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# ON SITE MISTAKES

BY

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**Abstract.** Constructions suffer inherent damages during their lifetime. However, there are some damages that develop due to designer, constructor or owner fault. It cannot be said that some are more important than the other and this is way this paper focus only on one of them. Several examples of on site mistakes are presented. The majority of them could have been avoided if the designer recommendations, as well as the current codes and legislation would have been followed.

**Keywords:** execution errors; unqualified labour force; disregarding the designs.

## 1. Introduction

The damages in construction may have several sources. Some of them appear in the design stage and are the result of poor design knowledge or misinterpretation of current norms. In this category are also included the errors regarding the material choice or the computation of the necessary quantities, and also poor detailing. Other damages appear in the execution step. The article will focus on this type of errors, presenting some on site examples. In the third

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category of sources can be included those produced during the lifetime of a building and refer to poor maintenance where the guilty ones are either the owner or those who use the construction. All of these causes are included in a wider category - anthropic damage sources. Another important category is represented by the natural damage sources which include earthquakes, strong wind, floods, landslides and other similar causes.

These sources do not necessary lead to the collapse of buildings, but may introduce various degrees of damage which can affect the security and life safety of the occupants. It is important to know the true cause in order to prevent further degradation or to select the most appropriate rehabilitation solution.

The consequences of a damaged structure could have higher impact on the surroundings and higher number of people could be involved in comparison with other types of accidents like car, naval or aeronautic crash. The losses must be established from both human lives point of view and direct material losses and collateral damages (damages of the gas pipes, fires, floods).

Regardless the construction type – houses, offices, schools, entertainment spaces, people spend the majority of their time inside and they should be safe and ensure the necessary conditions for a good quality of life.

Some of the errors that will be presented could have been avoided if qualified personal would have been hired, if the design prescriptions would have been correctly followed and if the designer would have been asked about changes during the execution process. The main problem is that usually somebody has to pay for the errors – the designer, the constructor or the owner. If the errors are identified in time and corrected accordingly an authorized recommendation, their effect is reduced significantly, if not, like a domino effect, everything can collapse.

## 2. Examples of on Site Errors

As said previously, the workers experience, as well as the coordinating engineer are fundamental in order to minimize the errors which can appear in the execution process. In other words, an experienced team could significantly reduce the eventual execution errors.

Among the most frequent on-site errors is the disregarding of details drawings from the designer. In this category are included the changes in the overlapping lengths of the reinforcement, the anchorage length and subtracting or adding openings.

A kind of error with which the authors came across on a construction site it concerned the missing of a foundation axis. In order to solve the problem supplementary measures had to be taken to connect the forgotten foundation

beam. The additional cost had to be supported by the builder, as it was his mistake.

A dangerous usual practice on the Romanian construction sites refers to changing the concrete class to an inferior one or purchasing lower diameters than those given in the designer drawings in order to reduce costs and to increase the profit for the builder. This is done with a high risk as both of them contribute to vulnerability increase and their effects are noticeable in time. A more damaging practice is to threw rocks into the fresh concrete foundation. This is used in order to reduce the concrete quantity, but with the risk of damaging the foundation reinforcement and to reduce its carrying capacity.

Using the unqualified labour force may lead to big errors as you can see in Fig. 1. What anyone should notice first is the mess on the construction site. Frameworks, wood pieces and nails are left randomly representing a real danger for anyone entering the location. Another huge mistake refers to the way some of the hollow bricks had been positioned – in order to obtain the required openings, the workers placed some of the bricks on horizontal direction, when they should have been put vertically. The main question should be: Who is to blame? Maybe the person in charge with the construction site, but also the one who made the brick walls. There will be some who might say that the mistakes are not that important and even though the structural system is represented by masonry system, the structure is not significantly affected. With all this a similar construction site might hide more mistakes which can seriously damage the structural safety of the construction.

Fig. 1 – On site error due to unqualified workforce.

There are many other more dangerous and expensive mistakes, as is the case of the gym construction from Fig. 2. The builder started to install the

arches without considering their large openings and the necessity to introduce coupling braces between the truss arches during the execution process. The general collapse, Fig. 3, was the result of this approach, obtaining a giant steak of elements impossible to reuse. Maybe some will wonder where was the designer and the technological sheets?! It is true that the designer has his fault also because he did not give complete information, but any builder should not have started such a construction without taking the necessary measures in order to be able to correctly assemble the structural system of the roof.

Fig. 2 – Truss arches roof system assembly without assuring lateral stability of the elements.

Fig. 3 – General collapse of the roof system.

A case which lead to major damages happened in Shanghai, China, in June 2009. The collapse of a 13-story apartment building occurred due to major construction errors which lead to the death of a worker. As it can be seen from Fig. 4 on the south side an underground garage was being dug to a depth of 4.6 m. The excavated dirt was put on the north side, to a height of 10 m. In this case, the building experienced an uneven lateral pressure from south and north to which heavy rain contributed with water seeping into the ground. The final result was that the building tilted and the hollow pillars with no rebars were snapped (http://hoax-slayer.com/13-story-buliding-collapse-china.shtml). The big distance from the closes building prevent a domino effect collapse. This error is common mainly due to insufficient reinforcing measures from the ground in case of excavations close to existing buildings.


Fig. 4 – Collapse building due to construction error (http://hoax-slayer.com/13-story-buliding-collapse-china.shtml).

Another outrageous case happened in Taiwan and was reveal by an earthquake. On the 6$^{th}$ of February 2016 a 6.4 degree on Richter scale and VII on Mercalli scale earthquake occurred 43 km far from the closest city, Pingtung, in the south part of Taiwan. This country lies near the junction of two tectonic plates and often sees tremors due to the fact that these plates slide with 80 mm

each year. The majority of victims occurred in Yongkang neighbourhood due to the collapse of Weiguan Jinlong residential building, Fig. 5 (http://www.deccanchronicle.com/world/asia/090216/developer-quizzed-over-taiwan-quake-collapse.html). The 16-storey building was a relative new one. After the collapse, large cans and foam appear to complete the complex concrete framework in post disaster photos, Fig. 6 (http://kuow.org/post/photos-cans-inside-taiwan-buildings-pillars-help-spur-call-safety-reviews). A structural engineer stated that prior to September 1999 it was not illegal to use cooking oil cans in order to fill out pillars/walls and make them look larger, but after they were replaced by styrofoam and formwork boards. The collapsed building (also called Golden Dragon) was completed in 1994. Currently the Court of Tainan are looking into this case in order to establish who is to blame.

Fig. 5 – Collapse building in Taiwan, 2016.

The building collapse raises questions regarding the construction quality in the area.

Beside the facts, some statements were given which suggest a more complex collapse cause. Firstly, the height of the structure does not follow the characteristics of the area (the majority of the surrounding buildings have only 3 floors). Secondly a team of experts noticed that the building collapsed to the east, where the ground floor had shops, which by their particularities damaged the building stiffness in elevation, leading to a weak ground floor. Thirdly, the execution firm went bankrupt which can significantly influence the quality of

used materials. Fourthly, experts consider that the ground shape, U shape, contributed to the general collapse of the building. Fifthly, the liquefaction of the foundation soil contributed to the disaster, as it is considered an irregular shape. Finally, these points of view were confirmed by an international expert team which investigated the site. Until a final verdict is given, it can be assumed from the photos that is the case of a huge error occurred during the execution process.

Fig. 6 – Cans in the structural walls of the collapse building in Taiwan, 2016.

Another case which lead to cost increase has to blame the constructor, the owner and the code. If the first two can easily be found, one can wonder who is paying for the code? During the execution process, after removing the framework of the columns from the ground floor, it was noticed that sawdust was inserted in the upper part, Fig 7. It can be stated that in this case, the structure was constructed with initial plastic hinges.

Fig. 7 – Damage structure due to sawdust in the ground floor columns.

The construction work stopped in order to find an appropriate solution. In this period, the owner decided to add a supplementary level and a smaller one. During the redesign work process, the seismic code changed from P100-2004 to P100-2006. The changes in the norm moved the importance class of the building from III to II, which increased the seismic force by a 20%. In order to increase the building safety and to include the changes it was recommended to introduce structural walls. The supplementary costs were divided between the constructor and the owner.

## 3. Conclusions

As the Latin saying "Errare humanun est" (It is human to make mistakes) it is recommended to take all the necessary measures to reduce them. In order to do this, sometimes is necessary to only follow the current regulations and laws. However, huge mistakes occur around the world affecting a very significant number of people on short or on long term.

The effects of the mistakes occurred in the building process may vary from minor cost issues to non-fulfilment of the fundamental strength and stability requirements. Reducing the number of mistakes can be achieved through an ample process that has to be initiated during the training of engineers in the faculties and continued by training and specialization of workers, by increasing the rate of controls from the state institutions and by improving the legislation in the field.

Discussions regarding mistakes in building activities and their effects can lead to the increase of the understanding level of the risks involved and contribute to the reducing of the mistakes frequency.

Further research will be done in order to present other types of errors that can occurs regarding the building execution and maintenance.

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GREŞELI DE EXECUŢIE

(Rezumat)

O construcție suportă degradări inerente pe durata de viață. Cu toate acestea, sunt unele degradări care apar din vina proiectantului, executantului sau beneficiarului.

Nu se poate spune că una este mai importantă decât alta şi de aceea acest articol se va concentra doar pe unul din factori. Vor fi prezentate mai multe cazuri de greşeli de execuție. Majoritatea ar fi putut fi evitate dacă se respectau recomandările proiectantului, cât şi normele de proiectare şi legislația în vigoare.