



WHY WERE OVER 5500 HUMAN LIVES LOST IN KOBE? HOW TO PROTECT IN FUTURE.

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SUMMARY

The fundamental object of earthquake engineering, to protect human life against unavoidable natural disaster earthquake, was not attained at the recent Kobe Earthquake. There were lost over 5500 human life under peaceful asleep in their sweet homes. The fundamental object was not attained, in spite of the early warning of the existences of such dangers by the auther and in spite of highly advanced knowledge of earthquake engineering. The main reason of this tragedy is that almost all of these killed dwellers lived in "Illegal Past-Permitted Old Weak Houses". The Building Standard Law System in Japan allows the existence of such "Illegal Past-Permitted" Old Weak Houses as the exemption from the application of the amended new Enforcement Order which was based upon the newly developed results of earthquake engineering. The retrofiting of these weak houses are very important and urgent problem to be solved, but it is very difficult because of the high expences. Only by the efforts endeavor of owners of retrofiting of dwellers may be perfectly impossible to retrofit their "Illegal Past-Permitted" Weak Houses. This difficulty is clearly shown the fact that the promotion of retrofiting in the cities of Tokyo and Yokohama, Japan, have made no progress in these three years at all untill today. Without retrofiting of "Illegal Past-Permitted Weak Houses", it will be perfectly impossible to realize the fundamental object of earthquake engineering, to protect human life against earthquake.

INTRODUCTION

How to protect human life against earthquake is no doubt the fundamental object of earthquake engineering. However there exist very many barriers to realize this object. At the recent Kobe-Earthquake there were lost over 5500 human lifes under their destroyed houses, in spite of warnings from highly developed knowledge and technology of earthquake engineering. The purpose of this research is to make clear the cause of this tragedy, i.e. the barriers to obstruct the practical application of advanced antiseismic technology, to protect human life against earthquake.

2. OBJECTIVES OF EARTHQUAKE ENGINEERING

The objective of earthquake engineering is no doubt to Protect Human Life against unavoidable natural disaster Earthquake. No one may raise any objection to this fundamental objective of earthquake engineering.

Therefore, late Newmark and Hall stated on this objective that, under all circumstances the margin should be sufficient to avoid calamitous failure with attendant loss of life or major personal injury even if the extreme maximum intensity of earthquake that can be expected in the region should occur. This philosophy implies different margins of safety for different types of structures [Newmark and Hall, 1968]. To realize this fundamental object of earthquake engineering, to protect human life against earthquake, the synthetic cooperative works, not only our earthquake engineering and seismology•from the natural scientific side, but also administrative power and treatment•from the social scientific side, must be carried out. Only under the over all cooperation of all these fields, the final fundamental object of earthquake engineering•to Protect Human

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Life may be achieved. However, if any one of these fields, to cooperate against earthquake, are missing, the objective to Protect Human Life may not be achieved.

3.WHY HAD LOST OVER 5500 HUMAN LIFE IN KOBE ?

3.1 Why Couldn't Avoid Such Calamitous Loss of Life in Kobe ?

Japan is believed generally to be as one of the good advanced safe country at the earthquake disaster, through the development of earthquake engineering. In spite of such common recognition, why had lost so many human lives at the last Kobe-Earthquake ? Why couldn't avoid such calamitous loss of life ?

3.2 Legal State of Buildings in Japan

At the last Kobe-Earthquake, Japan, there were killed over 5000 residents under peaceful asleep suddenly and instantaneously in their sweet homes early in the morning 5:46 am. 17. Jan. 1995. They were not acquainted at all with the fact that their legally permitted old homes in the past were too weak against earthquakes. Their homes were already once confirmed at their building time, by building official that their homes conform to the provisions of the Building Standard Law of Japan at that time (Article 6) as well as orders and ordinances, and were built before the amendments of its Enforcement Order (Cabinet Order No.196), Jul. 14. 1980, which requires about five times stronger seismic resistance than before the amendments (standard shear coefficient from 0.2 to 1.0 as retained horizontal strength) in the Article 88. However, the Building Standard Law of Japan (Law No.201, May 24, 1950) allows the existence of such "Illegal Past-Permitted Old Weak Building" (after the amendment of Law) in the Article 3. (Exemption from Application) The provisions of this Law or those of orders or ordinances based thereon shall not apply to buildings coming under any of the following items :

2. In case where buildings or sites thereof which are actually existing or under construction, repair or remodeling at the time of enforcement or application of the provisions of this Law or those of orders or ordinances based thereon, do not conform to those provisions or have unconformable parts, the said provisions shall not apply to such buildings, sites of buildings, or the parts of such buildings or sites thereof.

Such weak buildings, built before the amendment of the Building Standard Law Enforcement Order (Cabinet Order No. 196, Jul.14, 1980), were named "Illegal Past-Permitted Old Weak Buildings".

3.3 "Illegal Past Permitted Old Buildings" in Japan

Almost all the killed of over 5000, at the Kobe-Earthquake dwelt in such so called "Illegal Past-Permitted Old Weak Houses". Japan is believed, together with the United States, one of the most advanced country in the field of earthquake engineering. In spite of such advanced level of the science and technology in earthquake engineering, why had so many dwellers were killed at the Kobe Earthquake ? The fundamental objective of earthquake engineering "to avoid loss of life" was not attained at all at the Kobe Earthquake! It's a shame of civilized country!

It is a matter of common knowledge that, at the occurrence of accidental death, to make clear the cause of accident, is the first step to prevent the next accident.

It must be clearly recognized by the peoples who concern earthquake disaster mitigation the fact that over 90% of the died people at the last Kobe-Earthquake were killed under their so-called "Illegal Past-Permitted Weak Houses".

How nonsense discussion, leaving out the "Illegal Past-Permitted Weak Building especially Weak House" which caused over 90% of the death, at the discussion of earthquake hazard mitigation problem. Why exist so many such weak "Illegal Past-Permitted Houses" in Japan? It must be the main problem to protect human life. How to protect human life against earthquake, is the most important fundamental problem. The most important lesson from the last Kobe Earthquake is that the existence of so many "Illegal Past-Permitted Weak Houses" in spite of the fairly good developed country in earthquake engineering. Why so long years were been left their houses so

weak states and were been left so many peoples without legal protection against earthquake hazards in their dwelling houses.

3.4 Statistics of Examination of Corpse

Statistics of examination of corpse at the Kobe Earthquake in Kobe City by coroner Dr. Med. Yasuhiro Ueno, ass. Prof. Kobe Univ. [Ueno, Y. (1996)] indicates in the examined 3658 corpse in Kobe City,

Table1: Statistics of Examination of Corpse (By Coroner Dr. Med Ueno)

Place of death	in own house	3167 (86.6%)
Time of death	5:50 6:00	2944 (80.5%)
	in 17.Jan.	3547 (97.0%)
Cause of dceath	crush	3256 (89.0%)

Table2: Statistics of Number of Death (17. Nov. 1995) (By Hyogo-Police Head Quarters)

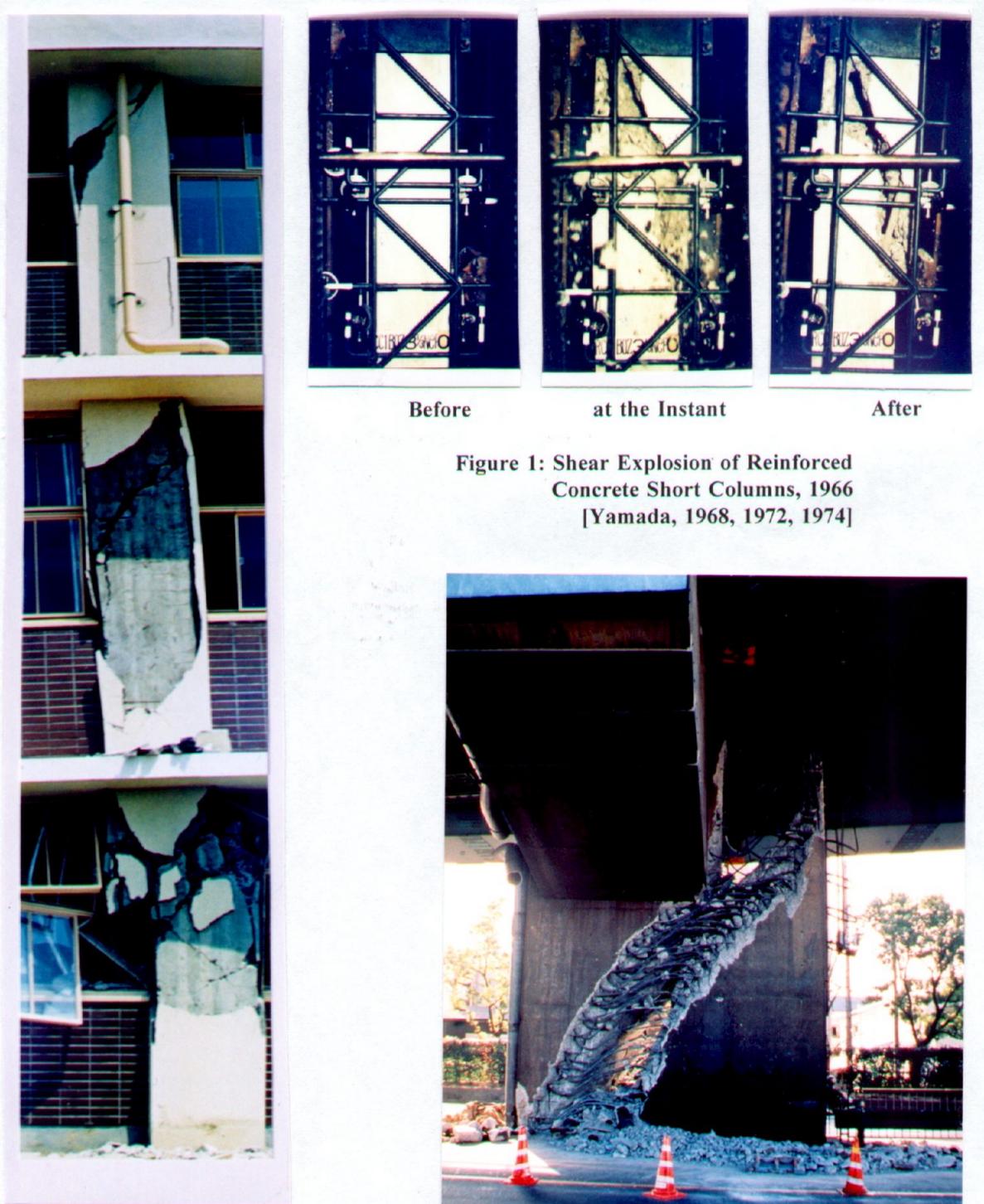
Hyogo-Pref.	Kobe City	3,879
	Ashiya City	396
	Nishinomiya City	999
	the rest	188
		5,480
Osaka-Pref.		21
Kyoto-Pref.		1
		5,502

These statistics show very clearly the importance of "Illegal Past-Permitted Old Weak House "Problem at the Kobe Earthquake.

3.5 Warning on the Existence of Collapse of so called "Illegal Past Permitted Old Weak Buildings"

The author had poited out and had given his warnings on the existences of dangers of collapses of buildings under earthquakes since the Tokach-Oki-Earthquake [Yamada(1968)(1972)(1974)(1976)(1983)(1990)(1993)] in the northern Japan 16. May. 1968. The author had proved and insisted his earthquake design theorem to apply 1.0G as excited horizontal earthquake load for lower and medium height buildings i.e. five times larger value than the current legal design value 0.2G. The proposed design value by the author demands the cross sectional area of Reinforced concrete aseismic walls in 3 story reinforced concrete buildings about 0.005 of building area, which was indirectly proofed by the destroyed reinforced concrete school buildings with little wall ratios than 0.005 at the Tokachi-Oki-Earthquake 1968 [Yamada(1976)], [Yamada and Kawamura, 1973a. b, 1976,1977]. The proposed design value 980 gal as horizontal excited acceleration of the auther as the aseismic design value of lower and medium height buildings was proved directly by the measured excited acceleration value of seismograph at the 9th. story of Tohoku Univercity, Sendai, [BRI, Japan (1978)], [Yamada(1980)] Japan at the Miyagiken-Oki Earthquake 12.June 1978, in the northern Part of Japan .

As the case of collapse of wodden houses at the Kobe Earthquake, they say that their old wooden houses were weakened by termite (white ant) and mold or lack of bracing. There were naturally existed some of such cases, but these cases were not the greater part.



Before at the Instant After

Figure 1: Shear Explosion of Reinforced Concrete Short Columns, 1966
[Yamada, 1968, 1972, 1974]

Figure 2: Misawa Commercial High School,
Tokachi-Oki. EQ., Japan
16.May. 1968
[Yamada, 1968, 1972, 1974]

Figure 3: Hanshin-Express Highway
(Designed 1966)
Kobe-Earthquake
17. Jan. 1995
[Yamada, 1996, 1998]

4. THE ESSENTIALS OF EARTHQUAKE DISASTER MITIGATION

In order to protect the human life against the collapse of their house by the unavoidable natural disaster earthquake, it must be given naturally their house sufficient resisting capacity against earthquake excitation. Prevention of the collapse of houses from earthquake excitation is the fundamental way of earthquake disaster mitigation. The first step to realize this earthquake disaster prevention, is to diagnose the existig houses whether they have sufficient seismic capacity or not. If their houses have not sufficient aseismic capacity, then they must be strengthened.

Through the strengthening of these weak existing houses, the fundamental object of earthquake disaster prevention "Protect of human life" may be attained. "Prevention of the collapse of houses by the strengthening" is the first step of earthquake disaster mitigation.

4.1 Disaster Mitigation Council in Hyogo Prefecture

The auther had advised Prefectural Governor Mr. Tokitada Sakai to establish Disaster Mitigation Council in Hyogo-Prefecture. Then, under Prefect. Gov. Sakai, in Hyogo Prefecture office, the author had founded the Disaster Mitigation Coouncil in Hyogo-Prefecture in the year 1978, and had given his warning on the existence of dangers of collapse of buildings under earthquake. He had advised at the first coucil meeting the necessity of urgent retrofitting of weak buildings, especially at first, fire stations, hospitals and school buildings, in Kobe, with the slides of the destroyed ambulance car under the fallen down roof of the Olive View Hospital, at the San Fernando Earthquake, U.S.A. 7. Feb. 1971.

In the Hyogo-Regional Disaster Mitigation Manual in Hyogo-Prefecture, the necessity of retrofitting of Illegal Past-Permitted weak buildings, was clearly indicated.

In spite of the advices and efforts of the author, retrofitting and strengthening of fire stations, hospitals and school buildings in Kobe City were not carried out. His advices [Yamada, (1976, 1983, 1990, 1993)] to retrofit the "Illegal Past-Permitted Weak Buildings" were perfectly neglected.

4.2 Retrofitting Works before Kobe Earthquake

Until the Kobe Earthquake 17. Jan. 1995, there were no retrofitting works of such weak buildings not only private but also official buildings because of such Illegal Past-Permitted buildings may exist by the Building Standard Law of Japan Article3, (exemption from application). As a result, at the Kobe Earthquake 17. Jan. 1995, main fire stations Ikuta and Fukiai and West Kobe City Hospital in Kobe City were destroyed and could not fulfil their functions, or even Hyogo police office in Kobe City were collapsed and a police officer was died under collapsed Police office building.

Article 3 in the Building Standard Law of Japan allows the existences of "Illegal Past-Permitted Old Weak Buildings" as exemption from the application of new amendment of Law which is based upon the newly developed knowledge of seismic engineering •newest result of scientific research•severe than the former one.

As a consequence very many "Illegal Past-Permitted Weak Old Houses" were left as Illegal but without retrofitting and were left without the protection of Building Laws and newest results of scientific research of earthquake engineering. Finally these old weak houses were destroyed by the Kobe-Earthquake and killed many human life.

5. BUILDING POLYCY ON THE ILLEGAL PAST PERMITTED WEAK BUILDINGS AFTER KOBE EARTHQUAKE IN JAPAN

5.1 Law of Promotion of Aseismic-Retrofitting of Buildings

Japanese government (Ministry of Construction) had legislated the "Law of Promotion of Aseismic Retrofitting of Buildings" as Law No.123, Oct. 27.1995, after 9 months of Kobe Earthquake. The purpose of this Law is to promote the retrofitting of buildings to safeguard the life, health, and property of people from the collapse of buildings by earthquakes in the Article 2. (efforts endeavor of owners of retrofitting of specified buildings)•school, gymnasium, hospital, theater, grand-stand, assembly hall, exhibition hall, department store, and office buildings, on which the Article 3. of the Building Law of Japan, exemption from application after the amendment of orders or ordinances are applied, i.e. specified buildings•so called "Illegal Past-Permitted weak Buildings".

The owners of such specified buildings must give their efforts to diagnose the antiseismic capacity of their specified buildings and in the case of necessary to retrofit their specific buildings in the Article 2 of this Law of Promotion of Aseismic-Retrofitting of Buildings. This new Law of Promotion of Aseismic-Retrofitting of buildings after 9 months from the Kobe Earthquake only request the endeavor of owner of such specified, so called "Illegal Past-Permitted weak Buildings" to be examined by the diagnosis and to retrofit their specific buildings. The retrofitting of these Illegal Past-Permitted weak Buildings are not forced but only are expected the efforts of owners.

Dwelling houses are excluded from this Law of Promotion of Aseismic-Retrofitting of Buildings. Only some change of the rate of interest, as a special case of the Government Housing Loan Corporation Law, is indicated in the Article 10 of this Promotion Law.

5.2 Retrofitting of Government Buildings in Japan

By the legislation of this new Law of Promotion of Aseismic-Retrofitting of Buildings, many a "Illegal Past-Permitted Weak Government Buildings" become possible to be examined officially at the first time their aseismic capacity and to be retrofitted officially drawn up a budget at the first time, not only the Government office but also the official residence of the Prime Minister! Too late but it's fine itself!

5.3 Retrofitting of Dwelling Houses in Japan

However, the "Illegal Past-Permitted Weak Dwelling Houses" of peoples are left again from the protection of the amended Building Standard Law Enforcement Order, based upon the newest results of seismic engineering. The main cause of loss of over 5000 human life "Illegal Past-Permitted Weak Houses" at the Kobe Earthquake are not removed at all.

5.4 Efforts of Diagnose and Retrofitting by the Cities of Tokyo and Yokohama and its Results

The Tokyo Metropolitan Government had prepared (7,200 Million yen • 60 Million Doller (\$1.00 = \120)), for provide the interest to 2000 houses according to the Article 10 of Promotion Law of 1995. However, there were no applicant to this provide of interest after 1 year of the issue of this Law, i.e. end of 1996 [Soeda, 1997], and after 3 years yet there were yet no applicant of loan for retrofitting [Soeda, 1998].

There are yet 14 Million "Illegal Past-Permitted" Buildings in Japan in the year 1998. Dwelling Houses in them, are reported 12 Million and Wooden Houses in them are 11 Million [Minemasa, 1998]. Retrofitted buildings were only 802 in "Illegal Past-Permitted" 14.4 Million Buildings in Japan at the end of sep. 1998.

City of Yokohama, one of the most advanced city of retrofitting policy of houses, free of charge to Anti-seismic Diagnosis of houses inYokohama, had finished the Anti-Seismic diagnosis of 5350 houses in 270,000 Illegal-Past-Permitted houses. 40.7% of the examined 5350 houses were somewhat dangerous and 29.9% were dangerous and only 30% were safe [Soeda, 1998]. The number of Anti-Seismic Capacity Diagnosis in Yokohama City was 2101 at the end of 1996 decreases to 738 at the end of 1998 [Kiyonaga, 1999]. These facts indicated above show the fact that it may be very difficult to realize the retrofitting of Illegal Past-Permitted weak-buildings, especially dwelling houses only by the efforts endeavor of owners.

5.5 Present State of Dangers to Lose Life under Illegal Past-Permitted Weak Houses in Japan

Almost all the Illegal Past-Permitted weak Buildings in Japan remain weak now yet without diagnosis and retrofitting. If a similar earthquake, like Kobe Earthquake, attack Japan again, the dangers to lose life under Illegal Past-Permitted weak houses are not decreased at all.

The purpose of the Building Standard Law of Japan is to safeguard the life, health, and property of people indicated, in its Article 1. But this fundamental purpose is not attained by the Article 3, to allow the existence of Illegal Past-Permitted weak buildings, in spite of the amendment through the development of seismic engineering.

Article 3 in the building Standard Law of Japan ignores not only the development of aseismic engineering but had caused so many loss of human life at the Kobe Earthquake 17. Jan. 1995 and will result more loss of human life in the future.

Warning on the existence of dangers of collapse under earthquake was given already 30 years ago by the author [Yamada, 1968, 1974]. Amendments of Building Standard Law Enforcement Order, reflecting the advances of seismic engineering, was given 20 years ago.

The Exemption from the application of the development of science and technology in earthquake engineering in the Article3, and delay of building policy, results the loss of human life on the contrary of the fundamental purpose of Building Standard Law of Japan to safeguard the human life.

6. WARNING AND ADVICE BY THE AUTHOR AGAIN

The author would like to give again his urgent warning on the existence of collapse dangers of "Illegal Past-Permitted Weak Buildings" especially "Weak Houses" like the calamitous death in Kobe and to advise to begin more effective policy and administrations to retrofit such "Illegal Past-Permitter Weak Building", to apply the results of recent progress of earthquake engineering. Without such effort, it is impossible to realize and to attain the fundamental object of earthquake engineering to protect human life against unavoidable natural disaster earthquake.

CONCLUSIONS

Over 5000 human life were suddenly lost by the collapse of their "Illegal Past-Permitted Weak Homes" at the last Kobe Earthquake 17. Jan.1995. in their peaceful asleep. The existence of "Illegal Past-Permitted Weak Homes" are allowed as exemption from the amended new Standard Law Enforcement Order in the Building Standard Law of Japan, which were based upon the development of the science of seismic engineering, but results the collapse of homes in spite of the warning from the development of seismic engineering.

The delay of the political treatment of such "Illegal Past-Permitted Old Weak Houses" results the los of human life under earthquake. The fundamental purpose of Building Law is to protect human life against earthquakes. The loss of huma life at the lat Kobe-Earthquake were caused by the existence of "Illegal Past-permitted Old Houses".

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