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Elementary School Buildings Condition Assessment: Case of Primorje-Gorski Kotar County (Croatia)

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Abstract:
This study deals with the condition examination of elementary school buildings in Primorje-Gorski Kotar County, Croatia. For schools to be functional and of high quality, adequate maintenance is mandatory. Therefore, school maintenance programs need information on the building's condition based on systematic and comprehensive assessments as a primary input. This study aims to establish a framework for assessing the condition of school buildings, based on which information can be obtained quickly and practically regarding the condition of all critical facility elements. To this end, a database on schools and their conditions was created. The conditions of school buildings in terms of damage and defects and their causes were determined. Descriptive and inferential statistical operations were performed on the collected data. A condition assessment of the buildings was performed using a questionnaire survey among the principals, based on the school buildings division model developed in this study; the model presents building elements and a systematic visual condition rating scale. According to the available data, this is Croatia's first condition assessment on elementary school buildings. The main results show that on average, the examined schools are in good condition. Moreover, according to the results, the school building condition is most affected by dilapidation and lack of financial resources.

Keywords:
maintenance; building condition; condition assessment; elementary schools; Primorje-Gorski Kotar County

1 Introduction

Collecting information in an organised manner is a fundamental tool for making quality decisions [1]. A systematic building condition assessment provides vital information for maintenance programs and work execution. The condition assessment process should analyse the facility conditions to identify and prioritise the maintenance work required to restore and maintain the desired conditions. Therefore, the desired condition or standard should be clearly defined [2, 3], and the assessment process should be guided by it to achieve an optimal level of maintenance for the efficient operation of buildings [3].

Maintenance represents all activities undertaken to preserve, protect, and improve buildings (following valid standards) and helps them serve the intended purpose and function during their life cycle. Managing maintenance implies determining strategies, goals, maintenance responsibilities, and methods of execution, with the implementation of the above through the management functions of planning, organising, directing, and controlling [3, 4]. Various models have been developed for more efficient maintenance management [3, 5-7]. It follows that maintenance can only be effectively managed if the need for maintenance is properly quantified [2].

This study focused on the quantification (assessment) of the condition of school buildings. This assessment is vital for achieving the conditions for the basic activities of the school, which should work effectively in providing an adequate and high-quality environment for learning and teaching to school users [8]. Considering their educational purpose, school buildings are among the most important facilities in the social community; they are very specific and quickly deteriorate owing to age, excessive capacity, and extensive use [9, 10]. Most public schools in the Republic of Croatia have been operating for years; they are dilapidated, and improperly and ineffectively maintained, leading to inadequate conditions and extensive damage. The challenge is the limited, and often insufficient maintenance funding that is provided by public authorities [3]. Studies [3, 11] have stated that in the Republic of Croatia, there is no up-to-date record of school property conditions. Based on such records and data analysis, it is possible to determine the criteria for investments, required funds, sources of funds, activities, priorities, and implementation deadlines [11]. A quick, cheap, and practical approach is needed to perform periodic building inspection as a verification process before conducting a more detailed inspection of severe defects. The need for a generalised and simplified approach to assessing the condition of building elements that can be transferred to the level of school buildings is emphasised.

This study aims to develop a methodological framework for assessing the condition of school buildings in the Republic of Croatia, which will provide adequate information to facilitate decision-making about maintenance. The goal is to offer a simple method for quickly providing information on the general condition assessment of the main building elements based on a survey questionnaire and a systematic condition rating. This approach can be used by school managers (principals) and owners (founders) to indicate the most urgent maintenance requirements and to recognise the leading causes of defects. Furthermore, this evaluation can be the basis for more detailed analyses of prominent elements to determine the exact level of deterioration of materials and parts of the building through experts' analysis.

The following working hypotheses are defined. First, it is possible to carry out a school's condition assessment, and based on this, the condition of school buildings including their elements and element groups can be determined. A condition inspection will show that the physical condition of individual school buildings is inadequate. In addition, the conditions of school buildings are not uniform. Within such a condition assessment, it is possible to determine the underlying factors that have influenced the current condition of buildings.

In the Republic of Croatia, no comprehensive research on the condition of school buildings has been carried out yet. To this end, a database was created on schools, as there were no available data. Subsequently, the conditions of school buildings in terms of damage and defects and their causes were determined. Descriptive statistical operations were performed on data related to school profiles and other data that are important for achieving the goals of this research. Inferential statistics were performed on the data for further meaningful and insightful interpretations to provide strong significance to the research findings. This study contributes to the knowledge and theory on the conditions of public school buildings. The presented conclusions are the result of the study of existing literature, the creation and analysis of a questionnaire to collect available data on the condition of school buildings, the processing of the obtained data, and the presentation of the results.

This study covers the area of Primorje-Gorski Kotar County in the Republic of Croatia and is limited to public elementary schools in this County. To meet the requirements of the study, a methodological framework was developed. Databases within the observed area were collected using a survey questionnaire distributed among the principals of elementary schools based on the school buildings division model developed in this study. The model divided the collected data into building elements, and a systematic visual condition rating scale was used.

The main results show that on average, the examined schools are in a good condition. However, some schools are lagging, and some do not have the building elements necessary for quality work. Hence, it is necessary to urge officials to equalise educational conditions for students. In addition, according to the results, the condition of the school buildings is most affected by dilapidation and financial resources, which are limited and often insufficient for maintenance

2 Theoretical background

The quality of education largely depends on the condition of the built property in which it is provided [12-14]. Therefore, for school buildings to be of high quality and perform their required function, maintenance must be continuously carried out. The school maintenance program is an organisational activity carried out by the school community to extend the life of a school building. It includes repairs, replacements, and the general maintenance of physical characteristics found in school buildings [15]. The maintenance of school buildings is taken care of and managed by their founders (units of local and regional self-government), together with principals, who are their professional and business leaders.

The condition of school buildings is an essential factor that affects the school environment and education; therefore, it should be systematically evaluated [8, 15]. Since school buildings are primary to the teaching process, collecting information about their condition is a critical element in the life cycle of school property management [8]. However, the condition changes over time, owing to various external and internal influences. Therefore, regular, accurate, and consistent condition assessments are required to keep records updated with significant changes in condition before they affect the performance of the building [2].

Building condition assessment is defined in the literature [3, 4, 13, 16] as the use of a systematic method designed to produce proportionate, relevant, and valuable information for conducting a technical assessment of the physical condition of the property. Creating such a database is necessary for better judgment, and for the most effective choice of maintenance work. In addition, it helps decision-makers to develop proactive capital planning and schedule maintenance interventions in the future [16].

Recording the condition of a building allows for a determination of which part has the most damage and defects [17]. A damage/defect is an undesirable or inadequate state, which affects a building's usability, performance, structural condition, or appearance [18]. Records of damage and defects in buildings are helpful when creating maintenance plans, confirming the maintenance budget, and demonstrating the consequences of incorrect maintenance [17].

More or less complex methodologies for assessing the condition of existing buildings have been developed worldwide [9, 15, 19-28].

Research conducted on school buildings showed their condition to be inadequate [9, 12, 15, 29-33]. Schools are rapidly deteriorating owing to their age and overcapacity [19]. The physical condition of schools is deteriorating faster than it can be repaired and faster than most other public facilities [34]. Financial resources for maintaining schools are limited [3, 15, 19], and user perception related to the current maintenance system is negative [15]. The ineffectiveness in solving failures and damage to schools has negative impacts on users [35]. Moreover, a student's success in learning is correlated with the condition of school buildings [8, 36]; however, there are no clearly defined systems for recording the condition of schools [8]. Therefore, conducting research on the conditions of school buildings would help policy makers and facilities maintenance professionals to improve maintenance efficiency and increase productivity among users [15]. Most existing building-condition assessment methods are highly complicated for users, time-consuming, expensive, and require a high amount of resources [19].

When considering the causes of the inadequate state of individual buildings and their parts, they are most often attributed to the dilapidation of buildings [5, 19, 37, 38], insufficient financial resources [5, 37, 38], inadequate building design solutions [5, 37, 39], and vandalism [5, 35]. Additional factors are, an unfavourable influence of the environment [5, 19, 39, 40], a large number of users [5, 19, 37-39], improper use of property [40], lack of maintenance culture [37, 38, 40], and inadequate quality material or work [5, 19, 37-41].

Literature related to the Republic of Croatia indicates that there is no analysis of the condition and equipment of school buildings. Therefore, criteria for investments, necessary funds, sources of financing, activities, priorities, and deadlines for implementing interventions on buildings have not been determined [3, 11]. According to the literature [11], the possibility of changing the criteria for the distribution of decentralised funds for school maintenance should be considered. Criteria like the condition and age of the buildings and compliance with the state pedagogical standards should be included. Schools are financed by public funds, which are limited and insufficient for the entirety of maintenance needs [3]. The authors of study [42] point to the inadequate construction and technical condition of school buildings in the Republic of Croatia. Croatian schools operate in outdated buildings, which results in neglect and damage owing to dilapidation and inadequate maintenance [3, 11]. Most school buildings are older than 30 years, and 25 % of all schools in the Republic of Croatia are older than 75 years [11]. As no methodology has been developed for obtaining information about the condition of school buildings in Croatia, quick general information about their condition and the conditions in which students learn is needed [3], which can be a benchmark for further investigations and more detailed and complex analyses.

According to the authors of [1, 17], research on the defects of buildings plays an important role in increasing the effectiveness of building maintenance strategies, thereby promoting a more sustainable construction industry. The key to a sustainable built environment is lifetime prediction, which depends on quantifying the degradation rate of building materials and building parts [2]. According to [19], the steps in asset condition assessment include decomposing the asset into parts, determining the condition scale as an assessment mechanism based on which the data to be analysed are collected, field inspection to detect defects and measure the severity of previously identified defects, and final evaluation and calculation state of parts. Buildings consist of many interdependent parts (elements), and their recognition and condition assessment serve as a benchmark for comparison over time, and with other buildings [43]. When evaluating the building's condition, it is common to decompose the building into elements such as walls, roofs, floors, doors, windows, finishes, heating, cooling, other electrical and mechanical systems, and so on. [5, 19, 20, 37]. Certain authors use predefined assessment scales when analysing the building elements' condition, which is most often carried out by surveys or field inspection [44]. These scales can consist of a different number of degrees (points) for evaluation, such as a 3-point scale (good/fair/bad condition) [37], a 5-point scale (very good/good/fair/bad/awfully bad condition) [2, 5, 19, 45], and a 7-point scale or more points [2]. According to the authors of [2, 44] the 5-point scale proved to be the most accurate and reliable. By comparison, a 3-point scale is too coarse for reliable results, while a scale of seven and more points is too fine and unsuitable for consistent interpretation [44].

The 5-point scale was further improved by the authors of [2], who, using the example of a hospital, proposed a system for evaluating the building condition with five points in colour and required maintenance activities. In their model, condition assessment is carried out at the building element level. Their method of assessing the condition was adapted for the needs of this research, and is presented in Table 1.

Table 1. Building condition assessment ratings (adapted from [2])

Rating coding	Condition	Action required/ Priority	Description
1	Awfully bad	Replacement/ Emergency	The element is broken, inoperative, or damaged beyond repair and should be replaced. The element's condition actively contributes to the degradation of the surrounding elements or creates a risk to safety, health, or life.
2	Bad	Rehabilitation/ Urgent	The element is very dilapidated, has suffered structural damage, or requires renovation. As a result, there is a serious risk of inevitable failure. In addition, the state of repair significantly impacts the surrounding elements or creates a potential health or safety risk.
3	Fair	Repairs/ Normal	The element requires repair, usually by professionals. A component or building has been exposed to abnormal use or abuse, and its poor state of repair is beginning to affect the surrounding elements. As a result, there is a backlog of maintenance work.
4	Good	Condition-based maintenance/ As needed	The element shows surface wear, minor defects, and minor signs of deterioration of the finish surfaces and requires maintenance/service. It can be restored through routine scheduled or unscheduled maintenance/service.
5	Very good	Planned preventive maintenance/ As planned	The element is either new or recently maintained, i.e., it shows no signs of deterioration.

Colour adds another dimension to reporting by making reports easier to use and more accessible to non-technical users. Colour also makes graphical reports more efficient and easier to interpret [2].

3 Methodological framework

After the authors' systematic reflection on the research issue, a methodological framework (Figure 1) was developed. This study was conducted through several segments that are meaningfully divided and presented in several sections.

In the initial observations, the importance of school buildings for the social community was noted, and inadequacy in caring for these buildings was detected. Efforts to create broader databases on schools and their maintenance have not been noticed. In addition, there are no records of the condition of individual school buildings, which would provide valuable data that can be used to identify the necessary measures to improve the current situation. Based on such records and data analysis, it would be possible to determine the necessary maintenance activities and operations, and the means for their implementation.

After the goal and hypotheses of the research were defined, a detailed literature analysis was carried out, where the important discoveries of previous researchers related to the discussed issue were highlighted. The knowledge from this part was used for further research, primarily for designing the survey questionnaire, processing, and presenting the results.

The collected data were statistically processed, and the results were presented in diagrams and in tabular form. The last steps in the research included checking the fulfilment of the hypotheses, and drawing conclusions.

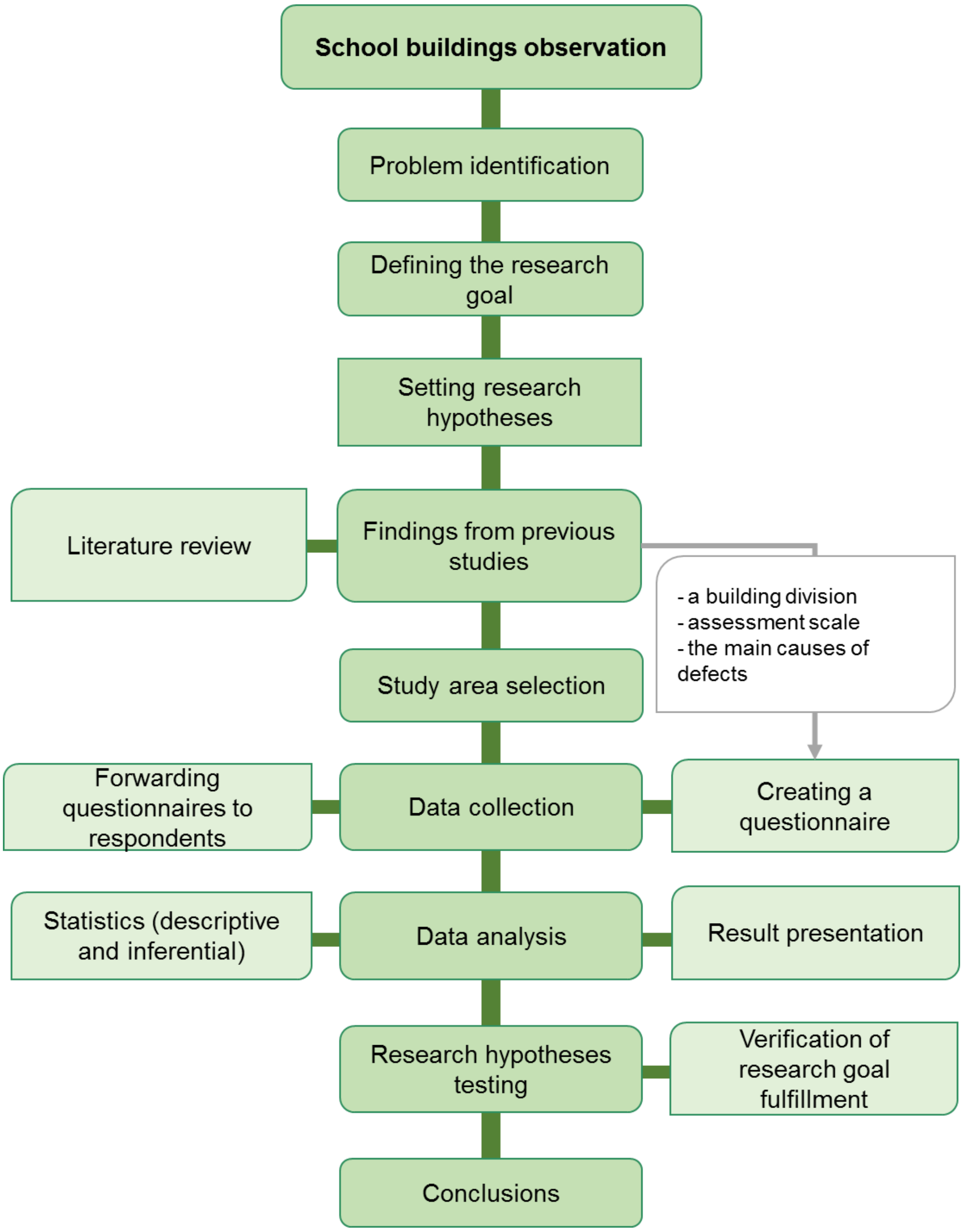

Figure 1. Methodological framework

3.1 Study area

The study area included in the research covers the area of Primorje-Gorski Kotar County. There are 57 public elementary schools in the county. The positions of elementary schools within the county are shown in Figure 2.

The largest number of schools, 31, is managed by Primorje-Gorski Kotar County, the City of Rijeka operates 23 schools, and the City of Crikvenica manages two schools, while the City of Opatija is the founder of one school.

Some of the school buildings from the investigated area are shown in Figure 3.

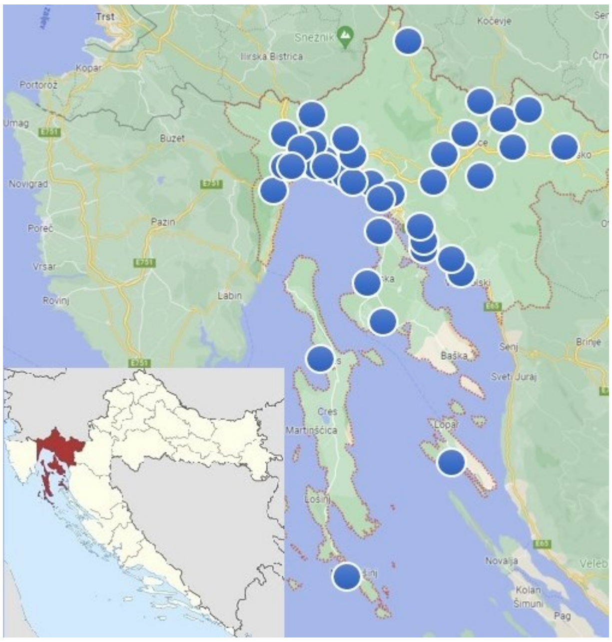

Figure 2. Positions of elementary schools in Primorje-Gorski Kotar County (adapted from [46, 47])

Primorje-Gorski Kotar County was chosen as the research area because of data availability, development, size, and enough elementary schools to create a representative data sample.
In addition, according to the literature [3, 48], there is no systematic and comprehensive analysis of the condition of school buildings in this county. According to [48], the recommendation is to create an analysis for elementary and secondary schools, which would be the basis for determining investment criteria, types, amounts, and sources of necessary investments for school facilities, as well as priorities and deadlines for their implementation.

Figure 3. Examples of school buildings from Primorje-Gorski Kotar County (photos by authors)

3.2 Development and content of the survey questionnaire

The survey questionnaire was recognised as an adequate method of data collection because of the size of the investigated area and the number of elementary schools in it, the amount of data required, and the duration of the research. Therefore, it is possible to record the condition of buildings in an area quickly and practically using a survey questionnaire; this is the main goal of this study.

A survey was conducted among the elementary school principals. The reason for choosing principals as respondents is that they are professional school business managers and are best acquainted with the functioning of the buildings they are in charge of. They live with the buildings every day. The principals are involved in building management, administrative issues, and solving all problems. The principal's responsibility as the head of the school is to initiate the process of maintaining the school building and cooperating with the school's founder, thereby making them sufficiently competent to recognise problems in school buildings and assess the condition of individual elements.

Several groups of data were obtained from the survey questionnaire. The first group of data consisted of general data on school buildings collected to gain knowledge about the basic characteristics of the sample. For example, information was requested on the year of construction, the year of the last renovation, the total internal surface of the building, the number of students, and the number of employees. Renovation here refers to works of a slightly larger scope, such as construction renewal and reconstruction. These are works on the existing building or taking measures to establish the appropriate state of the building, and they can be defined as procedures that increase the level of easement over the existing building [3]. Principals were also directly asked whether, in their opinion, the current overall school maintenance management process was efficient. The answers were in the form: 1 = no, 2 = partially, and 3 = yes. Effective school maintenance management implies proactive and high-quality implementation of maintenance activities while minimising resource consumption, primarily maintenance costs, avoiding work interruptions, and increasing staff and student satisfaction by creating conditions that ensure their health and safety, facilitating teaching, learning, and improving academic results [3]. This definition was indicated to the respondents.

In the second part of the questionnaire, the respondents were asked to rate the condition of individual elements of the school building on a defined scale (from 1 = awfully bad to 5 = very good) concerning the degree of damage and defects (Table 1). The principals also evaluated the extent to which the specified damage was affected by the separate causes of damage (from 1 = does not affect at all to 5 = highly affects). The elements of the building, as well as the causes of damage examined in the survey, were developed based on the literature review in Section 2. Within both rating scales of the questionnaire, each qualitative answer had an associated quantitative value.

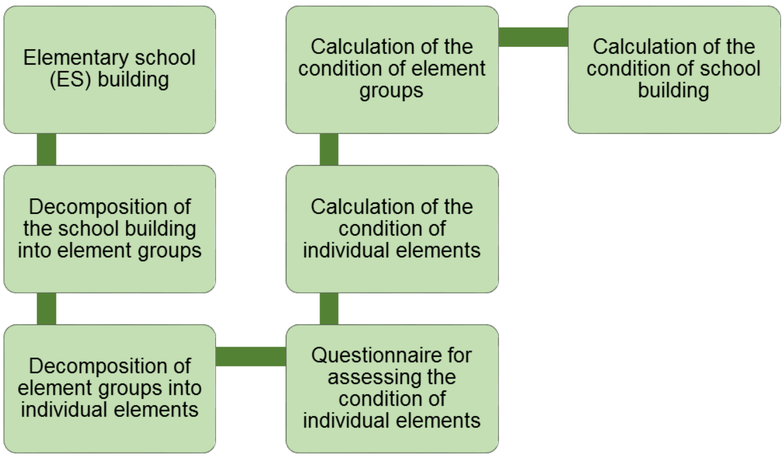

Figure 4. The method of collecting data on schools' conditions and displaying results

To facilitate the collection of data and display of results, the school building was divided into characteristic groups and associated elements that were evaluated separately. Based on the evaluation of the condition of the elements, the conditions were calculated for the element groups and then for the entire building, as shown in Figure 4.
The developed elementary school building division model into basic elements that were examined is presented in Table 2.

Table 2. An elementary school (ES) building division model into basic elements

Group number	Element group	Element number	Building elements
1.0	Structural	1.1	Bearing walls
		1.2	Pillars
		1.3	Beams
		1.4	Floor and mezzanine panels
		1.5	Roof construction
		1.6	Stairs
2.0	Architectural	2.1	Flooring
		2.2	Wall and ceiling coverings
		2.3	Roof coverings
		2.4	Partition walls
		2.5	Gutters
		2.6	Facade
		2.7	Windows and doors
		2.8	Furniture and equipment
		2.9	External environment
3.0	Electrical	3.1	Electric wires
		3.2	Distribution board
		3.3	Lighting fixtures
		3.4	Switches
		3.5	Sockets
		3.6	Lightning rod
4.0	Mechanical	4.1	Sanitary equipment
		4.2	Plumbing and sewage installations
		4.3	Space heating system
		4.4	Space cooling system
		4.5	Hot water heating system
		4.6	Chimney
		4.7	Fire protection system
		4.8	Elevator

This division of buildings applies to most high-rise buildings and can be used in future research. Other specific parts can easily be added to the above list, depending on the type and purpose of the building whose condition is being assessed.
The questionnaire was anonymous. To improve the response rate and reliability, the questionnaire had a simple design such that completing the questionnaire did not consume much time. Where possible, Cronbach's alpha test was used to measure the reliability of the questionnaire, which indicates the size of the measurement error in the questionnaire [49]. Questionnaire results with a Cronbach's alpha coefficient above 0,700 are usually acceptable [50].
The survey questionnaires were sent to respondents via e-mail. They were forwarded to all principals in the surveyed area, i.e., 57. Of them, 31 answered the questionnaire, which is a return rate of 54,38 %. Research on a similar issue was conducted on smaller samples with a lower return rate [5, 9, 12, 51, 52]; therefore, the achieved return rate is considered acceptable for the continuation of this research.

4 Results and discussion

The results of the survey questionnaires on maintenance management in elementary and secondary schools in Primorje-Gorski Kotar County are presented in detail in [3].
The collected data were statistically processed using the Real Statistics software. Descriptive statistics, correspondence analysis, and inferential statistics (correlation analysis, Kruskal-Wallis test) were performed. The statistical hypotheses were tested using inferential statistics. Descriptive statistics of data on the general characteristics of examined schools are presented in Table 3.

Table 3. Descriptive statistics of general data on schools

Indicator	Age	Years since the renovation	Indoor area (m^2)	Student number	Employees number
Mean	67,74	17,46	2.584,09	245,55	44
Standard Error	6,21	3,49	252,33	31,97	3,15
Median	54	12,5	2372	233	45
Mode	53	3	1000	-	30
Standard Deviation	34,56	17,12	1.404,90	178,01	17,55
Sample Variance	1.194,66	293,22	1.973.755,16	31.685,99	308
Kurtosis	−0,52	−0,88	0,01	0,88	0,35
Skewness	0,78	0,84	0,71	0,85	0,8
Range	129	48	5.436	746	68
Minimum	16	1	554	19	19
Maximum	145	49	5.990	765	87
Sum	2.100	419	80.107	7612	1.364
Count	31	24	31	31	31

The observed elementary schools were, on average, approximately 70 years old. The oldest was built in 1876 and the most recent in 2005. Most of the schools observed had some type of intervention during their existence, and on average 17,46 years had passed since a major intervention, comparable to the one in 2021, had happened. Seven schools have not been renovated during their existence, i.e., since their construction. The indoor area of the schools is approximately 2.600, 00 m^2 on average. The smallest building in the sample has an area of 554,00 m^2, while the largest has an area of almost 6.000,00 m^2. On average, looking at the observed sample of schools, the number of students was 245,55. In addition, 44 employees worked in schools, including non-teaching staff. The above data refer to the 2020/2021 academic year.
According to the principals, the current overall school maintenance management process is not completely efficient. A positive response of "yes" was given by 8, i.e., 25,81 %, while all others considered that it was not efficient (7; 22,58 %) or that it was only partially efficient (16; 51,61 %).
In the next part of the questionnaire, the principals evaluated the condition of the individual elements of the school buildings (listed in Table 2) concerning the level of damage and deficiencies. Each element had to be assigned one of the following condition ratings: 1 = awfully bad, 2 = bad, 3 = fair, 4 = good, and 5 = very good. The reliability control of this part of the questionnaire was carried out, and the value of Cronbach's alpha coefficient of 0,91 was obtained, which is a satisfactory result.
To visually illustrate the condition of the individual elements, the adapted method of displaying colours by the authors [2] was used. The individual condition evaluations of the school building elements, added by the principals, are shown in Table 4.

Table 4. Visual presentation of condition assessment of the individual elements of the observed school buildings

Schools	Element number																												
	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.1	3.2	3.3	3.4	3.5	3.6	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
ES1	4	4	4	3	4	4	3	4	3	4	3	1	4	3	3	3	4	4	4	3	4	3	3	3	2	2	4	4	0
ES2	5	5	5	5	5	5	4	5	4	5	5	3	5	4	5	4	5	4	5	5	5	5	4	5	4	4	5	4	0
ES3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ES4	5	5	5	5	4	5	3	4	5	4	5	5	5	4	5	4	5	5	4	3	5	4	3	4	3	4	5	5	1
ES5	5	5	5	5	5	5	3	3	5	5	4	5	5	4	4	4	4	5	5	5	0	2	2	5	5	5	5	5	0
ES6	5	0	4	4	5	4	5	3	0	5	5	5	3	5	5	4	4	4	5	5	5	5	3	5	5	5	5	5	0
ES7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	4	4	4	4	4	4	4	4
ES8	5	5	5	4	5	4	3	4	5	4	5	5	3	4	3	4	4	4	4	3	5	4	2	5	0	5	5	5	5
ES9	4	0	0	3	4	4	4	4	4	4	3	3	4	4	4	4	4	4	4	4	0	4	3	4	4	3	4	4	0
ES10	4	4	4	4	2	4	3	2	2	3	4	3	5	3	4	3	4	2	3	3	4	3	3	3	1	2	4	5	0
ES11	5	5	5	5	5	4	3	3	5	4	5	2	5	3	4	1	2	2	2	2	4	1	1	3	1	1	3	4	1
ES12	4	4	4	3	4	3	3	3	3	4	4	4	2	3	3	3	3	3	3	3	4	3	2	2	1	3	3	4	1
ES13	4	4	4	2	5	3	2	5	5	4	4	4	5	4	5	3	3	4	3	3	2	5	5	5	3	4	5	4	0
ES14	4	4	4	1	3	4	4	4	4	4	4	3	4	3	4	3	3	3	5	5	5	3	3	4	0	0	4	4	0
ES15	3	3	2	2	3	1	2	3	4	3	3	2	4	3	3	3	3	3	3	3	3	2	2	2	1	2	3	3	1
ES16	5	5	5	3	3	4	3	3	3	4	4	4	2	3	4	3	3	3	4	4	4	4	2	0	3	4	4	4	0
ES17	4	0	4	4	5	4	4	4	4	4	0	3	4	3	3	4	4	4	4	4	5	4	3	4	0	3	3	5	0
ES18	4	4	5	5	3	5	3	3	3	4	4	2	3	4	2	4	4	4	4	4	5	4	2	3	3	2	3	4	0
ES19	2	0	0	4	4	4	2	1	3	3	2	1	2	4	3	4	4	4	3	3	0	2	1	3	0	3	1	0	0
ES20	4	4	4	4	3	3	3	3	3	4	3	2	3	1	4	3	3	3	3	3	3	4	3	5	1	4	4	4	0
ES21	3	3	3	3	4	4	2	3	4	3	3	2	1	3	2	2	2	3	3	3	3	3	2	2	0	0	4	3	0
ES22	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5
ES23	4	4	4	4	4	4	2	2	4	3	3	4	1	3	3	2	2	2	3	3	0	2	3	3	2	2	3	4	0
ES24	3	3	3	3	4	3	2	3	5	2	5	5	4	3	3	4	4	5	5	4	5	2	2	5	0	4	0	4	0
ES25	5	5	5	5	5	5	3	5	5	3	5	5	5	5	3	5	5	5	5	5	5	4	5	5	5	5	5	5	0
ES26	5	5	5	5	4	5	3	4	4	5	3	4	3	3	3	5	5	5	5	5	5	2	2	3	0	3	3	5	0
ES27	4	0	0	4	4	4	4	3	4	4	3	1	5	4	3	4	4	4	4	4	0	4	2	3	0	0	3	3	0
ES28	5	5	0	4	1	4	1	3	1	2	4	3	2	4	1	4	4	4	4	4	4	4	4	3	2	4	4	4	5
ES29	5	5	5	5	4	5	5	5	5	5	4	1	2	4	3	2	2	3	3	2	3	4	2	4	2	3	4	0	0
ES30	4	2	4	4	2	5	3	3	2	5	4	4	2	5	1	4	4	4	4	4	5	4	3	3	1	2	3	4	5
ES31	5	5	5	5	3	5	3	0	3	4	5	5	5	4	5	2	3	4	4	4	5	4	3	0	0	3	4	4	0
Frequency 1	0	0	0	1	1	1	1	1	1	0	0	4	2	1	2	1	0	0	0	0	0	1	2	0	6	1	1	0	4
Frequency 2	1	1	1	2	2	0	6	2	2	2	1	5	6	0	2	4	4	3	1	2	1	6	11	3	4	6	0	0	0
Frequency 3	3	3	2	6	6	4	14	13	7	6	8	6	5	12	12	8	7	7	9	11	4	5	11	10	4	7	9	3	0
Frequency 4	13	9	11	11	12	15	6	8	10	15	11	7	7	13	8	14	14	14	12	9	6	14	3	6	4	8	11	16	1
Frequency 5	14	13	13	11	10	11	4	6	10	8	10	9	11	5	7	4	6	7	9	9	15	5	4	10	4	6	9	10	5
Mean	4,29	4,31	4,33	3,94	3,90	4,13	3,19	3,53	3,87	3,94	4,00	3,39	3,61	3,68	3,52	3,52	3,71	3,81	3,94	3,81	4,35	3,52	2,87	3,79	2,82	3,43	3,90	4,24	3,30

According to the results, the elements of the school buildings are mostly in good and very good conditions, as shown by the blue and green colours, respectively. A certain number of schools with building elements in poor condition (red and yellow colours) is a concern, which will worsen over time if adequate maintenance measures are not taken. The white colour (0) indicates those elements the school buildings do not have them; therefore, the principals could not evaluate them. Elevators are an element that the most significant number of schools do not have. As many as nine schools did not have a space cooling system, and two schools did not have a space heating system, which is unacceptable. It is essential to ensure that students in all schools have similar conditions for work and study, and all the equipment for quality education.

With the lowest overall mean condition score among elements is the space cooling system, with an of 2,82. It should be noted that, in addition to the element not being in good condition, a number of schools do not have it at all. Beams had the highest average rating among

elements, of 4,33. It was tested whether there was a significant difference between schools in the assessment of the condition of individual elements. First, the kind of distribution was determined, followed by the data on the assessment of individual elements by the school. This was verified using the Shapiro-Wilk test at a significance level (p-value) of 5 %, or α=0,05. By conducting the Shapiro-Wilk test using the Real Statistics software for each school, results were obtained, which showed that the normal distribution condition was not met (pE1-E31 < 0,05, normal: no). This result indicates that non-parametric tests should be used within inferential statistics. The difference between the data groups will be determined by the Kruskal-Wallis test. Applying the Kruskal-Wallis test makes it possible to conclude the existence of differences among three or more tested data groups. The null hypothesis is that there is no statistically significant difference in the ratings of the elements of individual school buildings.
Applying the Kruskal-Wallis test in Real Statistics at a significance level (p-value) of 5 % (α=0,05) results show that the null hypothesis should be rejected, i.e., that there is a significant difference between the schools (data from Table 5: p=1,74E-51 < 0,05; sig: yes).

Table 5. Part of the output when applying the Kruskal-Wallis to test the difference between the condition assessments of school buildings elements

Indicator	ES1	…	ES31	Value
median	3,5	…	4	
rank sum	8.989,5	…	12.322,5	
count	28	…	25	849
r^2/n	2.886.111	…	60.73.760	1,71E+08
h-stat				300,9589
h-ties				326,1926
df				30
p-value				1,74E−51
alpha				0,05
sig				yes

These results indicate that the condition of school buildings varies from building to building, implying that students do not have unique conditions for education. Looking at the maintenance actions required, according to Table 1, most school elements require condition-based and planned preventive maintenance. Condition-based maintenance is a combination of monitoring the condition of components and carrying out maintenance work when specific indicators show that there will be a failure or decline in the performance of building components. On the other hand, time-planned maintenance is preventive maintenance performed according to a particular time or numerical interval without checking the condition of building components in advance [3]. Looking at the same results for the condition of the elements of school buildings, but from the aspect of maintenance priorities from Table 1, the resulting distribution is shown in Figure 5. 3,67% of all elements of school buildings require emergency maintenance, and 9,24% of all elements require urgent maintenance. Other elements are in fair, good, or very good condition, and are not urgent for maintenance.

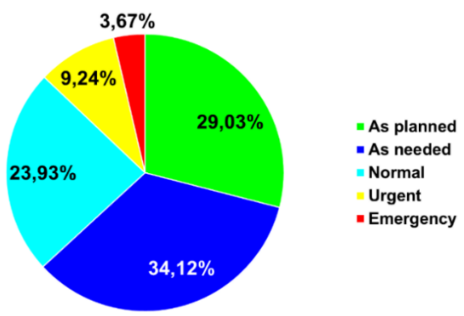

Figure 5. Distribution of school building elements by maintenance priorities

Furthermore, the condition results were calculated for groups of elements of school buildings, as shown in Table 6.

Table 6. Condition of element groups of observed school buildings

Schools	Buildings group mean			
	1.0	2.0	3.0	4.0
ES1	3,83	3,11	3,67	3
ES2	5	4,44	4,67	4,43
ES3	5	5	5	5
ES4	4,83	4,44	4,33	3,62
ES5	5	4,22	3,83	4,14
ES6	4,4	4,5	4,5	4,71
ES7	4	4	4,33	4
ES8	4,67	4	4	4,43
ES9	3,75	3,78	3,33	3,71
ES10	3,67	3,22	3,17	3
ES11	4,83	3,78	2,17	1,87
ES12	3,67	3,22	3,17	2,37
ES13	3,67	4,22	3	4,43
ES14	3,33	3,78	4	3,6
ES15	2,33	3	3	2
ES16	4,17	3,33	3,5	3,5
ES17	4,2	3,62	4,17	3,67
ES18	4,33	3,11	4,17	3
ES19	3,5	2,33	3	2
ES20	3,67	2,89	3	3,57
ES21	3,33	2,56	2,67	2,8
ES22	5	5	5	4,87
ES23	4	2,78	2	2,71
ES24	3,17	3,56	4,5	3,4
ES25	5	4,33	5	4,86
ES26	4,83	3,56	5	3
ES27	4	3,44	3,33	3
ES28	3,8	2,33	4	3,75
ES29	4,83	3,78	2,5	3,17
ES30	3,5	3,22	4,17	3,12
ES31	4,67	4,25	3,67	3,6
Mean	4,15	3,64	3,74	3,48

The lowest overall mean condition score was for mechanical elements 3,48. Structural elements had the best condition score with an average rating of 4,15. Electrical elements were in second place, and architectural elements were in third place in terms of condition, with average scores of 3,74 and 3,64, respectively.
The mutual connection or correlation between the evaluations of groups of elements will be examined next.
Correlation is determined as the conformity of the values of two groups of data, and expresses the degree of connection between the investigated phenomena. Correlation means that, based on knowledge of the value of one variable, the value of another variable can be predicted with a certain probability [53]. Pearson's and Spearman's correlation coefficients are most often used, depending on the type of data and their distribution.
When interpreting the correlation coefficient, the strength of the connection between the variables was interpreted in the manner shown in Table 7.

Table 7. Correlation coefficient values and strength of correlation between variables [54]

Range of correlation coefficient values	Level of correlation
0,80 to 1,00, −1,00 to −0,80	very strong positive/negative
0,60 to 0,79, −0,79 to −0,60	strong positive/negative
0,40 to 0,59, −0,59 to −0,40	moderate positive/negative
0,20 to 0,39, −0,39 to −0,20	weak positive/negative
0,00 to 0,19, −0,19 to −0,01	very weak positive/negative

The goal is to examine the connection between the evaluations of groups of elements; that is, whether it is possible to evaluate one group based on the evaluations of another group. By checking the normality of the variables with the Shapiro-Wilk test, it was shown that the variable of the condition of element group 1.0 was not normally distributed (p < 0,05, normal: no), while the other groups 2.0, 3.0, and 4.0 are (p > 0,05, normal: yes). This influenced the type of correlation coefficient that was applied between individual groups. Pearson's coefficient was applied only when both variables were normally distributed, whereas Spearman's correlation coefficient was used in the case of ordinal variables and when the variables were not normally distributed.

The null hypothesis is that there is no statistically significant relationship between the conditions of the element groups of school buildings. The results of the correlation analysis are presented in Table 8.

Table 8. Correlation coefficients and p-values between conditions of element groups

Element groups	1.0		2.0		3.0		4.0	
	coeff.	p-value	coeff.	p-value	coeff.	p-value	coeff.	p-value
1.0	1	0	0,69	1,79E−05	0,46	0,009	0,51	0,003
2.0	0,69	1,79E−05	1	0	0,56	0,001	0,74	1,97E−06
3.0	0,46	0,009	0,56	0,001	1	0	0,67	3,48E−05
4.0	0,51	0,003	0,74	1,97E−06	0,67	3,48E−05	1	0

Considering all p-values (α=0,05), the results are statistically significant, and the correlation coefficient can be interpreted. Between all variables, the null hypothesis is rejected, that is, there is a positive relationship between all evaluations of groups of elements, ranging from moderately positive to very positive. A positive relationship means that as one variable increases, so does the other. The highest correlation was between the ratings of groups 2.0 and 4.0, that is, architectural and mechanical elements, with a correlation coefficient of 0,74. According to the results, the architectural group of elements has the most connections with other groups, which means that this group of elements is the most consequential for other element groups, and should be given special attention during maintenance.

Then the condition ratings for the school buildings as a whole were calculated, which is shown in Table 9, together with other indicators of descriptive statistics.

Individual school buildings' conditions do not have low ratings. The highest mean score was 5,00, while the lowest was 2,59. The largest number of schools (14) were in good condition. In addition, 12 principals declared that their schools were in fair condition. The total mean score for all the observed schools was 3,73 (good).

To examine whether certain general data affect the overall condition of the school building and to what extent, the connection between the variables of general data from Table 3, as well as the efficiency of the maintenance process, with the assessment of the condition of the school building, was examined. The null hypothesis was that there is no significant relationship between the observed variables and the assessment of the condition of school buildings. The observed variables were mostly non-normally distributed (Shapiro-Wilk test: p < 0,05, normal: no); therefore, Spearman's correlation coefficient was used, and the results are shown in Table 10.

Table 9. Descriptive statistics of condition assessment of the observed school buildings

Schools	Indicators												
	Frequency					Mean	Median	Mode	St. Dev.	Sam. Var.	Kurt.	Skew.	Sum
	1	2	3	4	5								
ES1	1	2	11	14	0	3,36 (3)	3,5	4	0,78	0,61	1,66	−1,25	94
ES2	0	0	1	9	18	4,61 (5)	5	5	0,57	0,32	0,36	−1,11	129
ES3	0	0	0	0	29	5 (5)	5	5	0,00	0,00	-	-	145
ES4	1	0	4	9	15	4,28 (4)	5	5	0,96	0,92	3,43	−1,65	124
ES5	0	2	2	5	18	4,29 (4)	5	5	1,24	1,54	4,43	−2,08	120
ES6	0	0	3	6	17	4,54 (5)	5	5	0,71	0,49	0,30	−1,25	118
ES7	0	0	0	27	2	4,07 (4)	4	4	0,26	0,07	11,69	3,59	118
ES8	0	1	4	10	13	4,25 (4)	4	5	0,84	0,71	0,23	−0,92	119
ES9	0	0	5	20	0	3,65 (4)	4	4	0,85	0,71	14,44	-3,53	95
ES10	1	5	10	10	2	3,25 (3)	3	4	0,97	0,93	−0,20	−0,28	91
ES11	6	5	5	5	8	3,14 (3)	3	5	1,53	2,34	−1,47	−0,12	91
ES12	2	3	15	9	0	3,07 (3)	3	3	0,84	0,71	0,81	−0,91	89
ES13	0	3	6	10	9	3,89 (4)	4	4	0,99	0,99	−0,72	−0,5	109
ES14	1	0	8	14	3	3,69 (4)	4	4	0,84	0,70	3,14	−1,11	96
ES15	3	8	16	2	0	2,59 (3)	3	3	0,78	0,61	0,05	−0,55	75
ES16	0	2	10	12	3	3,59 (4)	4	4	0,79	0,64	−0,23	−0,08	97
ES17	0	0	6	16	3	3,88 (4)	4	4	0,60	0,36	0,03	0,03	97
ES18	0	4	8	12	4	3,57 (4)	4	4	0,92	0,85	−0,63	−0,23	100
ES19	4	5	7	7	0	2,62 (3)	3	4	1,21	1,46	−0,76	−0,48	63
ES20	2	1	14	10	1	3,25 (3)	3	3	0,89	0,79	1,58	−0,88	91
ES21	1	7	14	4	0	2,81 (3)	3	3	0,75	0,56	0,11	−0,28	73
ES22	0	0	0	1	28	4,97 (5)	5	5	0,19	0,03	29	−5,38	144
ES23	1	8	9	9	0	2,86 (3)	3	4	1,04	1,09	0,46	−0,75	80
ES24	0	4	8	7	7	3,65 (4)	4	3	1,06	1,11	−1,17	−0,11	95
ES25	0	0	3	1	24	4,75 (5)	5	5	0,64	0,42	4,24	−2,39	133
ES26	0	2	8	4	13	4,04 (4)	4	5	1,05	1,11	−1,24	−0,5	109
ES27	1	1	6	14	1	3,42 (3)	4	4	1,10	1,21	3,60	−1,8	82
ES28	4	3	3	15	3	3,36 (3)	4	4	1,25	1,57	−0,40	−0,86	94
ES29	1	6	5	6	9	3,59 (4)	4	5	1,28	1,63	−1,21	−0,34	97
ES30	2	5	5	12	5	3,45 (3)	4	4	1,18	1,39	−0,54	−0,56	100
ES31	0	1	6	8	10	4,08 (4)	4	5	0,91	0,83	−0,75	−0,53	102
Total mean						3,73 (4)							

Table 10. Correlation coefficients and p-values between general data on schools and buildings conditions

General data on schools	School buildings condition	
	coeff.	p-value
Age	0,10	0,604
Years since the renovation	−0,24	0,186
Indoor area (m^2)	0,22	0,239
Student number	0,06	0,756
Employees number	−0,13	0,492
Maintenance management effectiveness	0,44	0,012

The results show a certain correlation between almost all the observed variables and the condition of the school buildings. Given the amounts of p-values, in most cases, the correlation coefficients must not be interpreted, the null hypotheses cannot be rejected, the results are not valid for the entire school population, and they should be examined using a larger data sample. The correlation coefficients that have high significance are those between the current efficiency of the overall maintenance management process and the overall school condition. There was a moderate positive correlation between these two variables. It can be concluded that maintenance management, to some extent, affects the condition of school buildings; that is, this process should be as efficient as possible to improve the overall condition of the buildings. For certain connections to be recognised and better understood between these variables, they will also be presented graphically. Visualisation of the association between variables was performed using correspondence analysis. Correspondence analysis is an exploratory data analysis technique used to display contingency tables. It is a statistical data visualisation method by which the relationship between two variables can be analysed. As an exploratory technique, it is helpful in revealing patterns in data [55].

Categories of general data and mean ratings of school building conditions were first transformed into contingency tables. A correspondence analysis was performed on the contingency tables, producing symmetric biplots, as shown in Figure 6.

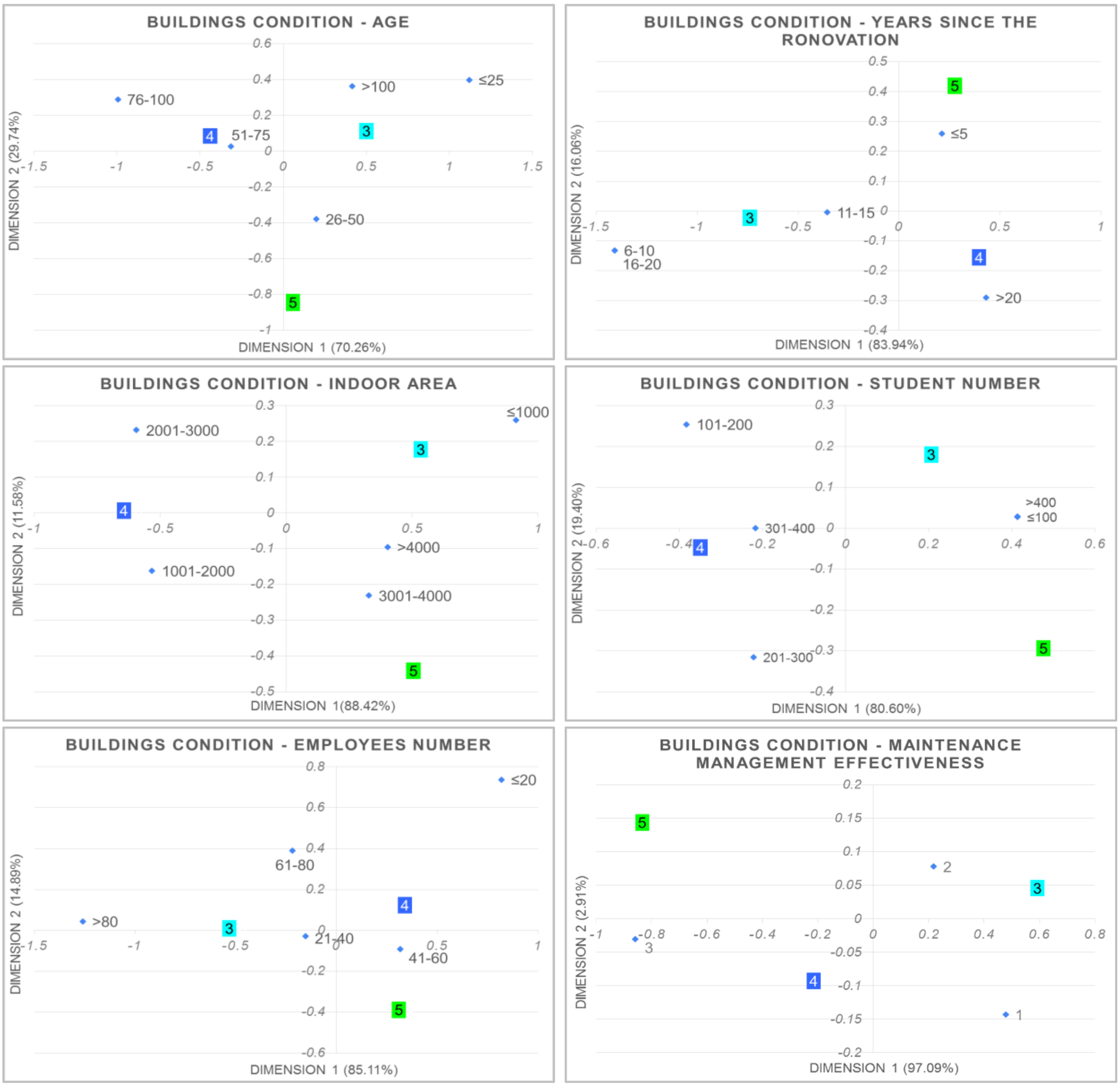

Figure 6. Correspondence analysis between general data on schools and buildings conditions

The graphs above are symmetric plots that show a global pattern within the data. The distance between row or column points provides a measure of similarity (or dissimilarity). Distances were measured using the chi-square distance. Row points with similar profiles are closed on the factor map. The same holds for the column points. Inertia is also an important parameter

and is a measure of variation in the contingency table. In the cases shown in Figure 6, the first two dimensions accounted for 100 % of the total inertia. From the graphs in Figure 6, it is evident which categories of schools have the most connections with certain ratings of school building condition. For example, for the relationship between the condition and age of the building, the graph shows that schools in condition good (4) are mostly associated with schools aged 51–75 and 76–100 years. Schools rated fair (3) were frequently associated with age ≤ 25, 26–50, and > 100 years. The grade very good (5) is the farthest from the origin and has the smallest number of schools for all age categories. In this way, the rules for reading such graphs, associations with the condition of the building, and other categories of general data, shown in Figure 6, can be recognised and observed.
To help determine and explain the causes of the condition of individual buildings, principals' opinions on this issue were also examined. To identify the factors that influence the condition of the examined schools, the ten most prominent factors (listed in section 2) that influence the appearance of damage to buildings were recognised in the literature, for which the principals had to declare how much each of them affects the condition of their building with ratings of 1 = does not affect at all, 2 = does not affect, 3 = moderately affects, 4 = affects, and 5 = highly affects. The reliability control of this part of the questionnaire was carried out, and a Cronbach's alpha coefficient of 0,84 was obtained, which is a satisfactory result.
Descriptive statistics of the obtained results are shown in Table 11.

Table 11. Descriptive statistics of data on the causes of damage to buildings

Indicator		Age	Insufficient resources	Inadequate design	Vandalism	Unfavourable environment	Number of users	Improper use	Lack of maintenance culture	Poor material quality	Poor work quality
Frequency	1	3	4	9	11	16	14	13	14	5	5
	2	1	4	0	8	8	3	5	2	4	6
	3	6	4	7	2	2	8	6	6	9	10
	4	11	11	10	9	9	6	7	9	10	6
	5	10	8	5	1	1	0	0	0	3	4
Mean		3,77	3,48	2,39	2,06	2,19	3,06	2,23	2,32	3,06	2,94
Standard Error		0,22	0,24	0,24	0,24	0,22	0,27	0,22	0,24	0,22	0,23
Median		4	4	2	1	2	3	2	2	3	3
Mode		4	4	1	1	1	4	1	1	4	3
Standard Deviation		1,23	1,36	1,33	1,31	1,22	1,48	1,23	1,33	1,24	1,26
Sample Variance		1,51	1,86	1,78	1,73	1,49	2,19	1,5	1,76	1,53	1,59
Kurtosis		0,45	−0,79	−1,41	−0,39	−1,58	−1,29	−1,53	−1,81	−0,79	−0,84
Skewness		−1,03	−0,64	0,39	0,91	0,31	−0,38	0,34	0,18	−0,36	0,02
Range		4	4	4	4	3	4	3	3	4	4
Minimum		1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	4	5	4	4	5	5
Sum		117	108	74	64	68	95	69	72	95	91
Count		31	31	31	31	31	31	31	31	31	31

According to the results, the school principals believe that the condition of school buildings is most affected by age, with an average score of 3,77 and the highest number of grades 4 and 5. Another cause of the poor condition of certain elements was the restriction on financial resources, with an average rating of 3,48. Such results correlate with findings from the theoretical background, and the relatively lower average impact ratings can be attributed to the average good condition of the examined schools. According to the principals, the most negligible impact on the condition of the building was an unfavourable environment, with an average score of 2,06. An unfavourable environment refers to an aggressive environment, such as sea salt, wind, rain, animals, and natural disasters.

Considering all of the above and the presented results, the set research working hypotheses can be confirmed. An assessment of the condition of school buildings was carried out, i.e., of their elements and group elements, and it was determined that the condition of some buildings and their elements is not adequate, as shown by specific low average condition ratings, as well as an insight into the fact that some schools do not have the essential equipment for quality work. The condition of school buildings varies from building to building, indicating that students do not have uniform conditions for education. Uniform conditions should be one of the fundamental postulates of the education system. According to the school principals, the most significant influence on the appearance of defects is the age of school buildings, which is approximately 70 years on average and correlated with the national average. Most buildings begin to deteriorate rapidly with age, even if all original components are replaced. Therefore, as building materials begin to age and lose quality, it is important to take necessary measures to ensure that the desired properties of the building are preserved through proper maintenance [38, 56]. Similar results were reported in other studies [5, 19, 37, 38]. The age of the building and the lack of maintenance care are the leading causes of poor building conditions.

This methodology of assessing the condition of schools with visual presentations can be helpful for school managers and founders. Based on this, school managers and founders can obtain quick and transparent information about the building's condition, i.e., its elements. The building condition is a crucial input for founders to develop the investment priority system, which will ensure the execution of the most critical and necessary works at the beginning of maintenance plans and enable more transparent planning of capital projects and maintenance works at schools. In addition, by monitoring the condition of individual elements, significant problems can be recognised before they appear, which will result in fewer breakdowns and damage, and greater satisfaction of users, i.e., the students and teachers. According to the results in this paper, most of the elements of the school are in good or very good condition, which, over time, if the school is not adequately maintained, will probably drop to lower grades. An element being in a fair condition is already an indication that it does not have the desired characteristics and is an alarm bell. Measures should be taken on the building elements assessed in this way to prevent major damage. More pronounced damage will cause higher maintenance costs. It is imperative to regularly maintain schools to extend their service life, maintain functionality and usability, and minimise costs. The goal should be to achieve uniform standards and quality of school facilities, and equal working conditions for all students throughout the country.

The building condition assessment system developed in this study does not say anything about the details of the damage, such as the type, exact location, cause, or consequence. Therefore, this research represents a possible approach for performing a periodic inspection of the building as a verification process before conducting a more detailed inspection of the detected severe defects. To maintain the building components in serviceable condition, it is necessary to study the degradation process and root causes. A method often used for these purposes is Failure Mode Effect Analysis (FMEA), which is highly recommended for future research. The FMEA method is used to determine different failure modes, their causes, and their direct and indirect effects on building components [24].

What is additionally emphasised is implementing Computerized Maintenance Management Systems (CMMS) in schools to facilitate decision-making, i.e., maintenance management. With the software, it is possible to include management functions in one place, as well as all stakeholders participating in the process. CMMS facilitates the organisation, identification, retrieval, and analysis of building and maintenance information.

Building inspections should be performed periodically to prevent further damage and deficiencies. Damage to buildings can have significant consequences. Damage to buildings creates an uncomfortable environment. Minor defects/damage may become more prominent over time and cause new defects, increasing maintenance costs. A deficiency can also cause a building to collapse. Ultimately, any defect or damage reduces the value of a property. These implications show that building damage significantly and negatively impacts society's social, environmental, and economic aspects.

5 Conclusion

This study was conducted to determine the conditions of elementary school buildings in Primorje-Gorski Kotar County. It is based on the application of the survey questionnaire method and the visual display of the results obtained, all to develop a quick and practical approach to assessing the school buildings' condition. No prior research has been conducted on this topic in the Republic of Croatia. This study's goals were achieved, and the hypotheses were confirmed.

For research purposes, a school buildings division model was developed to define four main groups of elements (structural, architectural, electrical, and mechanical). The results show that elementary schools in Primorje-Gorski Kotar County are in a relatively good condition. However, some schools do not have building elements, such as heating and cooling systems, necessary for quality work. Overall, the structural elements of the schools are in the best condition, and the mechanical elements of the schools are in the worst condition. The highest-rated building element is the beams, whereas the lowest-rated element is the space-cooling system. The condition of a building is most influenced by its age and the level of dilapidation, as well as the pronounced lack of financial resources for maintenance purposes.

Valuable results were obtained by performing a statistical analysis. A difference in the evaluation of the condition of the elements between schools was observed; this indicates that the conditions differ from one to the other. There is a high correlation between the groups of elements of school buildings, indicating that they can be predicted based on each other. The relationship between the general data and the overall assessment of the condition of schools was investigated, but no significant connections were found. To observe certain connections between the data, a correspondence analysis was also performed.

The method of checking the condition of the buildings presented here can be performed in schools from other areas and in other building types, by adding the required building elements. The advantages of the proposed method are its simplicity and the easy comprehensibility of its application.

The condition of school buildings from other counties cannot be directly determined, because they are not part of the surveyed population, and there is no statistical justification for this. As Croatian regions/counties differ in economic development, geographical features, climatic features, architecture and construction methods, and the number of students, to examine and compare the conditions of schools across the country, it is necessary to collect data from other regions as well. In addition, the building-condition assessment system developed here does not provide the details of the damage, such as the type, exact location, cause, and consequence. Therefore, this research represents a possible approach for performing a periodic inspection of the building as a verification process before conducting a more detailed inspection of the detected defects.

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