

BAM CITADEL, YESTERDAY AND TODAY -PREVENTION FACTORS OF BRICK MONUMENTS DESTRUCTION

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ABSTRACT : Bam historical citadel had been built more than two thousands year's age in heart of desert in Iran. It is the largest world muddy and brick complex. By two thousands precedence is a complete sample of Iran architecture, in different periods of history has been created and has been developed and we can see the specimen of centuries architecture in it.

Near one hundred and eighty years ago, some people of Bam lived there, Bam citadel consists of ancient city and castle had twenty hectar area (520 west part Length and 430 width) the area of citadel and castle was six hectar. There were deep pits around castle for defense against attacks.

There were thirty- eight control towers in specified intervals on rampart of castle. Between castles, governor's building had been established in five stories by brick and mud. Remained columns and arch in castle, bakeries, oil pressing chops and brick shelves in market indicate the past splendor. In Islamic period, two mosques, Masjed Jameh and masjed Hasrate mohamad, an Husineyeh consist of on court yard, one veranda by two symmetrical stories and several rooms had been built in Bam historical citadel. These monuments were destroyed in earthquake. There were one entrance in citadel and one palatal in traditional gymnasium. Style, it consists of four veranda. One dome and one pit, they were destroyed in earthquake. The entrance vault was comparable with sasani period. It was like glorious castle located on sixty one meter hill was like studded with jewels crown on Iran historical monument facades. The main materials were unbaked brick, motor, clay, straw, and frequently brick, palm tree trunk and rubber had been used. The ramparts were repaired, water ways were specified and some parts of columns were repaired and layered, the roof stable, barrack and the governor 1381.

Bam Citadel After Earthquake

After Bam citadel earthquake, national and international struggles began for recovery of reminded parts of this historical complex. From early days after earthquake Iranian board investigated the damages, and debris collecting and strengthening of remains constructions were started by consulting with international experts. Eight committees began preparing documents, international activities, and security. Public relation, enactive and technical affairs and people adds.

After two years of earthquake, debris collecting in external wall and its surrounding, barrack, masjid Jame, ice chest, sistani house and entrance of catle were ended. The safe remains which were probably collapse after shakes were strengthening partially by scaffolds installation. By establishment of Bam brick workshop which is the largest and equipped brick workshop in middle east, required birch for repairing Bam citadel was



Figure: Bam citadel before earthquake



Figure: Bam citadel before earthquake

supplied by local mines and by help of international and national experts we will see repayment of this historical citadel. At present, the documents, maps and pictures of Bam citadel are studied for regaining the greatness and spender of this historical citadel.

The Principles Of Repair And Strengthening

External repayment cause destruction which it was observed in Bam citadel, since in our country, eternal repayment is considered more than basically and constructional elements different constructional buildings require different strengthening trend related to the type of monument, its application and its location, for example, the bridge stress issue is different than other construction like dome, their damages are different, there damages are defined by construction, so we cannot say exactly what kind of dangers like earthquake, earth settlement or underground water hydraulic are threaten building we cannot decide about land of strengthening. Of cause it may be per meant or temporal. But in residential complex, water or soil resistance should be considered. Strengthening is one of the main factors which prevent Destruction of great human heritage monuments. Climate, basic construction allocation should be considered in repairmen.

In other words. External elements are considered more than basic and foundational elements. If repayment was carried out basically and based on principles, the level of damages was low. Strengthening topic of brick material is new issue in world. In categories of material, brick is not in good quality, but since it is local material and is cheap, so investigation of its damage and comprehensive studies has been conducted in international institutes. Finding new trend of changing brick into good quality material is carried about in Japan and other international research agencies. Like krayeteh. Brick has low tension capability, researchers seek new trends in enhance cling this capability. After establishing Bam workshop which is the largest and equipped workshops in Middle East, required bricks for repayment of bam citadel by use of local mine and by and of national and international experts have been supplied, so we will see rebuilding of this historical citadel.

INTRODUCTION

living on the earth depends on the mountains and they are conctructed by making mountain operations. Mountain production is also result of the continent move and quiet and alternative fracture of the earth crust. To overview the structure construction resistivity against earthqnake led to design it as properly. To this order, with proper designing, we can to resist in the building against risk of destruction by earthquake.

Pardakht, studied the earthquake destruction in two ways, and said that, earthquake destruction have two forms: fracture in the earth crust and destruction in the structure. By studying the earth crust form and how to establish it, can to be recognized the earthquake occurrence time, place and severity. These studies is done in several years in japan.

DESTRUCTION CAUSE OF THE BRICK-SHAPED BUILDINGS

These destructions are caused by non-hanking in the building foundation and lack of the loading reinforced walls that led to be ruined this city. Since brick made buildings are also lack of the metal framework. All structure loads are transferred on the building loading walls.

And if these walls have not to be reinforced, and not be constructed with regard to the structure load tolerance, they are destructing evan in low earthquakes.

About bam, the baic cause of destractions was that only several buildings has foundation hanking, and their executive operations were done as weak forms, then, when earthquake occurred, buildings were disintegrated, of course, in addition to older building in ban city, many new- constructed buildings under ten years were destructed, because, in despite of having concrete foundation and metal and also semi-metal frame work, these building had not resistance against upper rishter ecrtquake, to the cause of side non-haltering system. Side haltering system in a system than the buildings to be resisted against side loads and pressures of wind or earthgake, and lack of this system is famous in brick-shaped and of brick buildings more than metal frame work ones. In the present circumstances, to execute the side haltering system in bam city bcuildings was not or it has been executed as non-expertly and all causes led to be destructed them wthich they were stable against earthgack, in view of people.

THE REINFORCING WAYS OF THE BRICK- MADE BUILDINGS

basically, the brick-made material rein foreing category is a new ways issue in the world. In view of classification, sun-dried brick is a member of the undesirable materials. But, because, it is cheap and native in many world areas, now, pathology and comprehensive studies about this subject have been regarded by international institutions.

That which is followed in japan and also other international investigation institutions such as kratre, it to find new ways to convert the sun-dried brick to one desirable material. Sun-dried brick have low elasticity. But investigators try to gain new ways to increase this capacity of the sun-dried brick.

The various labs have constracted to overview the material behavior in throughout world. In these experiments, are studied two subjects: material kind and their loading ways. Their loading is done two manners: side and vertical. A successful construction desigher is studying the earth, construction form, loading ways, internal forces rate on constraction and used material charactiristics and recognizing force distribution ways in any points of the building.



Figure: Bam citadel after earthquake

In this case, can to use side forces as su: table loadings, and to prevent its destruction. Construction engineering is working in to four types: heuristics, practical experience, induction and analyse. In the first way, experts are doing based on own views. In the second way, as second stage of engineering science course, the obtained experiments in past and all places are used by civil engineers. Iran is in this stage almost. In recent several decades, aritmatic induction and deduction have been used in the world. In these ways, collected experiments from construction and eath are studied by aritmatic calculations and induction. 6-but, a method that has been a tributed in recent several years in the developed countries, is analytical way. In this way, by using exact aritmatic calculations, anr analysed the material quality and earth type with pressure rate on the construction due to the earthguake to gether. This method has done by computer modeling and have high precision human beings can to produce any materials with per capacity and ability to work at now.

In this age, can to produce the construction that they resist against earthquake forces. With studies on the earth, earthquake rate and place is predictable. Then, construction resistivity against these forces is measurable. For loading in this building, construction units have been connected to gether.

This connection has given special feature to the menar jonban, which it prevents from destraction against earthquake. About older building such as arg-bam, can or must to use from connection factor. The connection in the construction is made by suing the materials such as glss wires. But, befor anylning, we need to recognize the material, earth and past contry engineering. Menar-jonban model in esfahan, can in telligent construction) can to be suitable mode in the brick-made buildings reinforcement for older ones, because this building is a connected constraction. And this factor is very effective to prevent destruction.

With attention to be obvious of ancient layers and construction state variations, archaeology and construcation engineering are very important to gain one strategy and repair and conservation desigh. It is necessary to have various teams such as earthquake, construction, archaeology, architecture, material and urbaning and etc, for educational workshop, and to prepare primavy necessities is important for this workshop. One of rebuilding ways of the brick-made buidings is concrete injection in the sun-dried bricks. Beacus, basically, that is such material with the lowest resistivity against side strains.

Sun- dried brick riesistance against strain is 5 kg in cm² and concrete resistance is about 100 kg in cm². Many countries such taly have worked in this case. And varius monuments have been resisted against earthquake, can to use these experiences and etc. reinforcing possibility in brick-made buildings is with error percent, nad they are experts that they work in this case. But, howere, this project expense must be sustained because to be high expense, can not to do to reinfore the monuments in throughout city. Meanwlile, to resist stome buildings is I taly have low expense relative to the brick-made buildings in iran. Because, to resist stone buildings is possible by concrete injection and rein forcing the stone connection plase. But about sun-dried brick, can not to do this work. Because, it is very vulnerable and it is collapsed with low strain.



Figure: Lack of observance in repair and strengthening

To construct brick-made buildings, is to build homes with metal frame work and brick-made view none the less, can not to build the reinforced brick made constructions against earthquake.

Meanwhile, to build the resisted brick-made buildings against earthquake based on monuments reinforcing systems need to very high expenses. It is possible in one story, and brick-made constructions more than one story are collapsed with the smallest quake also, hanking is necessary to resist these buildings.

Archi valz-scott architect- expert of environmental conservation and Islamic architecture believed that his research is based on special wall construct, that he recognized it in 25 years ago in gala and oman ancient cities and he called it (layer technic) in this technic, sides and basic core of wall includes three layers of sun-dried bricks as clocm diameter are grouted continuously.

I followed this technic in various archaeo logy and architecture projects in several yeares, in different places. And I found it in west-southern iraq to Jordan deserts, from saudia-arabia peninsula to yaman and oman and now in iran from Tehran to bam. In buildings that, I have seen, various compounds have been used from plaster of clay and straw and sun-dried brick, to the grout mixture, lime and stone without layer change.

I saw the oldest sample of this technic in Bahrain. A wall with small square stones had been grouted. This wall come back to soo years (B.A). and it shows that, this technic has tested from 700 years ago. Its advantage is that if its external layer to be damaged, this damage would not be transferred to upper or lower layers. By attention to bam earthquake picture, I am sure that old arg and its castle can be keconstructed and gained to old splendid again.

By recognizing wall construction direction by primary architects can to add other layer to it. It is not effective to cover wall with uniform layer from gatch or to add external layer of cooked-brick ever. Them, when I hear news about to rebuild of building by cement and clay mixture and barbed wire connection, I worry about bam.

Reinforcing is a part of the repairing. It must regard to base, its settlement and climate in the reparining. Building repair is about view more, in other had, it must be attentioned to external view to the basic and base issues.

From construction view, the different buildings need to various reinforcement based on building type, its application and settlement place. For, example, bridge problems about tension is completely different from other building problem such as dome and its damages. The different damages are defined by attention to the building. For this reason, we can not to say, what is threatening a buildings such as flood, earthquake, earth falling down or water hydrolic of water tables of the buildings and what to be must done the reinforcing of course, reinforcing is possibly to be temporary or constant. By using special technics of brick-made buildings resistance and power, can to increase 60 to 70 percent.

IMPAIRMENT MECHANISMS AND STUDYING AND INVESTIGATING AXES IN ARG-BAM

With studies done about now to ruin and primary study about impairment mechanism (cause and effects), it is followed:

I- impairment kind: majorly, two impairment there is in vertical elements or walls and towers.

A: to impair and to separate the connective parts and repaired ones in walls with attention to the impairment in old earthquakes had weatherrings other ruins, castle repairs and basic extensions annexations was not suitable and rains has been created as commonly.

B: by attention to very high volume of loads and debris in back and over stone walls around basic castle construction and to that material dynamical purging and more vertical acceleration, was made impairment as purging with surface fracture level.

2: past earthquake effect in ArG-Bam:

There are older cores of construction with plaster of clay and straw in walls and towers ruined parts, and one wall has made with 1-1/5m thickness in two sides of primary wall, when to reconstruct with all repairment. In effect of recent earthquake, due to weak shear resistance (viscosity and low friction) in annexed walls, wall construction is doing separately and annexed part is ruined commonly cracks kind in the internal cores and plaster of clay and straw shows that destruction isn't erosive and it is caused by event.

That which is important for documentation group, is the present state of ArG-Now, documentations are done with the simplest and primary tools. Possibility is very low, executive managers had to install a computer that it had been found under loads, by this method, reconstructing project is doing. Iran cultural heritage organization, at first step, decides to draw anything, especially deteriorating things.

One important principle in the international domains, is regard to the people will. This building must be reconstructed in saving design, to live national remembrances to conserve genuineness in this case, we decide to form the various special commissions, international committees and educational workshops, to gain to this purpose documentation studies includes of evidences and data collections that there was in this time, and data related to past of ArG. The terrestrial and arial pictures have been collected from the cultural heritage organization documentation center and mapping organization. Of course, part of

these pictures or related films are presented in the media and or even personal album.

Generally, documentation studies in documenting sections includes pathological studies, archaeological anthropology, earth quake science and Geology are related to how behave the brick-made constructions against earthquake.

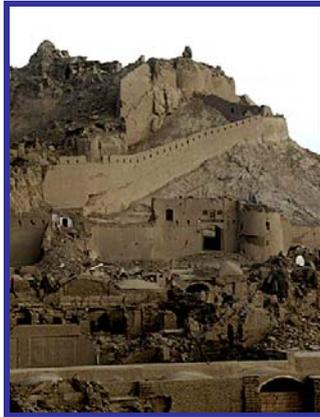


Figure: Pictures of citadek bam after earthquake

CONCLUSIONS

About arg repairing and rehabilitation and by suing technology in related to earthquake, we must to revive past country experiences and knowledyes and cultural technology. We must to take the repairing strategies appropriate with reinforcement based on economical possibilities and to conserve the material nature and architecture related to function, construction and setlelement way. In this case, it is important to find new ways in engineering to safe construction.The exact and comprehensive studies would be determined the desirable reinforcing rate in per sections. Meanwhile reinforcement sense in city level and historical arg is completely different.

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