Application of the Indoor Safety Location Design

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Abstract

Earthquake has been playing a vital role in China, when the earthquake coming, due to the limitation of time and location, there are a lot of people can't escape timely and will be hurt, this is an unavoidable reality. This leads to the damage via earthquake in our country, indoor injuries accounted for the major part, so we urgently need an indoor anti-shock measures to guarantee their safety. There are a lot of people invented products shockproof bed, shockproof table, but most of the design of the product can protect the few number of people, because the catastrophic earthquake hazards. Need we urgently need an indoor safety location to help more people? This paper's main research is that how to use Auto CAD and Solid works to make security location of rendering more intuitive feeling for individuals. This article introduces the design of indoor security location before and after process, including preparation of Solid works, the design of indoor security location structure, basic parameters, three-dimensional figure, a two-dimensional view, and the optimization and post-production.

Keywords

Design of indoor security; CAD and Solidworks; Three-dimensional Figure.

1. Introduction

The reasons for choosing this proposed research project is that these might be theoretical and professional design.The purpose of this design is to meet the characteristics and improve the shortcomings, to provide an indoor safety location. When the earthquake coming, not only can it be more efficiency, but also with more stability, in order to ensure personal safety.In order to achieve the above objective, the technical solution adopted in the design is to provide a space-enclosed indoor safety refuge corner which is modified on the basis of an ordinary shockproof table, including overall reinforcement, cushioning and damping, a fixed supporter, etc. And then increase the space for the second half of the closed door self-help, survival necessities on the base for help. In the true sense of the epicenter of rapid self-help and after distress work.According to Xiaoqing Wang, Jianguo Zhao(2010)[1], they were explained the principle of automatic life saving. Furthermore, The study of the shockproof function of furniture also mentions the unification of practicability and beauty via Qi-sheng Zhuang, Han-ning Zhang, Wenjie Sun(2015)[2]. The design of shockproof functional table furniture researched and development based on the new automatic shock bed also mentioned how to realize maximize shockproof by Rui Wang, Haiyang Liu, Jianqiang Zhou(2011)[3] and Qi-sheng Zhuang, Han-ning Zhang, Wenjie Sun(2015)[2], to protecting personal safety. The earthquake damage prevention and reduction about furniture, Shan Luo, Huiyuan Guan(2013)[4] mentioned the design of earthquake-resistant furniture, and made a detailed exposition for it, meanwhile, the existing problems and development strategies in China's emergency shelters had been discussed in Zhiqiang Wang, Zhicheng Wang(2011)[6] and theDiscussion on the Design of Eaithquake Prevention and Disaster Reduction for Cabinets furniture had been discussed in Shan Luo, Huiyuan Guan (2012) [5]At present, my research topics are rarely published in the domestic knowledge network. There were only eight patents in China. The research on this topic is a good combination of the views and opinions of the former people.

2. Methodology

Crank and slider to achieve the rotation and movement of the conversion of the plane connecting rod mechanism, also known as crank connecting rod mechanism [7]. The components of the crank-slider mechanism that make up the moving pair with the frame are slide blocks, and the components that connect the crank and the slider through the rotary pairs B and C are the connecting rods (Figure 1).

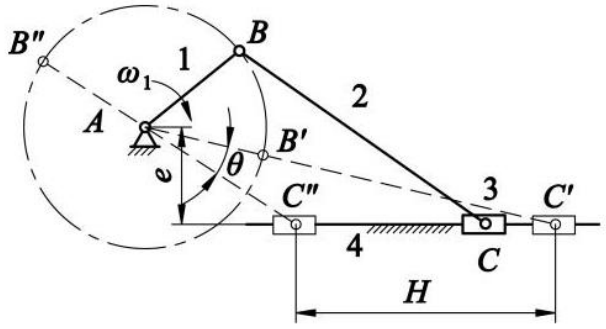

Figure. 1 1-Rocker; 2-link; 3-Slider; 4-Fixed base.

The overall framework includes low alloy high strength structural steel (at the same time with quenching + medium tempering heat treatment to achieve better toughness effect) on the production of the anti-vibration surface and the fixed bracket, quenched and tempered steel (two shockproof desktop requires better mechanical properties of the material) Made under the shockproof surface, and the carburizing steel (the bottom also has the effect of enhancing the stability, that is, the need for relatively large mass of material) triangle fixed base of four parts.

3. Disadvantages of Traditional Anti-shock Measures

3.1 Shockproof Bed

When the earthquake comes, it is necessary to go to the bedroom and open the safe closed door for self-help. In this way, a lot of time were lost in the process of self-help. Taking into account the top of the earthquake Measures but did not notice the side of the safety precautions, because when the earthquake hit the direction of the object is uncertain. In the enclosed space inside the anti-seismic bed, it may cause self-rescuing oxygen deficiency, so self-rescue Unnecessary injury during the self-help process (Figure 2). [8]

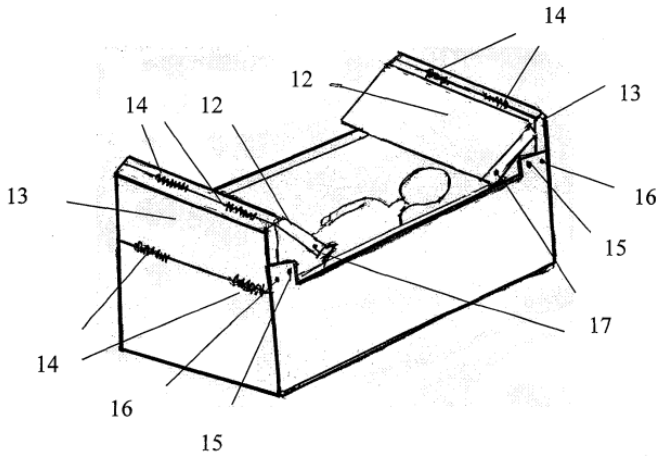

Figure. 2 12-Mankind; 13-Bedding lower section; 14-Spring hinge; 15-Screws; 16-Locking mechanism; 17-Emergency locking mechanism.

3.2 Shockproof Table

From this picture, we can see that there is no obvious shock absorption characteristics, such as the damping spring damping tools. Although the drawer above the compartment can place some anti-vibration tools, but when the earthquake coming, the above anti-vibration panel is cutting, which can lead to the destruction of self-help earthquake-resistant appliances. The table shape alone does not have strong stability. Although there is a stabilizing device on the four legs, this does not guarantee the stability during the earthquake. The design of the anti-vibration table also only takes into account the security of the top space and does not take into account the safety of the rest of the space, and can not fully play the role of security(Figure 3).

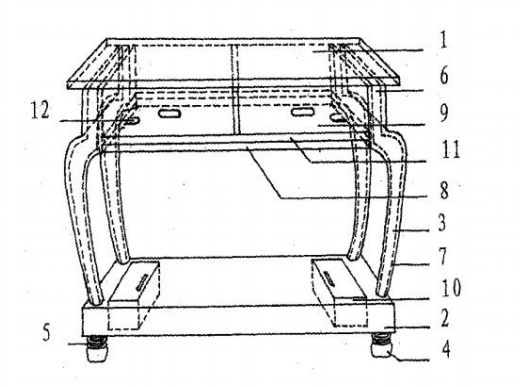

Figure. 3 1-Table surface; 2-Buffer space; 3-Table legs; 4-Buffering fixture; 5-Buffer device; 6-Impact fixing device; 7-Impact cushioning material; 8-Table bottom fixing surface; 9-Table bottom; 10-Emergency water; 11-Joiner mechanism; 12-Vent hole.

4. Shockproof Table Corner Design with Simulation Cushioning Performance

The advantages of using the corner, combined with its own triangular fixed bracket features, and a huge stable base contributed to the strong stability. Using the anti-vibration surface and the lower anti-vibration surface, to some extent, it achieved a two- The stage damping effect, each fixed bracket has a special damping spring, once again enhance the damping effect. Since the design of the shockproof table only takes into account the safety issues of the top space, the safe refuge angle makes up for such a flaw. The application of the crank-slider mechanism makes it difficult for the Closed door to break open from the outside, both protecting the self-help in the space infinite ahead (Figure 4). [9]

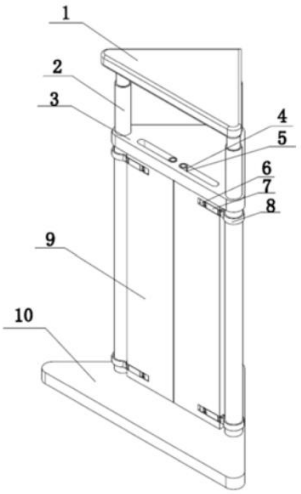

Figure. 4 he first desktop; 2-Table legs; 3-Second desktop; 4-Sheave; 5-link; 6-Small collar ; 7-Turning rod; 8-Large collar; 9-Closed door; 10-Fixed base

5. Force Analysis and Calculation

5.1 Anti-Vibration Panel Strength Check

We Q420, for example, Q420 low-alloy high strength structural steel strength limit is $\sigma_b = 520MPa - 680MPa$, anti-vibration panel using a Rectangular steel, of which the inertia moment of the shaft $I_Z = bh^3/12$ bending coefficient, $W_Z = bh^2/6$, $b = 20mm$, $h = 50mm$. Take the upper limit of the strength limit $\sigma_b = 680MPa$, which is $\sigma_{max} = 680MPa$.

$$W_Z = \frac{bh^2}{6} = \frac{0.05 \times 0.0025}{6} = \frac{5}{6} \times 10^{-5} m^3 \tag{1}$$

$$M = \sigma_{max} \times W_Z = 5666.67\ N \cdot m \tag{2}$$

$$F = \frac{M}{L} \times L = 1.5m\ ,\ F = \frac{5666.67}{1.5} = 3777.78\ N \tag{3}$$

But we have to know at this time is calculated in one of the three points, the total needs to be multiplied by 3. That is, $F_{total} = 3F = 3 \times 3777.78 = 11333.33\ N$, $m = F_{total}/10 = 1133.33\ Kg$, From the above calculation, we can see that the total weight that can be endured last is 1133.33Kg, that is, 1 ton of multi-weight, and this is calculated without considering the anti-shock spring. What items in the room will be more than 1-ton weight, almost no bar, if it is above the reinforced concrete, then add the role of shockproof spring is no problem.

5.2 Shockproof Spring Safety Inspection

Through access to information we can get the elastic modulus of steel E are mostly between $1.9 \times 10^5 - 2.2 \times 10^5 MPa$. The length of spring steel was 20mm, after the maximum compression becomes 5mm.By calculating we can see that it can withstand the stress is great. The stress will be less than σ.

$$E = \sigma/\varepsilon,\ \varepsilon = 15mm,\ \sigma = E\varepsilon = 1.9 \times 10^5 \times 15 \times 10^{-3} = 2850MPa \tag{4}$$

5.3 Pre-Tightening Mounting Bracket Mounting Bolts

According to a series of calculations, we can draw: F0=F+ F'', that is, the total pulling force of the bolt is the sum of the working load and the residual pre-tightening force given to it by the coupling. First determine the allowable tensile stress of the bolt $[\sigma] = \sigma_S / S_S$, $[S_S] = 3$.

Select the bolt material is 35 steel, select the bolt performance level 5.6 level.

Tensile strength limit:

$$\sigma_B = 5 \times 100 = 500\ MPa \tag{5}$$

Yield limit:

$$\sigma_S = 6 \times \frac{\sigma_B}{10} = 6 \times \frac{500}{10} = 300\ MPa \tag{6}$$

$$[\sigma] = \frac{\sigma_S}{[S_S]} = \frac{300}{3} = 100\ MPa \tag{7}$$

Now we assume a bolt with a weight of 500Kg. Of course, the actual condition of the bolt will not be so great. Therefore, we calculate F = 5000N, assuming the bolt diameter d = 42mm, we can see that by manually d1 = 37.129mm, d2 = 39.007mm, p = 4.5mm, H = 0.866p = 3.897mm.

Dangerous sectional area of bolt:

$$A_C = \pi/4\left(d_1 - H/6\right) = 1045\ mm^2 \tag{8}$$

$$\sigma = F/A = 5000/1045 = 4.78\ MPa < [\sigma] \tag{9}$$

5.4 Safety check of safety angle

Connection rod material 20 steel, [τ] = 30MPa, diameter d = 20mm. Traction F = 15KN.

Shear stress:

$$\tau = \frac{F_S}{A} \tag{10}$$

$$F_S = 15000\ KN \tag{11}$$

Cross section:

$$\tau = F_S / A = 15000 \times 2 \times \pi / 4 \times \left(20 \times 10^{-3}\right)^2 = 23.9\ MPa < [\tau] \tag{12}$$

So, connecting rod to meet the requirements.

6. Conclusion

This article describes a kind of earthquake-proof table with enclosed space. It provides an effective and convenient method of self-seeking for indoor damage caused by earthquakes. After earthquakes and earthquakes, it solves the problems of self-rescue, survival, and help. The search and rescue time is reduced and the personal safety is ensured. At the same time, such a shockproof mechanism has the characteristics of small occupied space, wide applicability to people, and strong versatility.

Acknowledgements

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