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Kırıkkale'de Bulunan Hasan Ali Yücel İlkokulu'na Uygulanan Güçlendirme Yönteminin Analizi

Analysis Of Building Reinforcement Method For Hasan Ali Yücel Elementary School In Kırıkkale

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ÖZET

Bu çalışmada, Kırıkkale ilinde bulunan Hasan Ali Yücel İlkokulu'na yapılan güçlendirme çalışması analiz edilmiştir. Okulun mevcut durumu ve yapılan çalışmaların irdelenmesi, yapının mimarisi ve kullanıcıların minimum düzeyde etkilenmesi amaçlanmıştır. Çalışmada sonuç olarak; okulun güçlendirmesinde yerinde dökme perde duvar uygulamasının seçildiği görülmüştür. Yapıda iki adet 30x200 ve 2 adet 30x400 cm'lik 4 adet yerinde dökme perde duvar uygulaması yapılmıştır. Uygulama aynı sayıda ve aynı yerde birbirinin devamı şeklinde tüm katlarda devam etmiştir. Ayrıca yapının ıslak zemin ve koridorları, yer kaplamaları ve tavan ve duvar boyaları yenilenmiştir.

Anahtar Kelimeler: Güçlendirme, betonarme yapılar, eğitim yapıları, hasar ve onarım, Kırıkkale

ABSTRACT

In this study, the building reinforcement provided for Hasan Ali Yücel Elementary School located at Kırıkkale province has been analyzed. The aim is to examine the current status of the school and the work carried out, and to minimize the impact on the architecture of the building and the users. As a result of the study, it has been seen that cast-in-place curtain wall application has been selected for the reinforcement of the school. The building has 4 cast-in-place curtain wall applications, 2 30x200 and 2 30x400 cm. The application has been repeated on all floors in the same number and in the same place. Furthermore, wet floors and corridors, floor coverings, ceiling and wall paints have been renewed.

Keywords: Reinforcement, reinforced concrete structures, education buildings, damage and repair, Kırıkkale

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1. INTRODUCTION

Humans have needed shelter to protect themselves from environmental conditions and to feel safe since the day they existed. The needs other than shelter have started to arise with the change in conditions and the differentiation of needs. Therefore, they build structures with different features and for different purposes (Tezel et al., 2020). One of these structures is education buildings. Reinforced concrete construction is preferred in education buildings due to its long useful life and high strength.

Reinforced concrete structures can be deteriorated or excessively damaged due to aging, overloading, bad design, change of use of the structure and earthquake. This adversely affects the durability and usability of reinforced concrete structures. These effects lead to short- and long-term performance and safety concerns (Raza et al., 2019; Engindeniz et al., 2005; Koutas et al., 2019; Siddika et al., 2019; Raza et al., 2022; Khan et al., 2022).

These structures may be subjected to renovation, restoration, remodeling or reinforcement to meet the modern demand for buildings that have been damaged in their working life (except for monumental buildings). These may include the installation of new columns, walls, beams or trusses (Foraboschi, 2022).

Structural elements are usually reinforced to resist the applied load over their operational lifetime to prevent economic loss (Khan et al., 2022).

In this study, the aim is to examine the current status of the school and the work carried out, and to minimize the impact on the architecture of the building and the users.

2. STUDY AREA: KIRIKKALE

Kırıkkale, located at the intersection of roads that provide transportation from west to east, is a city that has hosted different civilizations thanks to its location. The historical background of the province is similar to that of Ankara, to which it was previously affiliated (Kırıkkale Municipality Culture and History Journals, 2008). No archaeological research has been carried out to document the ancient history of the province from the past to the present, but a few scientific researches have been carried out. According to these researches;

- The history of the province is similar to that of Anatolia (Ay, 1995).
- The mounds, ruins and historical ruins within the borders of Kırıkkale province show that the province dates back to BC (Kırıkkale Municipality Culture and History Journals, 2009; Ulukavak, 2011).
- Since the ancient ruins in the city center belong to the Chalcolithic period, it is seen that the province and its surroundings are dated back 7000 years (Karadeniz, 2006; Metin, 1997).
- Ceramic remains from Çatal Söğüt Mound have been documented to belong to the Bronze Age (Gülyazı, 2004).
- In 1073, Ankara was under the protection of the Turks. In Kırıkkale, turkification started to be seen on the same date (Kırıkkale Municipality Culture and History Journals, 2008).

- Although Kırıkkale was under Byzantine's protection for some periods, it came under Seljuk's protection between 1100-1200 (Kırıkkale Municipality Culture and History Journals, 2009).
- After the 14th century, Kırıkkale came under Ottoman's protection as far as Malatya province (Vural, 2018;Tekel, 2021).

Kırıkkale is a province in the Central Anatolia region, neighboring Çorum and Yozgat in the east, Ankara in the west, Çankırı in the north, and Kırşehir in the south (Figure 1). The province has a population of approximately 276000 and its surface area is 4630 km^2.

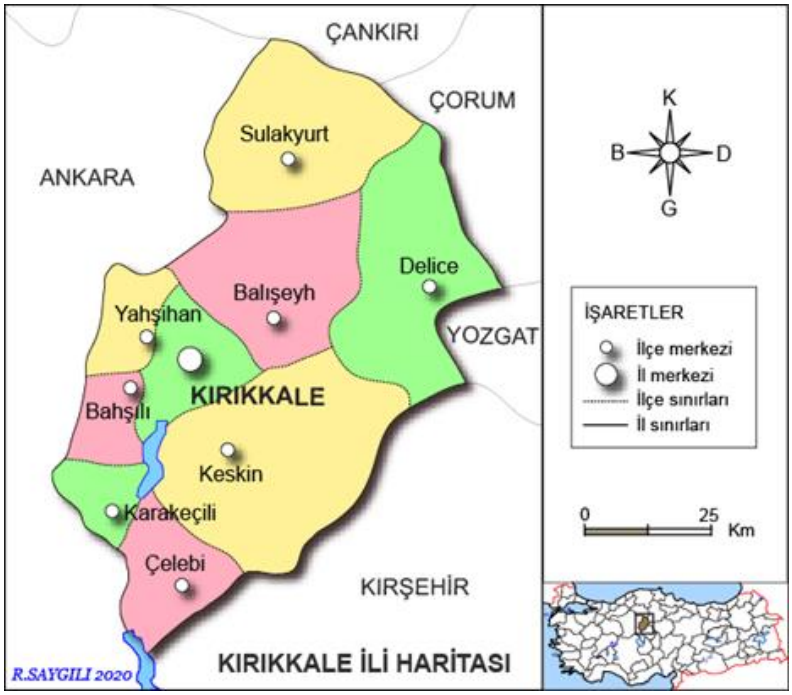

Figure 1. Political map of Kırıkkale (Web message 1)

Kırıkkale, which is the intersection point of the eastern, southern and Black Sea roads, serves as the gateway of 43 provinces to the west. A large part of Kırıkkale is surrounded by small or large rivers. A 92 km of the Kızılırmak River is located within the provincial borders and forms the border with Ankara. Kırıkkale consists of 9 districts, 185 villages and 11 municipalities together with the central district (Tekel, 2021).

3. DAMAGES TO REINFORCED CONCRETE BUILDINGS

Project errors, overloading of the structure and foundation settlements cause cracks to occur in reinforced concrete carrier systems. When these cracks reach a certain depth, the structure is at risk (Sargın, 2020). Therefore, damaged structures should be identified immediately after taking safety precautions. After the determination studies, the structure is repaired, reinforced or demolished depending on the damage (Raofe, 2019).

Types of damage in reinforced concrete structures are as follows;

- Damage to the flooring;
- Damage to the beams
- Damage to the columns
- Damage to the lapping zone of beams and columns
- Damage to the curtain
- Cutting cracks
- Bending cracks
- Sliding damages

4. TYPES OF REINFORCEMENT IN REINFORCED CONCRETE BUILDINGS

4.1. Element Based Reinforcement Methods

4.1.1. Reinforcement of Columns

Most of the reinforced concrete buildings designed before DBYBHY (Specification for Buildings to be Built in Seismic Zones) (2007) do not have curtain wall elements. That the buildings do not have curtain wall elements requires more detailed and careful design of the columns. Problems such as axial load capacity, low ductility, bending moment, etc. occur in the columns due to the loads affecting the structure (Şahin, 2019).
Columns need to be reinforced so that the damaged column can resist possible loads and increase its load carrying capacity (Ayaz, 2020). An example of column reinforcement is given in Figure 2.
Columns are reinforced as follows;

- With steel caging
- With sheathing
- By coating with fibrous polymer
- By adding wings.

Figure 2. Reinforcement of Columns

4.1.2. Reinforcement of Reinforced Concrete Beams

Another reinforced structural element is the beams. Reinforcement of reinforced concrete beams are conducted as follows (Figure 3);

- Reinforcement of beams by coating them with steel plates,
- Reinforcement of beams with sheathing,
- By coating with fibrous polymer.

Figure 3. Reinforcement of beams

4.1.3. Reinforcement of lapping zone of beams and columns

Column-beam joints are the nodal point where structural elements are found together and are under the impact of horizontal and vertical loads. Therefore, they are very delicate areas where workmanship is not easy (Karaca, 2022).

The following methods are used for reinforcement of column-beam joints (Figure 4);

- Reinforcement of joints with sheathing,
- Reinforcement of joints with steel plates,
- Reinforcement of joints with fibrous polymer.

Since reinforcement with sheathing method is a difficult method, reinforcement with steel plates or reinforcement by coating with fibrous polymer is generally applied (Sargın, 2020).

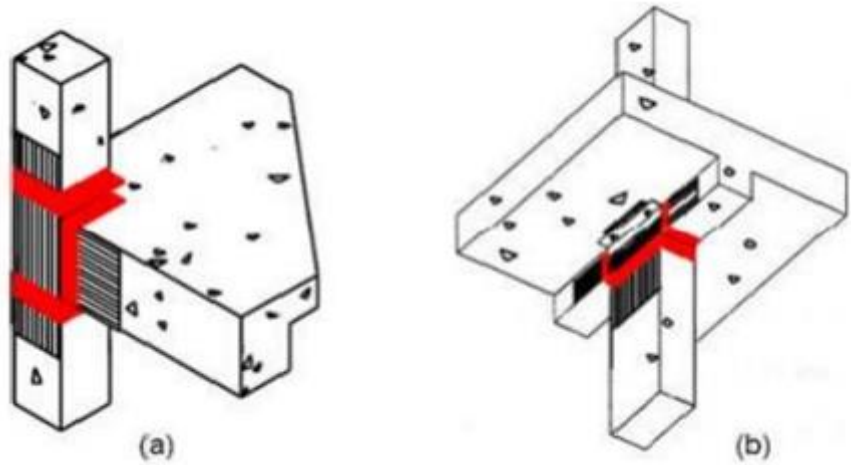

Figure 4. Detail of reinforcement of column-beam joints

4.2. System-based Reinforcement

4.2.1. Reinforcement of nonbearing walls

Nonbearing walls have a great impact on the center of rigidity in the building, the distribution of columns and beams, the production of short columns and earthquake load (Gündüz, 2019).

The method of reinforcement of nonbearing walls (Figure 5) is used in buildings with a maximum of 3 storeys. The system is constructed to improve the rigidity and shear strength of the nonbearing walls as a block from the foundation to the roof. In this system, which is completed in a short time, the residents of the building can stay in their homes during the application (Karaca, 2022).

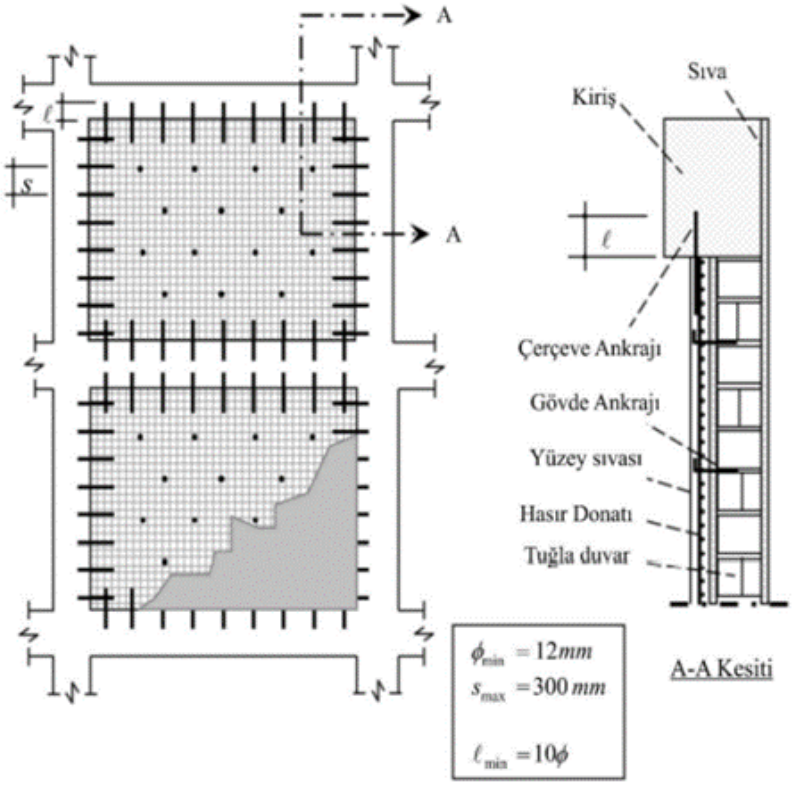

Figure 5. Reinforcement of nonbearing walls

4.2.2. Reinforcement of reinforced concrete frames with cast-in-place curtain walls

This method, which is used in cases where the rigidity and strength of the structural system is not sufficient, is the most widely used method due to its low cost and wide usage area. The biggest disadvantage of the method is that the curtain wall must be constructed along the entire wall (Figure 6) (Gündüz, 2019).
Reinforcement of reinforced concrete frames with cast-in-place curtain walls is applied as follows;

- By adding reinforced concrete curtain wall inside the frame plane
- By adding reinforced concrete wall adjacent to the frame plane.

Figure 6. Reinforcement of reinforced concrete frames with cast-in-place curtain walls

4.2.3. Reinforcement of reinforced concrete frames with steel diagonal members

When building reinforcement is done by adding curtain walls to the building, the weight of the building increases, which leads to an increase in the earthquake load. The most effective way to eliminate these problems is to add lightweight and high rigidity elements to the system. The most effective method for this is the reinforcement of reinforced concrete frames with steel diagonal members. This method is applied by adding steel diagonal members to the frame plane. The most important advantage of this method, which takes a very short time to apply, is that the diagonals can be added without closing the door and window openings (Karaca, 2022). Figure 7 shows the details of the method of reinforcement of the frame with steel diagonals.

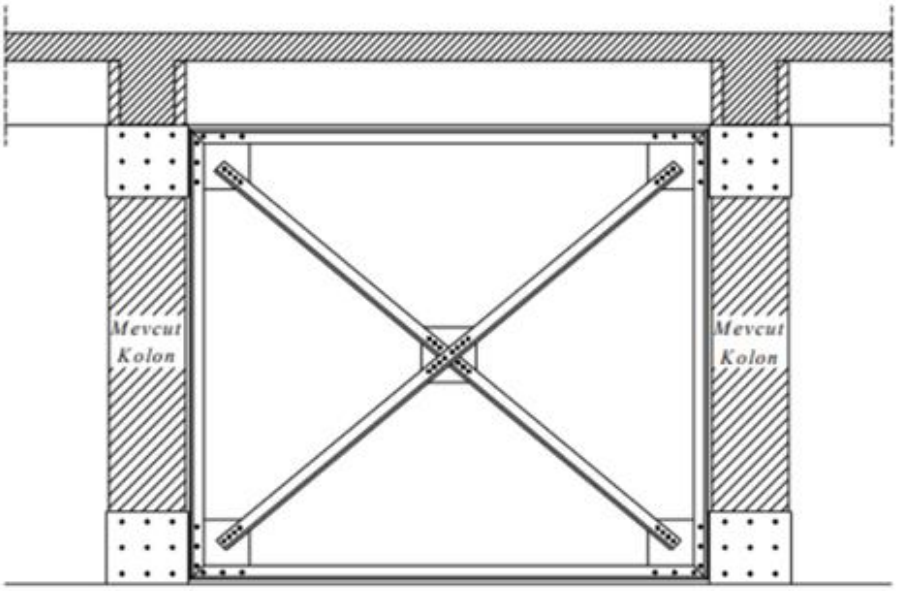

Figure 7. Reinforcement of frame with steel diagonal members (Karaca, 2022)

4.2.4. Reinforcement of the structure by adding exterior curtain walls

This method is preferred in cases where interior application is not possible due to the use of the building. It is applied in places with high earthquake risk in accordance with architectural conditions. It is applied on the outer frame of the building, adjacent to the frame and connected to the frame with anchor rods. Exterior curtain walls should be constructed from the foundation level to the top of the floor (Figure 8) (Karaca, 2022).

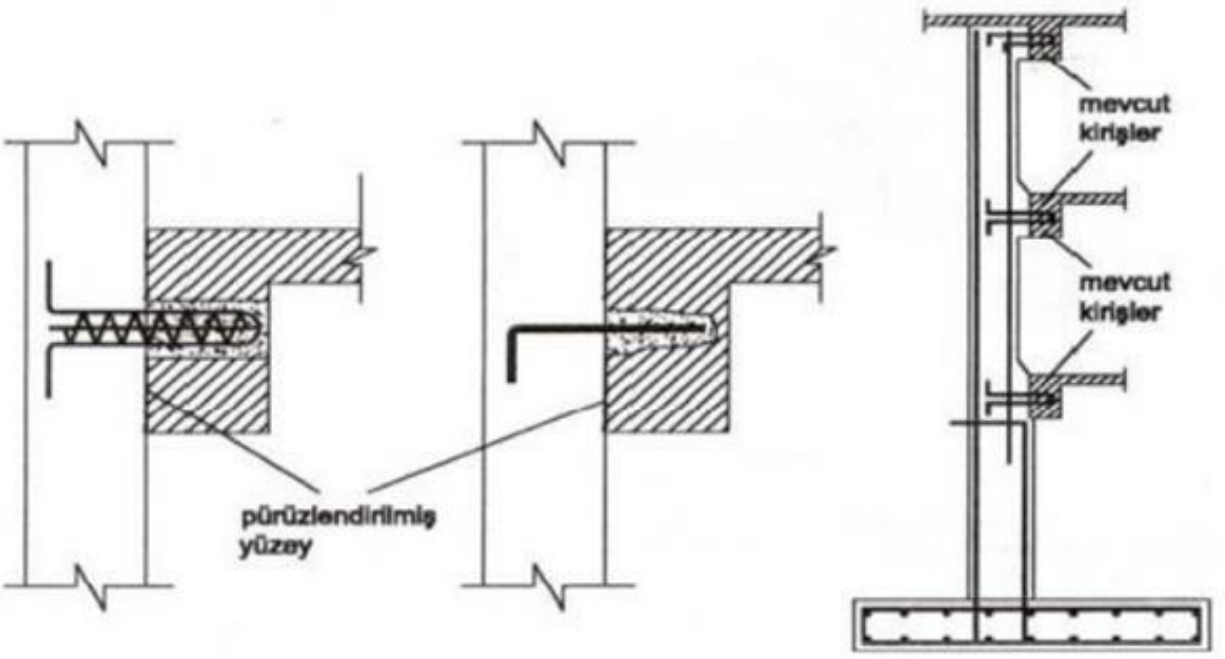

Figure 8. Connecting the exterior curtain walls to the adjacent frame with anchor rods (Öncü, 2011)

4.2.5. Reinforcement by adding new frames to the reinforced concrete system

This method can be applied from exterior without the need for users to evacuate the building. In this method, the aim is to transfer the horizontal loads on the structure to the ground by bearing them with rigid members (Karaca, 2022). In this method, also the frame to be added should start from the foundation level to the end. Furthermore, the foundation system and the foundation of the previous structure should be connected to each other to ensure healthy load sharing (Karapınar, 2020).

4.2.6. Reducing the weight of the reinforced concrete system

The loads on the building during an earthquake are directly proportional to the weight of the building. Therefore, by reducing the weight of the building, the earthquake load on the structure will also be reduced. In this method, the top floor or more than one floor of the building is demolished or the materials forming the interior walls of the building are selected from lightweight materials (Erdel, 2019). Furthermore, the construction of a new roof of lighter materials by removing the previous roof, reducing the extra loads on the roof to the ground, constructing balconies and concrete walls from lightweight materials are among the effective ways to reduce the weight of the system (Karapınar, 2020).

5. CURRENT STATUS OF HASAN ALİ YÜCEL ELEMENTARY SCHOOL AND REPAIRS CARRIED OUT

Hasan Ali Yücel Elementary School, which has been analyzed within the scope of the study, started education in ..... The school consists of basement, ground + 2 floors. The reinforcement work to the educational institution started in ..... and was completed in ..... Figure 9 shows the basement floor, Figure 10 the ground floor, Figure 11 the first floor and Figure 12 the second floor plans of the school.

When the plans are analyzed, the length of the basement floor is 32.85 m and its width is 14.80 m. Floor space is 486.18 m2. There is a multi-purpose hall, 4 warehouses, 2 wc, boiler room, workshop, canteen and conference hall on the floor. Reinforcement works were carried out in 4 places in the basement floor. Cast-in-place curtain walls application was selected as the reinforcement type. Two of the cast-in-place curtain walls are 30cm x 200 cm and two are 30cm x 400 cm. In addition, walls and ceilings were painted, tile mosaic was applied to some areas on the floor and laminated flooring was applied to some areas.

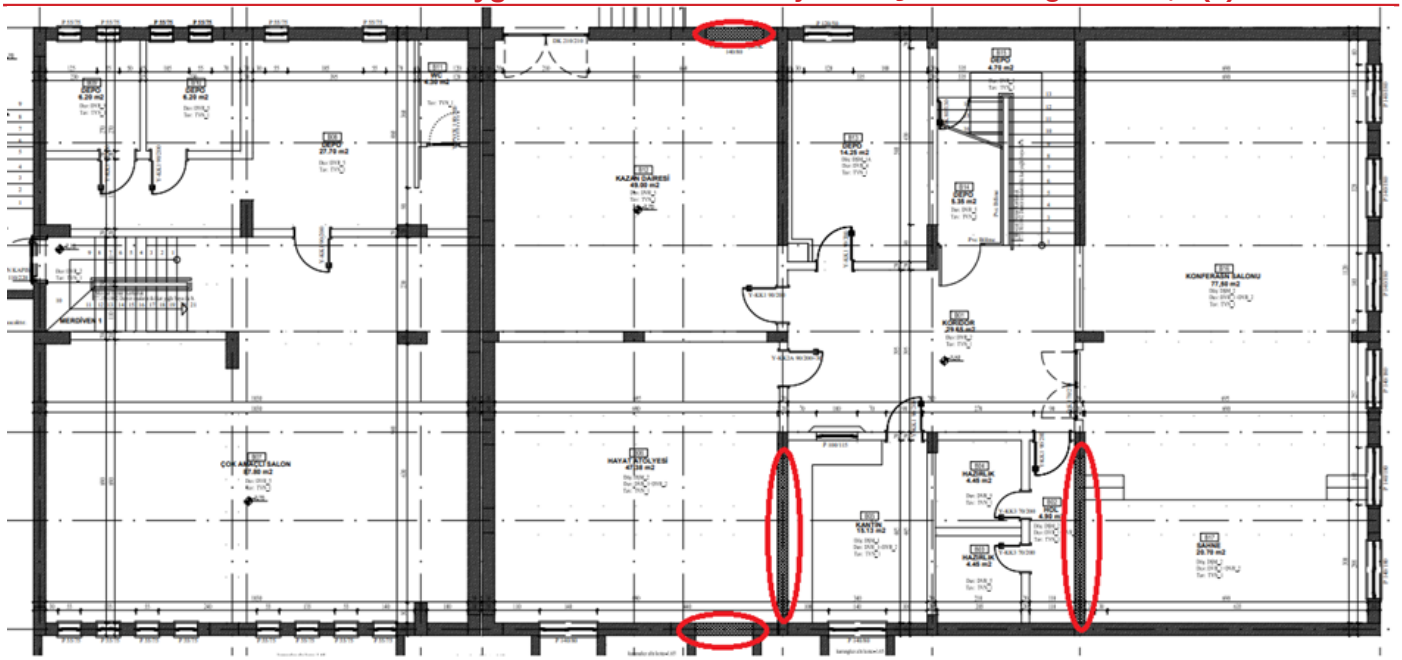

Figure 9. Basement floor reinforcement application plan

The ground floor space is 486.18 m2. There are PTA, male/female teacher wc, janitor room, female student wc, teachers' room, kindergarten class, vice principal's room, clerk, library and 2 classrooms.
Reinforcement works were carried out in 4 places on the ground floor. Cast-in-place curtain walls were applied as reinforcement type. The curtain wall application in the basement floor was repeated in the same place and in the same number on the ground floor. Two of the cast-in-place curtain walls are 30cm x 200 cm and two are 30cm x 400 cm. In addition, walls and ceilings were painted, tile mosaic was applied to some areas on the floor and laminated flooring was applied to some areas.

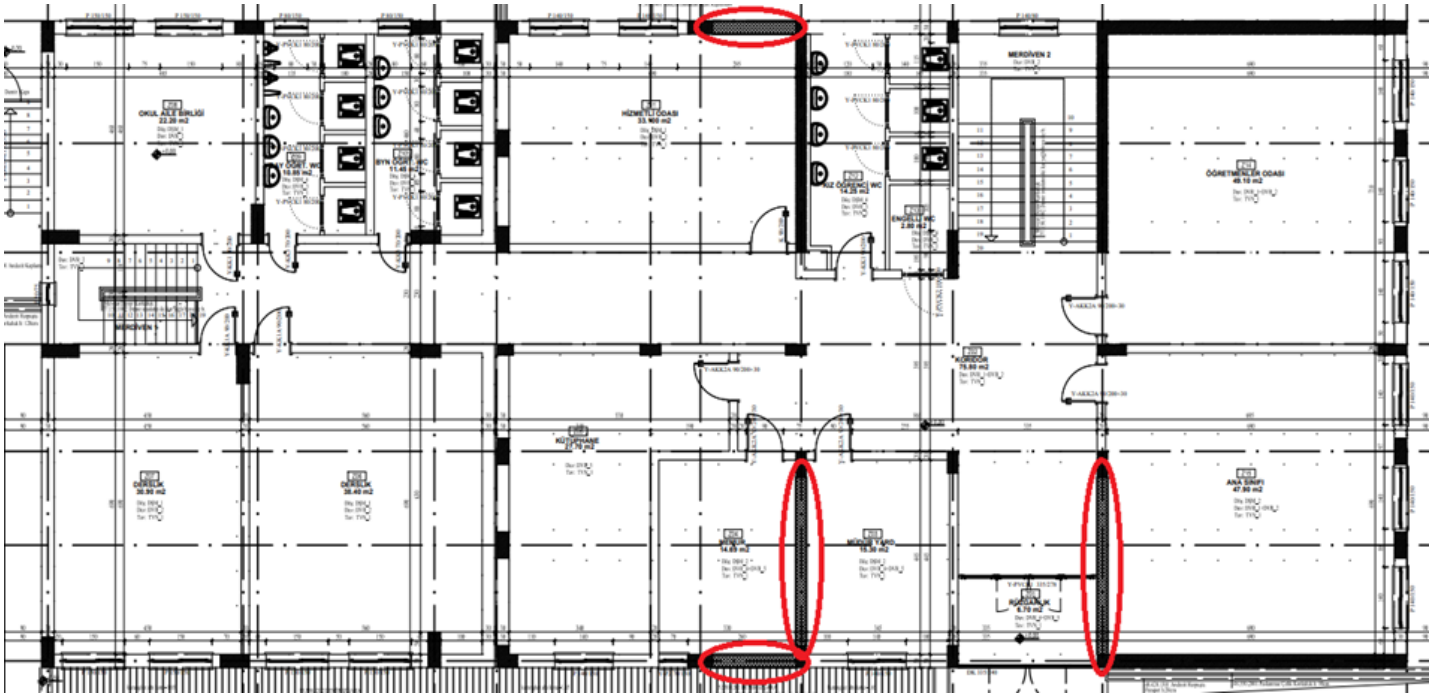

Figure 10. Ground floor reinforcement application plan

The first floor space is 486.18 m2. When the plan is analyzed, there are male/female student wc, male/female teacher wc, 6 classrooms, support education room and principal's room. Reinforcement works were carried out in 4 places on the first floor. Cast-in-place curtain walls were applied as reinforcement type. The curtain wall application on the ground floor was repeated in the same place and in the same number on the first floor. Two of the cast-in-place curtain walls are 30cm x 200 cm and two are 30cm x 400 cm. In addition, walls and ceilings were painted, tile mosaic was applied to some areas on the floor and laminated flooring was applied to some areas.

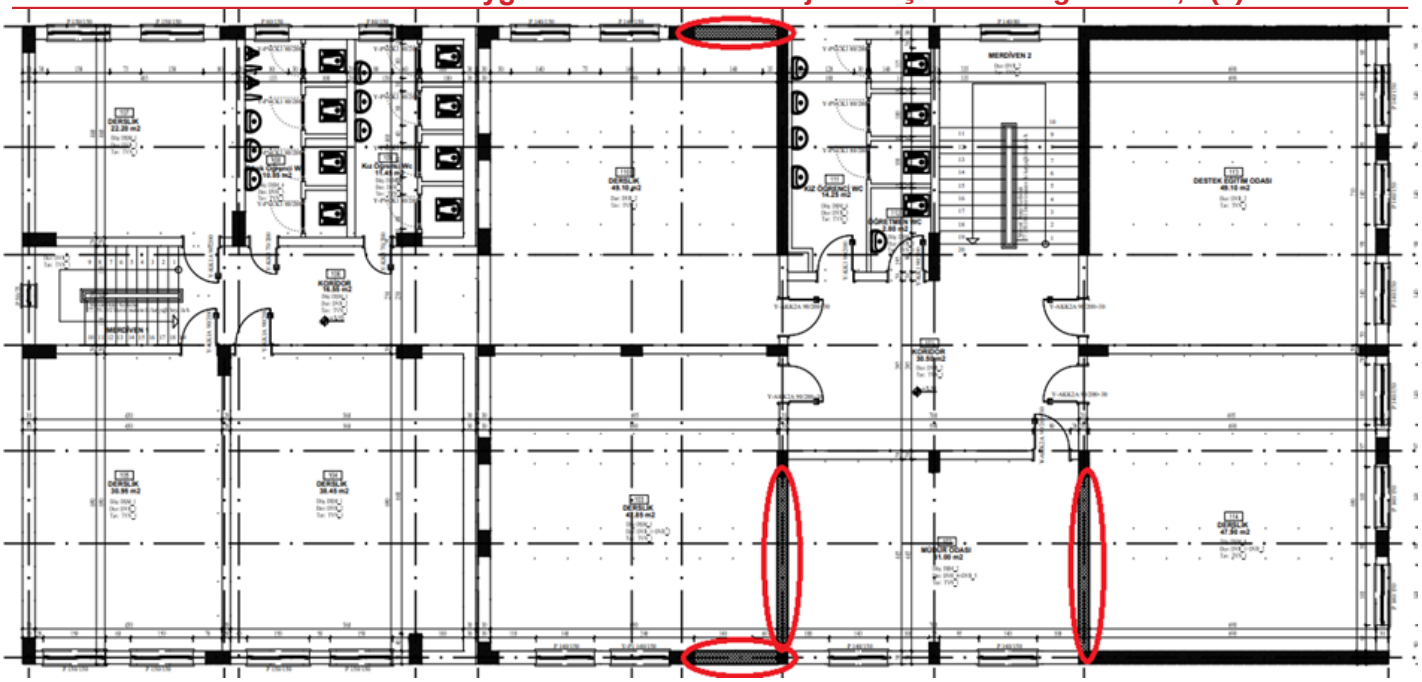

Figure 11. First floor reinforcement application plan

The second floor space is 486.18 m2. When the plan is analyzed, there are male/female student wc, male/female teacher wc, 6 classrooms, 1 prayer room.
Reinforcement works were carried out in 4 places on the first floor. Cast-in-place curtain walls were applied as reinforcement type. The curtain wall application on the first floor was repeated in the same place and in the same number on the second floor. Two of the cast-in-place curtain walls are 30cm x 200 cm and two are 30cm x 400 cm. In addition, walls and ceilings were painted, tile mosaic was applied to some areas on the floor and laminated flooring was applied to some areas.

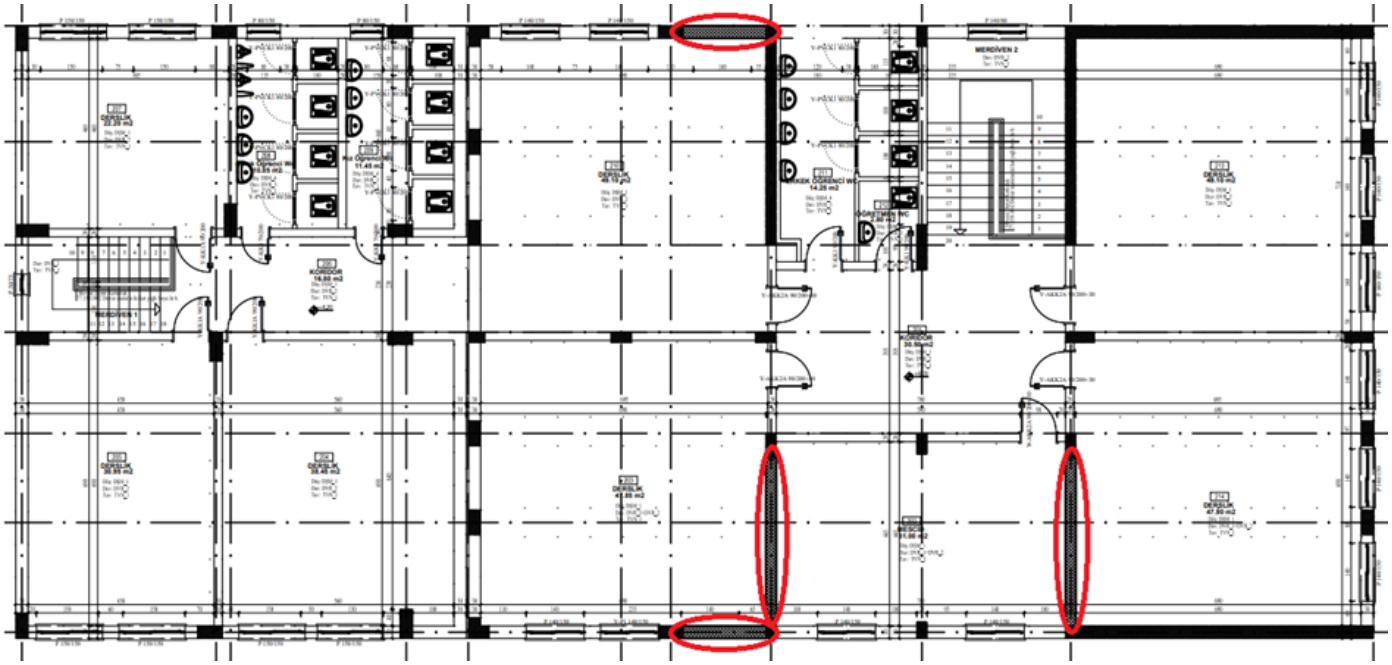

Figure 12. Second floor reinforcement application plan

6. RESULTS

In the study, the reinforcement of Hasan Ali Yücel Elementary School in Kırıkkale province was analyzed and the results obtained are listed below.

- In the frame system of the basement, ground + 2 floors, 4 cast-in-place curtain walls were applied.
- Two of the cast-in-place curtain wall applications were made on exterior walls and two on interior walls.
- The cast-in-place curtain wall is applied as interconnected on all floors.
- The wet floors and corridor floors of all floors were repaired using tile mosaic.
- While some walls were left in their current form (wall+plaster+paint), some walls were treated with

wall+perlite plaster+water-based paint.

- School doors and windows were replaced with PVC doors and windows joinery.
- Other educational institutions can also be examined and reinforcement works can be initiated by taking Hasan Ali Yücel Elementary School as a reference.
- When reinforcement is carried out, care should be taken to ensure that the reinforcement method to be chosen is easy to apply and that the school building is made useful.

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