

# THE ADVANTAGES OF STEEL IN BUILDING CONSTRUCTION REGARDING THE ENVIRONMENTAL IMPACTS OF BUILDING MATERIALS

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## Abstract

*Besides the other advantages of steel, it really worth to note that the environmental advantages of constructional steel is gaining a very big importance as the sensitivities of societies for the green environment is increasing each day. It is commonly accepted fact that the steel presents a lot of positive environmental impacts as being the effective reasons of consumer preferences regarding; sustainability, refurbishment, recyclability and reusability issues. Therefore; the detailed considerations of these environmental concepts in relation with different practices and construction facilities in different countries are actually important. Recyclability and reusability properties can become very important factors, if the waste management and landfill of building wastes becomes a problem. Waste management may become a serious concern after the earthquakes, if the buildings are not resistant enough and made of brittle materials which are relatively difficult to process comparing with the recyclable and reusable material steel. So the paper will discuss the main environmental benefits of using constructional steel. In this regard; possibly encountered difficulties for a proper waste management of irreparable building stock made of massive and brittle building materials like concrete and brick will be explained. The subject will be discussed in comparison with the advantages offered in using steel as the alternative environment friendly building material. Some important environmental issues will be evaluated in considering the practical cases experienced during the latest earthquakes occurred in Turkey.*

## **1 THE GREEN BUILDING CONCEPT AND THE NEED FOR THE ENVIRONMENTALLY SOUND STRUCTURES**

It is an accepted fact that, all human beings have a responsibility for the protection of the environment as being the most precious entity for the world of today and for the future generations. Within this context, as the world population grows faster than before, increasing amount of material consumption creates also the problem of increasing waste and increasing pollution. Therefore it is almost a common goal for the societies to prefer consuming environment friendly products in their daily lives. This delicate approach is a determining factor for the consumer preferences of all types products in all segments of the market. On the other hand; construction industry can be accepted as one of the important users of material and energy. That is why it gains a big importance for this sector to consider energy savings, renewable raw material usage and minimisation of the pollution as much as possible. Regarding these important environmental impacts of construction industry, steel construction can be accepted as a very advantageous construction method. Comparing with the concrete buildings, steel structures have lower negative environmental impact concerning the energy use, raw material consumption and created material waste. Sustainability of steel as the construction material supports its strong position against the other building materials as well.

## **2 THE IMPORTANCE OF BUILDING SYSTEM AND ENVIRONMENTAL CONCERNS IN THE EARTHQUAKE COUNTRIES**

Considering the natural disasters threatening human life by causing structural failures of buildings for many years, earthquake is very important one of this kind of disasters regarding its damages.

Turkey is an earthquake country taking place in a highly effected seismic zone. As it is well known, there are some major seismic faults originated from the movements of the specific continental plateaus with respect to each other. The North Anatolian Fault in Turkey is one of these important faults which caused serious earthquakes in the history of the region.[1] The latest earthquake occurred on 17'th of August 1999 with  $M_s=7,8$  Richter scale magnitude has been sourced from this fault and affected The Marmara Sea region of Turkey creating a very serious damage afterwards. It must be stated that, this earthquake was the second biggest earthquake affecting the region up to now and caused thousands of life loss and great material damage behind. 50 thousands of reinforced concrete buildings are heavily damaged in 5 main cities of the region. On the other hand, it is a known fact that human loss was mainly caused by collapsing heavy buildings which were either not designed according to the related seismic design code or not constructed properly at the required structural performance.

Obviously this was not a natural outcome but, unfortunately a human failure. Therefore the public opinion and the related professional groups has started to discuss the alternative building methods and building materials together with the other improvement measures to be considered for the conventional design and building systems in the country. Despite the high potential value and dynamic structure of the construction market in Turkey, the amount of steel consumption as being a very competitive building material can not be considered to be at the desired level. Reinforced concrete buildings constitute the highest portions of the construction preferences as the traditional way of building system in the country. That is why the considerations of earthquake resistant, flexible, light weight and environment friendly steel building systems for the commercial and residential area are gaining a big importance as the new construction alternatives at this stage in Turkey.

On the other hand; one of the biggest problems encountered after an earthquake is the demolishing of collapsed or heavily damaged buildings. If the damaged building stock is consist of medium-rise buildings made of heavy and brittle construction material just like reinforced-concrete buildings, it is not easy but a real big concern to manipulate and demolish heavily damaged buildings and remove such a bulk material waste afterwards. Actually this is a big serious environmental issue both considering environmental contamination during demolishing and waste removal stage and considering the created landfills which are the real damages to the nature. Although there are also recycling methods for reinforced concrete and brick type materials as well as for the others, it is not easy to put such a process into work while the time and recycling facilities are very limited for such a huge amount of building materials after an high intensity earthquake. Actually practising a recycling process for such a huge number of material stock requires very big stock and handling areas, many recycling plants and long periods to proceed. Naturally this serious environmental problem has been lived in Turkey for the required handling, demolishing and landfill stages of collapsed or irreparable buildings and their material waste after the latest earthquakes. These are why this environmental issue must be taken into account when making the preference for building system and building materials for the earthquake risking areas.

When considering this environmental case for building material selection, constructional steel comes forward as being a very competitive and advantageous building material which can be easily dismantled, repaired, fixed and reused in parts whenever required. Steel is also very suitable building material for economical material design. It can be economically used in different sectional sizes of hot rolled or light gauge forms either as framing member or as the complementary building parts.[2] Especially it became a wide application to use light gauge steel framing for residential construction successfully in many countries. This construction system presents a lot of advantages in the residential area concerning the advantages of dry-wall construction, prefabricated or panel type framing systems, easy and fast construction and environment friendly and energy efficient buildings.[3]

### **3 ENVIRONMENTAL BENEFITS OF CONSTRUCTIONAL STEEL WITH THE RELATED INDUSTRY FIGURES**

Steel is % 100 recyclable material without degradation and its recycling rate can go up to beyond % 60 for the constructional steel in some countries.[4] Magnetic separation utility gives an advantage to steel for the removal of material from the other surrounding solid wastes. It is also very important to note that, promoting steel as the alternative way of building system against wood is a very positive and

effective environmental approach in considering the destruction of trees and thus the scarcity of our forests. While it is predicted that the iron ore resources will last 7 million years with today's mining activities; it is not easy to renew the diminished forests especially within a short period of time. It is also important for our environmental values to note that; the energy need to produce 1 ton of scrap-based steel is about one fifth of the ore-based steel. From life-cycle perspective, materials may have down-cycling property which produces lower grade materials. Actually steel is the only material with a closed material loop which is an important advantage when compared to many down-cycled materials. It can be % 100 recycled to the same product, function and quality as before. It is also possible to convert the recycled steel into another metal product easily depending upon the industrial needs and market demands. More than 435 million tonnes of steel are recycled each year. On the other hand, steel industry is spending a great effort to bring the emission levels much more down the upper limits. Almost all the constructional steel products contain recycled steel. In general a new steel framing material contains % 28 minimum recycled steel.[4] So, it must be realised that the constructional steel which becomes a post-consumer recycled material in the future also supply us an important advantage in saving landfill spaces and contributing to the conservation of our nature.

It is also another effecting figure that 200 square meters of steel framed house can generate as little as one cubic meter of recyclable scrap during the construction. When 1 ton of steel is recycled, 1100 kg of iron ore, 635 kg of coal and 55 kg of limestone are conserved. Steel is also energy efficient. Framing with steel consumes only % 6,3 of the total life-cycle energy used by a home; while the rest is consumed by heating, cooling, refrigeration and lightning. The determining factor in the energy lifecycle of a steel framed home is the quality of the installation of the selected insulation system. Steel framed homes can be build thermally efficient by choosing a proper insulation system and material.[5] Actually it is possible to design and build thermally efficient houses with required indoor atmospheric conditions, air-tightness and steel roofing with reflective finishes saving the energy by keeping the building cool during the hot days. Since the steel framing members are not treated with chemical substances like pesticides or toxic materials to protect the building from rot, termites and vermin as in the case treated lumber; they don't cause the contamination of the nature.

As far as the environmental issues are concerned; whenever we can reuse a material instead of producing a new one by using raw materials, even these raw material are also recycled; we can save on resources and energy which are the real gains for the conservation of nature. When we consider the importance of this fact, it is quite obvious that constructional use of steel offers great advantages concerning the refurbishment and reusability properties. Refurbishment projects which are used in many applications in many countries are especially preferred for being a dry construction creating a clean and waste free working environment. In most of the cases, this type of construction also allows refurbished buildings to be operational during the construction work which is also a very big advantage.

## **4 CONCLUSION**

Constructional steel presents a lot of positive environmental impacts regarding its sustainability, refurbishment, recyclability and reusability issues. It also presents a lot of advantages in making energy efficient buildings. Additionally, when considering the earthquake resistant, durable and easily reusable or dismantling buildings; steel construction becomes a very strong building alternative. It gains a special importance concerning the required structural performance, damaged building reinforcement and waste material management especially in the earthquake areas. As a result, it is important to note that; constructional steel must be continuously promoted as a strong alternative building material in the global construction market in order to convince building owners, the design community and building contractors to built in steel against the other traditional building systems.

## **5 REFERENCES**

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