Quality Problems and Quality Control of the Protective Equipment in Air Defense Projects

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Abstract: Building protective air defense units in garages of civil buildings and in metros is a trend nowadays. In this mode, people get effectively hided and protected when air strike happens. At every important entrance and exit of an air defense project, protective equipment and facilities must be installed, because these areas are the weak points of the project under the air strike. Therefore, quality of the equipment is very important. Under this background, the research group made a survey of several air defense projects and the equipment of them in Chongqing China. It shows according to the survey results, that quality problems occur mostly during the production and installation process. Solutions to these quality problems are discussed and suggested in this paper.

1. Protective Equipment in Air Defense Projects and Categories

The air defense projects are the underground projects that are used to resist damage effects and protect the command system, the communication system and the hiding staff. The civil air defense projects in China are integrated in underground garages, underground municipal facilities and metro stations.

In air defense projects, the weak points are entrances, exits and air vents, which are mostly the targets in wars. The entrance and exits (including connecting ports between 2 protective units and passage ways to the outside of the project) are larger in size and the air vents are smaller. In wars, the staff pass through the entrance and exits sometimes if needed, and the air vents are semi-open till attact comes. Therefore, protective equipment must be installed at these points to prevent and weaken the damage effect of weapons into the inner area of the project.

Taking the example of the 6th entrance of a air defense projects in Chongqing, which are studied by the research group, the layout are illustrated as follow:

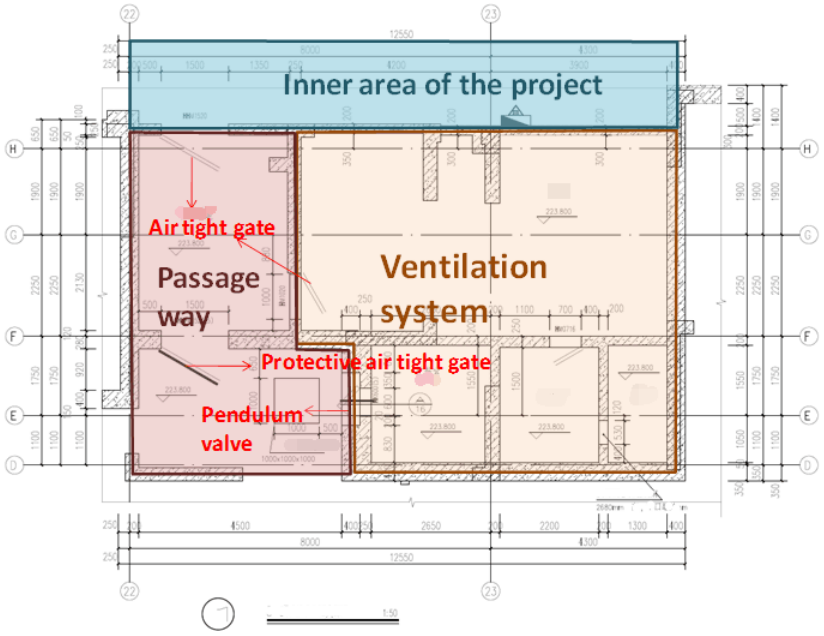

Fig1: Entrance, exit and air vent in air defense project and relative protective equipment

The protective equipment at a passageway of the air defense project are the protective gate, the protective and air tight gate, the air tight gate and the plugging plate. The protective equipment at a air vent of the project are Pendulum valve, Rubber hose valve, Overpressure exhaust valve and air tight valve. These equipment are illustrated as follow:

Fig 2: Protective Equipment

2. Research Background

In order to research the quality problems and quality controlling measures, the research group has worked with the cooperated company and made a sampling survey of protective equipment in Chongqing China. The research has covered 252 projects (residence garages, municipal facilities and metro stations) and 1650 equipment and their key parts. In this research, detailed statistical analysis of quality problems has been made and quality controlling measures are discussed.

3. Main Quality Problems of the Protective Equipment

3.1 Main quality problems in the production stage

The research group has sampled the quality of the protective equipment in the existing projects, and found that there are some quality problems in the process of production, which affect the resistance performance, the air-tight performance and the using performance of the products, which

are as follows.

- The material is not qualified. For the steel or other metal materials used for protective equipment, the strength, hardness and ductility of the material can not reach the requirements of the design strength, which affects the impact resistance of the products. The main reason is the problem of material procurement, mostly for informal brands of steel products or second-hand steel. For some concrete protective products (such as the protective airtight gate of reinforced concrete), there is a problem that the performance of concrete is not up to the standard. The main reason is that some manufacturers use self-made concrete instead of qualified commercial concrete, so that the concrete filled in the gate can not reach the required standard.

- Error of material model. In the process of purchasing and selecting of the material, the model error is easy to appear, such as the thickness deviation of the steel plate used in the gate body is greater than the standard deviation. The deviation of the height of the section steel and other dimensions of the gate frame are larger than the standard deviation. The steel bar for the gate frame anchored is on the low side, and the angle steel used in the gate frame is smaller than the standard, etc.

- The weld does not reach the standard. It is mainly embodied in three aspects: one is the problem of weld flux itself, such as the failure of flux or the wrong selection of the flux model; the two is the lack of the weld height, the leakage or less welding, the cleaning of the slag; and the three is the defects in the welding process, such as the porosity, the slag, the bite, the unsoldered penetration, and the corrosion untreated, etc. The details mentioned above are mainly related to the technical level of the welders.

- Axis and plane control deviation. The survey found that the width and height of the gate frame and gate body, the verticality of the gate frame, the thickness of the gate body and the center line of the gate frame and the gate body have a super standard deviation. The axial deformation of the gate frame causes the structural strength to decrease. Also there is a large deviation in the neutral line between the rubber strip on the gate body and the press line on the gate frame, and the joint parts of the rubber strip show errors. Meanwhile deviation of the hinge coaxiality and the perpendicularity of the centerline could be found, which causes the opening and closing force of the gate leaf too large, and the smoothness of the gate leaf movement is hindered. Furthermore there is a misalignment deviation between the locking box and the lock, so that they can not be completely closed. Sometimes manual cutting is adopted by the part of the interlocking mouth, which causes the unevenness of the cutting mouth. Also the manufacturing precision of the worm gear is insufficient, so that the locking force is greatly increased.

- The quality of airtight control measures. It is mainly reflected in the inaccurate compression of the airtight rubber strip and the air permeability defect of the gate frame itself: For the compression of the rubber strip, the height of the closed section is often less than the design size, and the size of the press line is designed to cause the leakage of the rubber strip. As for the air permeability defects of the gate body, it is mainly manifested that the weld quality of each component is not up to standard, resulting in weld leakage

- Other quality problems: other common quality problems, such as the accuracy of the machining parts; the use of welding instead of bolt in the moving threshold installation, result the unuse of the moving threshold; the coating process has problems in the adhesion and weatherability of the film; the level of the gate body is not up to the standard; the identification is not in place or no identification, etc.

3.2 Main quality problems in the installation stage

Most of the quality problems in the installation stage are mainly in the following aspects.

- Gate frame installation position deviation. The main embodiment is that the installation height of the gate frame does not meet the design requirements. The final threshold height of the gate frame is beyond the design standard deviation, so that it affects the use. Secondly it is the plane deflection of the gate frame, which makes the plane of the gate frame deviate from the plane of the gate frame wall. Thirdly is the verticality deviation of the gate frame.

- The gate frame support is not in place. After the bar of the gate frame is binded to the gate

frame wall, the gate frame wall is then to pour as a whole, and the frame support must be set up before pouring. It often appears that the supporting parts are not set in place and the frame is not firmly installed and displaced. In addition, the number and type of bolting reinforcement are sometimes not up to the standard requirements.

- Locking and hinge assembly and debugging do not meet the design requirements. There are two main problems: first, the machining accuracy of locking and hinge is not up to standard; secondly the assembly quality of locking and hinge is not up to standard. Among them, the main problem of locking is that the locking force exceeds the standard, and the gate leaf is locked.

- The gate frame and the gate body can not fit tightly. The reason is that the plane degree of the gate frame and the gate body is not up to the standard, and both of them can not be fitted. For example, the gate frame and the gate body are often deformed because of improper storage, so that they don’t match together.

4. Quality Control Measures

According to the conclusion from this study, the quality control of all kinds of protective equipment must be focused on the whole process of production and installation. It should be carried out from three aspects: the production process, the storage and maintenance process and the installation process

The production process refers to the whole process of the purchase of raw materials and external components, production and production, and finally to the completion of the production of the products. In this process, the problem of product quality is easy to appear because of the shortage of technology and management. Combined with the actual situation, the specific quality control points of protective products are as follows.

- The main points of the quality control of the gate frame production process should be paid attention to the strength and precision of the structure, the fitting degree of the gate frame and the gate body, the quality of the welding seam, the material of the glue bar and the welding strength of the anchorage hook. The machining dimensions of cutting plate, gas cutting and bending plate forming should be carried out according to the negative tolerance, and the cutting, drilling, punching and cutting holes should be carried out according to the positive tolerance, and the deviation of the blanking is not more than 2mm. The positioning tooling is used as far as possible in the group welding support plate and the slant flat steel. When the locking box is welded, the cement mortar must be prevented from entering the lock. The angle of the gate frame of the anchorage hook must be straightened and the straightness is controlled within the qualified range.

- It is a must to pay attention to the structure strength of the gate body, the consistency of the gate body and the gate frame, the consistency of the position of the inlay bar and the position of the gate frame, and the accuracy of the position of each opening. Concrete gate bodys need to use qualified commercial concrete, and the maintenance time should be adequate. As the frame of the gate body, the I-steel and the channel steel must be checked for the quality problems such as warping head and uneven, and the welding process of the panel and skeleton should be carried out according to the prescribed procedure. After welding, internal stress relief treatment is needed to prevent late deformation.

- The quality control of airtight valve production should mainly focus on shell processing. For casting shell, it is necessary to select qualified clamping devices when machining. The coaxality of the spindle should be paid attention to in the machining process

- The storage of products should be kept neatly and clearly marked, and pads should be applied when placing them. Products that are stored for a long time should be selected as ingate as possible, and their parts should be maintained before long storage.

- The product should be maintained at least once a year after the delivery of the product. The seal should be kept in good condition and protected with talcum powder. It should be replaced after aging, and the moving parts should be treated with oil injection.

- The product also needs proper packing protection, mainly from the aspects of rust prevention,

moisture resistance, pressure resistance and impact resistance.

The protective equipment should be installed in accordance with the design requirements of the civil air defense engineering protection system. In the process of installation, the quality management should be strengthened so as to ensure the wartime effectiveness of the protective equipment. In the first place, the installation conditions must be checked before the installation, including the control and verification of the construction design drawings and technical requirements. The protection equipment must have a factory inspection report and a factory certificate verification, and the inspection report of the supervision unit should be obtained. In the second aspect, the drawings and the site should be checked and checked repeatedly. The specifications, models, location and direction of the protective equipment should be checked carefully to ensure that they are consistent with the engineering design, especially for the installation order, and to ensure the correct verification. In addition, the elevation of the civil units should be checked and checked again and again. The third aspect is to examine the site installation plan.

Taking the common protective equipment as an example, the research group has the following quality management experience in this research work.

- The gap between the two bodies of the double gate have special requirements. The bad construction will affect the function and use of the gate. Therefore, we should first assemble the gate body and the gate frame, then install them.

- Vertical rotated gates are usually constructed by first erect gate frames and then install gate body. When the gate frame is erect, the temporary supporting steel on the gate frame must be demolished after the gate frame wall is demolished.

- The 45 degree oblique interface of the rubber strip on double gate products must be directly attached to ensure the reliability of the sealing performance.

- During the installation, all parts must not be damaged, and the rubber strip and cushion of the airtight rubber strip and valve can not be dry or split

- When the gate body of the reinforced concrete gate is in the open state for a long time, the temporary support at the bottom of the gate body should be added, and the end position of the gate body should be set up by the elastic buffer to avoid the deformation of the hinge page of the gate and the damage of the gate body.

- For gates with live threshold function, the threshold must be installed after the gate is installed.

5. Conclusion

According to this research, it is found that the quality problems may occur in the process of production and installation, which can affect the performance and safety of the whole air defense project. For the defense industry, quality and safety are always the first. The air defense enterprises should start from the process of production and management, optimize the production process, specify the quality assurance system, and ensure that the equipment installed in the air defense project are reliable products.

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