Koldinghus once again, into a white Baroque castle with features of a palace. This was the castle that burned out almost totally on March 30 and 31, 1808. The fire probably was caused by fierce heating of the rooms (due to the very cold late winter), which was left unattended by the Spanish troops then occupying the castle, when they retired for quarters after celebrations.

Thus, in its lifetime of five centuries Koldinghus has experienced 5 main-periods: the Gothic house, the two Renaissance castles of Kings Chr. III and Chr. IV, the Baroque castle of King Frederik IV, and the period of Ruins from 1808. Nevertheless several features of exterior and interior appearance and of

construction distinctive for each period have remained until today, and in particular appeared quite clearly in the ruins of the castle. This interesting circumstance is well worth observing, as it very decisively influenced the philosophy of restoration and hence the concept for restoring the castle's ruined south and east wings in particular.

No proper documentation of the castle-design and construction is known to exist, but some main features of appearance, arrangement and use of rooms and of principal constructions are known from contemporary and later descriptions, and a few drawings depict the castle in its various periods. Fig 1 and Fig 2 depict the early Renaissance castle and the Baroque castle of around 1725 as restored. Except for a few details to be seen in the ruins almost no evidence of the details in the various castles has been found, in the Royal Archives or elsewhere.

Following intensive discussions of a decade the vast work of restoration commenced in 1975, divided into 3 stages. The first stage was completed in 1980/81 comprising new tile-roofs on the north and west wings and the restoration of the church hall below the main tower. The second stage involving roofing and permanent covering of the east and south wings was completed in 1989 and the third stage comprising the

Fig 1. The four-wing Renaissance castle of King Christian III, ar. 1550.

Fig 2. Koldinghus to be restored in Baroque style, prior to 1808.

interior decoration and completion of the entire castle is close to conclusion by mid-1990.

THE ARCHITECTURAL CONCEPT OF RESTORATION

In 1969 a government commission issued a report discussing the fundamental problems of ruins (to be left), restoration or reconstruction of Koldinghus. Realizing the complexities and aesthetic doubts of reconstruction to any of the periods described above the commission concluded that considerate restoration to a suitable extent and protection of the then remaining ruins would be the solution. The external form of the castle should essentially be retained, while in the interior possibilities were left open. This conclusion harmonized quite well with the philosophy and perceptions of the architects of the restoration: that a historic building should be seen not only as the house itself built long ago in a certain style, but also should involve the life-cycle of the building, recog-

nizing its use, wear and tear (its historic identity so to say).

An initial proposal of restoration envisaged the two wings protected by a glass-facade covering the large gaps in the walls, suspended from an interior simple steel construction also carrying the roof. The proposal, although it received support, however was not accepted, and after further studies the architects presented a new proposal of restoration, closely meeting the wishes of retaining the external Baroque forms and in the interior presenting many innovative features. As will be appreciated from the account below the structural designs of the proposal were complicated, and the overall design as well as many details were developed in close cooperation with the consulting engineers. The proposal left the vulnerable wall remains, at considerable lengths around the south-east corner of the wings, almost untouched, wrapped into and covered by a largely self-supporting structure. The structure includes a horizontal steel truss at roof-floor level, supported by slender glue-laminated wood columns, carrying the roof constructions as well as a light wood-framed external wall construction closing the gaps of wall missing. The superstructure further carries galleries for viewing down at the ruins and the hall itself. The concept left major parts of the hall (formerly the main chapel of King Chr. III castle) open and spacious in its total height of about 17 m. In the western end of the hall, now known as the Ruin Hall, three recessing floors are resting on slender glue-laminated columns. For impressions of the structures and some architectural details, see Fig 3, 4 and 5.

The proposal, which included restoration of other parts of the castle as well, was accepted by the authorities involved in 1985, with further detailing to follow and work on site to commence shortly after.

ENGINEERING DESIGN AND PARTICULAR STRUCTURAL FEATURES

From the outset it was imperative that the structure outlined above caused no action to the weak wall-remains and foundations neither from loads, vertical or horizontal, or deflections etc. Such interaction could essentially be avoided by making the new structure

Fig 3. External restoration at South-East corner of Koldinghus Castle.

Fig 4. Koldinghus, south wing. Section in Ruin Hall and external protective wall.

entirely self-supporting and introducing some flexibility in connections such as column-bases and capitals, the latter built branch-like with cardanic steelframes supporting the steel-truss above. The truss stretches throughout the wings in an obtuse L-shape, anchored non-fixed at both ends into walls of sufficient strength. The total length of the truss is 74 m and its width 8 m.

Fig 5. Ruin Hall of Koldinghus. Restoration of former Royal Chapel.

The new external, oak-wood shingled wall construction as well as the interior 3 galleries are suspended from the roof, and the wall is counterbalanced by steel-rod anchors into the North-wall piers of sufficient strength. For architectural and structural reasons the prefabricated glue-lam columns are of open cross shape except for the two main columns in the Ruin Hall with fluted shafts. There are other noteworthy constructions to be seen such as the intermediate floors with connecting stairs and a newel stair from ground floor to galleries. Finally should be noted that the smaller towers of the courtyard and the south-west external tower are all restored though internally modified to serve as access and exit-ways.

FIRE SAFETY DESIGN AND DETAILS

It will be appreciated that the concept of restoration and the actual design, apart from certain unusual structural problems, also raised some problems concerning fire safety and precautions. However, a total fire safety design was developed in close cooperation with local and national fire authorities with particular

attention drawn to the safe evacuation of people in the halls and rooms and easy access for the nearby fire brigade of the City of Kolding via exit-ways in the adjoining towers. By aesthetic reasons in particular, but also by several technical reasons, installation of sprinkler-systems in conclusion was considered inappropriate, and it was decided then to install an automatic fire and smoke alarm system with detectors placed at carefully chosen positions in 4 levels in the halls of the southern and eastern wings; in other rooms and halls of the castle detectors were to be located as locally most suitable. The entire alarm system of course is linked to the guard-room as well as the fire alarm centre in Kolding.

Standpipes are installed in the towers of the castle, and hand extinguishers and water hoses are supplied all over the castle. Outside and nearby the castle are placed several fire-hydrants, and finally the castle lake can supply unlimited quantities of water for fire-fighting. None of the rooms and halls are provided with smoke ventilation, automatic or manually operated, as aesthetic and technical circumstances prevented installation of this otherwise commonly used precaution.

Besides the active fire-control measures discussed above the total fire safety concept of course includes a number of passive measures: To prevent fire spread within the premises of the castle, it is divided in four fire-sections (compartments), and further these are divided into smaller fire-cells as far as practicable. Proper fire-doors are installed, of course, in the passages in the separating walls. The four existing towers with access and exit stairways to all floors as needed, including the roof-floor, are restored to be separate compartments, and the now missing Queens Tower in the courtyard's north-east corner will be reconstructed to serve as separate exit-way. The new protective wall construction, covering parts of the south and east wings, with external cladding of hardwood shingles will have interior surfaces of non-combustible gypsum-boards, as will the ceiling of the Ruin Hall. In adjacent smaller rooms lightweight concrete slabs form the roof. As to the fire protection of the steel-truss in the roof-floor no (fire) protective cover or painting of the very steel profiles

is provided, but the truss is protected at bottom by the ceiling gypsum boards and the wood constructions and mineral wool insulation, or by roof-slabs. Walkways are installed on top of the steel-truss to provide easy access for inspection and fire-fighting. In parts of the halls some exquisite wood constructions such as interior stairs, intermediate floors and balconies carries a fairly high fire-load, but do not necessarily present any high fire-risk, it has been concluded. The fire resistance rating of the columns is not seen to be entirely clarified, and for some of them it might have been advisable to do a simple fire-resistance calculation, as it is recognized that suitable fire-testings could hardly be effected. As an additional precaution the fire authorities felt it desirable to impose certain restrictions as to the use of some rooms and halls. And finally, guards are on permanent duty during day hours, and a night-watch makes scheduled rounds throughout the castle.

In conclusion the authorities felt satisfied that the total fire safety concept as discussed above provided the necessary safety, in particular by securing the paramount life-safety, while at the same time it would pay due attention to the architectural and aesthetic features of the restored castle.

The choice of an automatic fire and smoke alarm system to be installed as the primary active fire precaution raised some problems of technical nature and some aesthetic concerns. The Danish regulations on such systems cannot directly be applied to complex buildings such as Koldinghus castle, and a systems design closely tailored to the actual circumstances and needs was developed. In the Ruin Hall, however, particular difficulties arose in balancing technical needs and aesthetics, and it was decided then to try finding the optimal design for safe alarm function, incl. location, number and types of detectors (flame and smoke ionization types) by performing suitable fire-tests in the hall. Understandably the very idea of making fire in the hall, whatever small, caused some concern. However, testing was performed as planned with a total of ab. 55 detectors placed at the pre-selected locations in four levels of the hall, and test-fires acc. to P/EN 54-9, TFI and TF4 (open cellulosic fires (wood) and open plastic

fires (polyurethane foam)), placed at varying locations at the two lower floors, were discharged. Further some simple smoke-tests (cold smoke from a smoke-generator) were done, and throughout the testings the temporary alarm system reacted satisfactorily with signals arriving to the control panel from the detectors proper. No damage at all from smoke or fire could be traced after the testing, it should be noted. The permanent fire alarm system was then detailed and subsequently installed in the premises of the castle.

KOLDINGHUS CASTLE AS A MUSEUM IN TRANSITION

It is said that the most valuable exhibit of Koldinghus Museum is the castle itself, and that may well be true. Koldinghus of today offers a rare opportunity to see and study evidence of architecture and building technology of earlier historic periods at one site, and the previous restorations represent changing attitudes to such works. The spectacular ruins in their long open-air period inevitably left impressions on most bystanders, and still do in their new environment. The present museum in the north and west wings of the castle presents fine historic collections, including many valuable exhibits dating from the Swedish and Napoleonic Wars, around 1650 and early 1800s.

The restoration now completed open up the prospect of increased and widened activities of the museum, fulfilling a cherished wish of the curator and his staff. The smaller chapel of King Chr. III is restored beautifully to be a lecture and film room, and the Ruin Hall (the former main chapel) opens for numerous activities in exceptional surroundings, such as exhibitions of historical or contemporary themes, seminars and conferences, major audience lectures, music or scenic performances, popular meetings etc. Some smaller rooms restored or redecorated may serve as resort for special studies, workshops and similar activities. Koldinghus actually can be transformed into a vivacious culture-historical centre for the community and region.

POST SCRIPTUM

It will be appreciated that the restoration of

Koldinghus, of great complexity and order of magnitude, would necessarily involve a considerable number of persons and bodies, local and central authorities etc. Owners and managers of the castle itself are the Danish Ministry of Housing and Building, and obviously the Conservationist Community and the Public interests were other major parties concerned, as well as the architects, Inger and Johannes Exner, professor, Aarhus, and the consulting engineers, Messrs. Moller Pedersen and Holm Christensen, Kolding. Principal contributors to developing the fire safety concept were Fire Chief of Kolding Mr. John Bejerholm and the National Fire Inspectorate, Copenhagen, with assistance from the Technical Services of the SKAFOR (non-life) Insurance Association on alarm systems and the National Testing Institute, Dantest, on the fire-testing, both of Copenhagen.

It is gratifying to know that with the inevitable differences of opinion and numerous problems surmounted, it is fully agreed that the fine restoration of Koldinghus will lend great pleasure and inspiration to the future guests of the castle.

The total cost of restoration amounts to approx. 75 mio. DKK (ab. 20 mio. DM).

The formal opening of Koldinghus Castle was held on September 1, 1989, attended by HM the Queen.

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