Research on The Hidden Dangers and Countermeasures of Electricity Safety in College Students' Apartments

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Abstract. Students' apartments in Colleges and universities are densely populated, which is a high incidence area of campus fire. There are many hidden dangers of electrical safety in student apartments. In terms of buildings, the infrastructure construction is not standardized, the overall function design does not match, the power supply and distribution lines and safety facilities cannot meet the current needs of life, the power lines are aging, the insulation layer is damaged, and so on. In terms of power consumption, high-power electrical appliances are used in violation of regulations and requirements. The reasons for the above safety risks are: the school management personnel have weak safety awareness, do not pay enough attention to the safety management of electricity, the quality of some electrical equipment is not up to standard, the hidden danger investigation and rectification is not strict, and so on. The main countermeasures are: the school should fulfill the main responsibility of safety work, strengthen the apartment safety management, strengthen the students' awareness of electrical safety, popularize the knowledge of electrical safety, investigate and rectify the hidden dangers of electrical safety, etc.

Keywords: Student apartment, Safe electricity use, Hidden danger investigation, Corrective measures.

1. Introduction
As an educational, academic, political, and autonomous training base for senior professionals, colleges and universities are responsible for the management and guarantee of the life and property safety of students in apartments. According to the statistics of the Fire Rescue Bureau of the Ministry of emergency management, a total of 252000 fires were reported nationwide in 2020, with 1183 deaths, 775 injuries, and direct property losses of 4.009 billion yuan. In 2020, electrical reasons continue to strongly affect the trend of fire. 85000 fires were caused by the violation of electrical installation and use regulations, accounting for 33.6% of the total number of fires, of which 68.9% were caused by a short circuit, overload, poor contact, and other line problems [1]. As an important living place for students in school, student apartment has long been a high-risk area of campus fire because of its dense staff and loose management. It is an important task to study the hidden danger of electricity safety in student apartments, analyze its causes and solutions, and promote the modernization of campus safety management ability.
2. Hidden dangers of electricity safety in apartments
There are many kinds of hidden dangers in the electrical safety of student apartments, which are mainly manifested in the two aspects of nonstandard power supply and distribution lines and improper operation of electrical appliances.

2.1. The power supply and distribution lines are not standardized, and the quality of patch boards needs to be improved

2.1.1. The infrastructure construction is not standardized, and the overall function design does not match. To meet the basic needs of students’ accommodation and living lighting, the state has issued a series of "dormitory building design specifications". At present, code for the design of dormitory buildings (jgj36-2016) is widely used. The code has made clear and specific provisions on dormitory power load, dormitory power distribution system design, electrical lighting, socket installation, etc. Due to the shortage of beds in some schools, other buildings and facilities were converted into student dormitories. After reconstruction, the mismatching of the overall function design of building facilities brings many risks, which are difficult to effectively prevent, manage and control.

2.1.2. Due to the aging of infrastructure, the original design of power supply and distribution lines and safety facilities cannot meet the current living needs. Some student apartments in Colleges and universities were built before 2000. The original design of power supply and distribution lines and facilities meet the then "code for design of dormitory buildings", which can meet the daily needs of students. With the development of information technology, a large number of information terminals such as computers, tablet computers, smartphones, and so on enter the students' dormitories. At the same time, "hot fast", hand warmers, electric bicycle chargers, and even induction cooker and other electrical appliances often appear in the students' dormitories. This electrical equipment greatly increases the power load of a dormitory and threatens the safety of the original power lines.

In the student apartments built before 2000, the number of power outlets is often small, or even there is no power outlet, or the installation position of the socket is not suitable, which brings inconvenience to the students. Students have to use patch boards or even connect them with patch boards. Because there is resistance at the connector of the patch board, the carrying capacity of the line is reduced. There is no distribution box and leakage protector in the dormitory. The power socket and lighting lamps are connected in parallel and share one circuit. The electrical system of the student apartment did not adopt a safe grounding method, did not do the total equipotential bonding, and did not do the local equipotential bonding in the bathroom with bath facilities. In the case of electric leakage and overload, accidents such as electric shock and fire can easily happen, and the consequences are unimaginable.

2.1.3. Aging of power lines and damage of insulation layer. The conductor material does not meet the current specification requirements and the current-carrying capacity does not meet the standard. The power supply wires of some student apartments are aluminum rubber insulated wire (BLX) or aluminum PVC insulated wire (BLV). The current carrying capacity of an aluminum conductor is about two-thirds of that of a copper conductor at the same cross-sectional area and ambient temperature. Although the price of rubber insulated wire is dominant, the insulation layer is easy to be damaged, which leads to leakage [2]. This increases the probability of potential safety hazards to a certain extent. If it is used for a long time, the consequences are worrying.

After long-time use, the insulation layer of the conductor will become brittle, damaged, and fall off due to the cold and hot impact caused by light and temperature changes, corrosive gas corrosion, pressure changes, vibration, and other factors, resulting in leakage and even short circuit, and fire. At the junction of copper conductor and aluminum conductor, the aluminum conductor is easy to be oxidized (commonly known as rusty), the contact resistance increases and the conductor is hot, which
leads to accidents. For example, on December 1, 2002, a fire broke out in the dormitory building of Adult Education College of Nanjing University because of the aging line.

Before the promulgation of the construction law in December 1997, the supervision system of construction projects was not widely implemented, and the leakage protection devices were not widely used. Due to the lack of effective supervision, the construction workers may cut corners and do not place wire pipes in the walls. Once the line is damaged and electric leakage occurs, it is very likely to lead to wall electrification and induce the risk of electric shock.

2.2. **Improper operation of electrical equipment**

2.2.1. **Illegal use of high power electrical appliances.** Individual students use high-power electrical appliances in the dormitory for their convenience. Common high-power electrical appliances are: "fast heating", induction cooker, electric kettle, hairdryer, etc. The use of these appliances can easily lead to an overload of the circuit and heating of the conductor. The more the overload, the faster the conductor heating. The allowable temperature of the conductor insulation layer is generally 60 °C. If the line is overloaded for a long time, the calorific value of the line will increase, and the insulation layer will accelerate aging. When the temperature is higher than 256 °C, the insulation layer will spontaneously ignite and separate from the wire, resulting in a short circuit and fire accident. When students buy this kind of electrical appliance, they tend to be greedy for cheapness and don't pay attention to product quality, which further increases the probability of hidden dangers.

2.2.2. **Violation of regulations and requirements on the use of electrical appliances.** The common electrical appliances in the apartment include computers, mobile phones, and their chargers, desk lamps, electric fans, electric kettle, etc. Due to the lack of power sockets and fixed position, each dormitory has several patch boards. The patch panel has the rated load-bearing capacity. If the load exceeds the rated load, the wires of the patch panel will be heated or even spontaneous combustion. It is not suitable to charge the mobile phone for a long time. If the charging time is too long, the poor charger may be hot and spontaneous combustion, and the battery may explode, causing a fire. For example, on August 11, 2007, in a female dormitory of a university in Hefei, the mobile phone was charged for a long time when there was no one, and the charger was hot and on fire. When there is no water in the water dispenser, the power must be cut off to prevent the machine from heating and spontaneous combustion. Incandescent lamps should be kept away from inflammable, to avoid the glass shell heating and igniting the surrounding articles. For example, on June 28, 2003, in the student apartment of Peking University Medical Department, the incandescent lamp was working all the time when nobody was there, and the glass shell ignited the surrounding objects due to heat, causing a fire.

3. **Causes of potential safety hazards**

3.1. **The establishment of school safety concept is not stable, the safety management is not precise, and the measures are not effective enough.**

Article 8 of "Regulations on school safety in Shandong Province" clearly stipulates that schools should fulfill the main responsibility of safety work. The main person in charge of the school is fully responsible for the campus safety work [3]. However, some schools do not pay enough attention to campus infrastructure construction, security risk investigation and rectification, apartment safety management, and other related work, thus leaving security risks.

3.1.1. **Turn a blind eye to the security risks of infrastructure, and the security awareness is weak.** The aging of power supply lines is not formed in a short time, it must have experienced a long process. Infrastructure function does not match, such as the use of other buildings as student dormitories, there must be many security risks in electrical safety and management. Other power supplies and distribution facilities are in disrepair for a long time, the installation specifications cannot keep up with
the requirements of the times, and the quality of infrastructure and electrical equipment is not up to standard. The reason why the above-hidden dangers exist is that the school has a weak sense of safety and has a fluke mentality.

3.1.2. The school safety management is not precise. The use of high-power electrical appliances is almost prohibited in the student apartments of colleges and universities. However, in the surprise (without prior notice) safety inspection, it is often found that students use "fast heating", hairdryer, electric kettle, wire pulling, electric vehicle battery charging, and occasionally find induction cooker. These phenomena show that the apartment safety management is not precise, meticulous, lax, not real, but also shows that the school does not pay enough attention to safety management.

3.1.3. The investigation and rectification of school safety hidden danger is not strict. Some colleges and universities do not fully implement their safety responsibilities, and their rights and responsibilities are not clear. "In the investigation and rectification of potential safety hazards, we attach importance to inspection, but neglect rectification, which is" strict and hard "in inspection, and" loose and soft "in rectification, and even some" false rectification "phenomena exist" [4].

3.2. The students are lack knowledge and awareness of safe use of electricity, and improper use of electrical appliances
Students do not know much about the safe use of electricity: on the one hand, they turn a deaf ear to the school's electricity safety requirements, rules, and regulations, and even have resistance; on the other hand, they do not know enough about the safety risks of electricity use, and they do not fully understand the serious consequences of fire, leakage, and electric shock, and they are blindly confident or fluke.

Improper use and management of electrical appliances and improper use of electrical appliances are important reasons for inducing safety risks. For example, incandescent lamps should be kept away from inflammable, and electric blankets should not be folded. Violating the common sense of safe use of electricity can easily lead to safety accidents. For example, on May 5, 2008, in the female dormitory of the Central University for nationalities, the rechargeable radio lamp was charged for a long time, causing a short circuit of the electrical circuit and causing a fire.

3.3. The quality of patch panel and electrical equipment is unqualified

3.3.1. Unqualified patch board. Limited by their economic conditions, some students often buy low-cost and unqualified patch boards. The main performance of inferior patch boards is: (1) the conductor core is too thin and the current carrying capacity is not up to the standard. (2) lack of ground wire, once the electrical leakage occurs, the leakage protector will lose its function, causing the risk of electric shock. (3) the plastic shell does not use flame retardant materials. When it is overloaded or short-circuited, and close to the fire source (heat source such as electric heating), the plugboard shell without flame retardant characteristics is easy to catch fire. (4) the use of copper-clad aluminum or copper-plated iron sheet to make the patch board contact with the copper sheet will lead to the decrease of the carrying capacity of the patch board, and it will heat when the current is high [5], and even cause a fire. For example, on January 4, 2007, in the dormitory of a university in Jingzhou, Hubei Province, the aging and wear of the power cord of the patch panel, coupled with long-term overload operation, led to a fire.

3.3.2. The quality of electrical appliances is unqualified, or the product design is defective, and there is no safety protection device. In addition to computers and mobile phones, the common electrical appliances used in students' dormitories are "fast heating", hand warmers, electric blankets, and electric bicycle chargers. Due to the lack of an automatic power-off protection device, "hot fast" has serious safety risks. There are many fire accidents caused by using "hot fast" to boil water all over the
country. For example, on December 13, 2004, a fire broke out in a male dormitory of a university in Zhengzhou. The internal structure of the inferior hand warmer is extremely simple. It relies on 220 V single-phase alternating current to heat the electrolyte to achieve the purpose of heating. Because the internal electrolyte is charged, and the lack of automatic power-off protection device, there is a serious safety risk - once the electrolyte leakage, or because of long-term power on the burst, it is easy to induce the risk of electric shock. If the insulation layer of poor-quality electric blanket resistance wire is damaged, the resistance wire will be exposed, which is easy to induce the risk of electric shock. If you charge the electric bicycle battery in the dormitory for a long time, the battery may explode and burn due to overheating, resulting in a fire.

4. Solutions

4.1. Implement the main responsibility of school safety work and strengthen the organization and leadership

Schools should strengthen the sense of crisis and urgency [6], implement the responsibility system of a school principal, clarify responsibilities and strengthen supervision. We should further strengthen the supervision and inspection of the safety work in Colleges and universities, and rectify the problems such as the mismatching of infrastructure functions, the aging of power supply and distribution facilities, and the equipment capacity that cannot meet the current demand within a time limit, and do a good job of "looking back". We should appropriately increase the number of apartment safety management personnel, give full play to the important role of headteachers and counselors in apartment safety management, formulate an apartment safety management system, and strengthen daily electricity safety inspection.

4.2. Strengthen the students' safety awareness, popularize the common sense of safe use of electricity, and improve the students' self-protection ability

Schools should take the "safe production month" as an opportunity to publicize the knowledge and typical cases of safe electricity using radio, radio, We Chat official account, and micro-blog media, to arouse students' safety awareness and stimulate their inherent safety needs. We can take advantage of the opportunities of large-scale theme activities and theme class meetings to carry out various forms of electricity safety education. It is necessary to innovate the form and content of safety education, such as developing mobile games of electricity safety, carrying out electrical safety knowledge competition, popularizing electricity safety knowledge as soon as possible, and improving students' self-protection ability.

4.3. Replace the aging power supply and distribution lines whose ampacity cannot meet the current power demand and improve the indoor security facilities

Adhere to the guiding ideology of "life first, safety first", do a good job in source control, replace the aging power supply and distribution lines and transformers whose capacity cannot meet the current power demand. At the same time, the following work should be done well: (1) The line transformation should be carried out in the dormitory without security facilities, and the distribution box should be installed. The power switch, the leakage protector with appropriate rated current (the rated leakage action current should not be greater than 30mA), and some air switches should be installed in the distribution box; (2) The indoor general equipotential connection should be well done, and the local equipotential connection should be made in the toilet with bath facilities; (3) The power sockets should be installed at suitable positions, and the number of sockets should be consistent with the number of beds. The power socket should not be set on one wall. The power socket and indoor lighting circuit should be controlled separately. For example, air conditioners, electric water heaters for bathing, mechanical exhaust device, etc. should be set with a special power socket [7].
4.4. Investigation and treatment of potential safety hazards

The school should organize relevant personnel to carry out a safety inspection in the apartment from time to time, and the inspectors should give full play to the role of "microscope" and "searchlight" of safety inspection [8], and carefully check out and register the hidden dangers of electricity use in the student apartment To provide safe and comfortable learning and living environment for students, we should find the root, trace the source, comprehensively and systematically rectify, and strive to improve the effectiveness of hidden danger investigation and treatment.

In the process of investigation and rectification, the responsible person, rectification standard, and completion time should be defined, the accountability system should be formulated, the rectification quality of hidden dangers should be linked with the work quality assessment of the responsible person, and the staff's sense of responsibility and enthusiasm should be brought into full play to implement the investigation and rectification of hidden dangers.

5. Conclusions

In addition to the traditional measures mentioned above, the school should also make full use of modern scientific and technological means, such as artificial intelligence, big data technology, to monitor the power consumption data of each dormitory in real-time, automatically judge the power consumption safety situation in the apartment, and decisively deal with various security risks that may occur. The school should adhere to the work policy of "people-oriented, prevention first", fully fulfill the main responsibility of safety work, strengthen organizational leadership, strengthen safeguard measures, investigate and manage hidden dangers, strive to build and improve the school safety prevention construction system and major risk prevention and control system [9], and lay a solid foundation for the construction of a civilized, harmonious, fair, legal, honest and friendly university campus.

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