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Disaster medicine center to a big earthquake in TMA – Construction engineerings to provide disaster medicine

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ABSTRACT: The 1923 Kanto eathquake in Japan produced a large number of casualties. If a similar quake were hit present day in kanto region, medical functions of hospitals filled with patients would be destroyed with people unable to provide care. As a protective measure against medical facilities damage, the systems of disaster medicine operation center with latest engineering technologies such as a base isolation system (BIS), an interstitial space ceiling system (ISS) and temporary ward system has been developed. These systems serve to prevent damages to medical functions in the event of a big earthquake.

1 PURPOSE

At the time of the Kanto Earthquake of 1923, the Tokyo Metropolitan Areas(T.M.A) suffered great damage from the main shock and the aftershocks. Medical facilities were destroyed totally with people unable to provide care in the earlystages of the earthquake.

Dr. KAWASUMI of Japan has deduced from the past statistics that there is a 69-years cycle (err margin:10 years) of big earthquakes in the T.M.A.. The next big earthquake is due any time now.

If a similar severe quake were hit present-day in Kanto region, since medicine as practised in hospitals today uses the latest

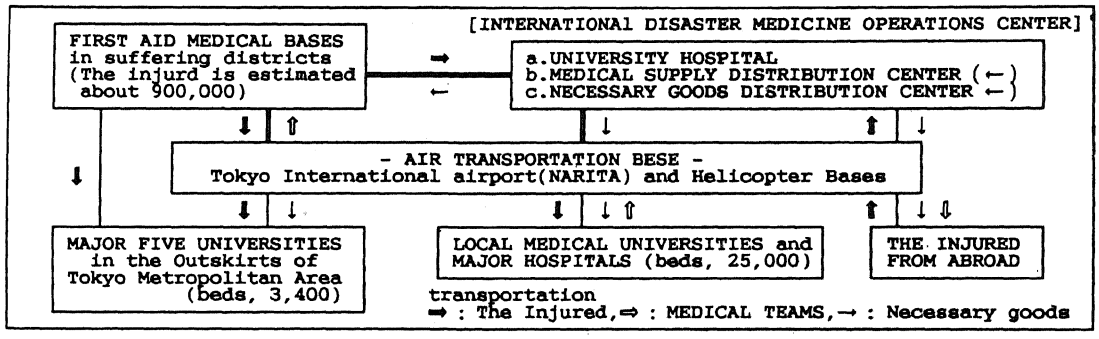

Figure 1. A Proposal of International Disaster Medicine Supporting System

Table 1. Damages in Kanto eathequake 1923 and forecasted damages in Reemerged Kantou eathequake (Medical facilities)

	Kantou EQ. 1923	Reemerged Kantou EQ.
Suffering district	Tokyo Metropolitan Area (T.M.A.) ,Japan	
Human damages	about 132,000 dead (Tokyo and Yokohama)	about 150,000 dead and * 265,000 (Injured)*
Hospital building	Buildings were destroyed	Collapse will be unlikely
Treatment function	Functions were destroyed	Treatment facilities and medical functions will be destroyed.

* From the test calculation by NATIONAL LAND AGEMCY,1988

high technology including complex electronic systems into treatment facilities, the severe damages to various medical systems and functions will be inevitable.(Table 1.)

As a protective measure against these outcomes, a new system to provide disaster medicine and construction engineering has been studied for many years.

2 A PROPOSAL OF INTERNATIONAL DISASTER MEDICINE OPERATIONS CENTER

We estimate the number of the injurd about 900,000 by primary and following secondary disasters and all city functions in the T.M.A.would be destroyed.

The most effective response to such a mass casualty incident would be to mobilize large-scale rapid air transport throughout the country as shown in Figuer 1. There are major four universities in northern part outskirts of Tokyo and more than 100 hospitals at local universities situated near the local airports.

We propose the construction of international disaster medicine operations center consist of a)university hospital, b)medical supply distribution center and c)necessary goods distribution center located near the main airport of Tokyo International airport (Narita) as shown in the right side up of Figuer 1. In the event of emergency treatment at times of major disasters, the information system of the disaster medicine operations center will be switched to the prearranged exclusive code for emergency treatment for processing items such as composition and service records of medical teams and of auxiliary teams, and supply and consumption of emergency medical goods

3 INTRODUCTION OF BASE ISOLATION SYSTEM (BIS)

to prevent confusion of emergency treatment activities. The details on these systematization are described on another report of "I.Tanahashi and K.Yomaru : -A new system to provide disaster medicine-" shown in references.

After the earthquake, by and by, city functions such as electric service, traffic system and many other things will be started to recover, the injured will be also started to transport back to the T.M.A.. Functions of hospitals expect to be alive.

we want to propose a new construction engineering of base isolation system (BIS) for hospital building to be alive in the event of major earthquake. Figure 2 shows a concept of main medical facilities in the international disaster medicine operations center.

Since all the major hospitals within the T.M.A have been constructed to resist earthquakes and fires, collapse of such buildings is highly unlikely. Damage, however, to examination and treatment equipments and

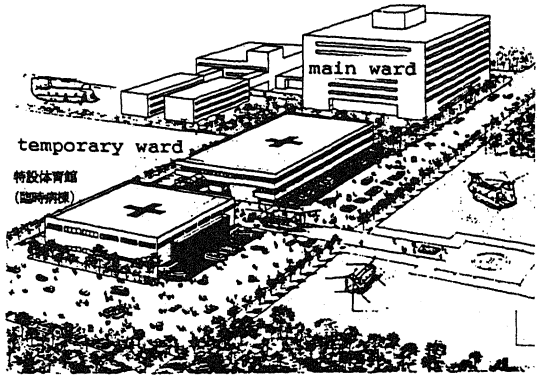

Figure 2. A concept of medical facilities for disaster medicine.

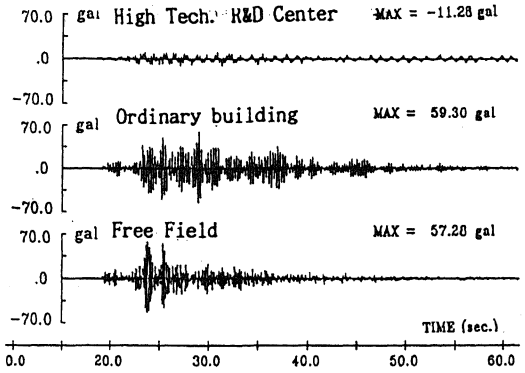

Figure 3. Observed acceleration waves at Tokyo Bay earthquake feb.2.1992.

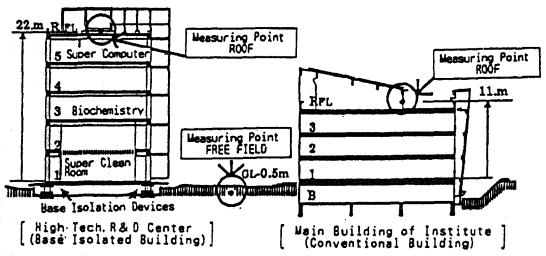

Figure 4. Earthquake observation points of base isolated (R&D) and ordinary building, and free field.

functions of various devices will be inevitable.

Base isolation system made of laminated rubber bearings and dampers converts seismic motion into gentle movements with longer periods and reduces seismic forces.

Figuer 3. shows "Tokyo Bay earthquake, M=5.9, Feb.2, 1922" observation data on base isolated building, ordinary building and free field, which observation points are shown in Figuer 4.. The acceleration at the

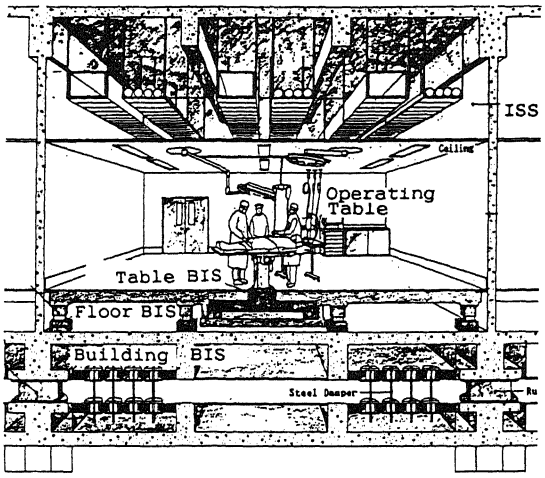

Figure 5. MBIS and ISS for operation ward.

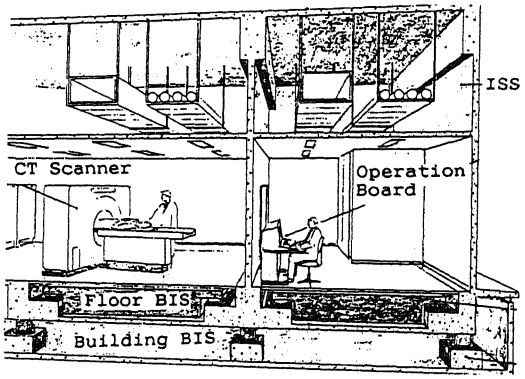

Figure 6. MBIS and ISS for diagnastic room.

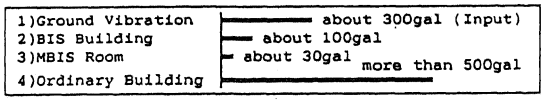

Figure 7. Estimation of response at BIS and MBIS building and ordinary building excited by ground motion.

roof of isolated building was about 1/5 of that at the free field. The system has been adopted at many buildings in japan.

Figure 5. and Figure 6. shows a proposal concept of multiple base isolation system (MBIS) enhanced isolation effects. This system can be divided into three levels of a) base isolation for principal medical wards, b) floor isolation for operating rooms and diagnosis and treatment rooms and c) equipment isolation for microsurgery table.

These islation systems would be able to applyed to the medical principal wards such as, emergency treatment centre, examination

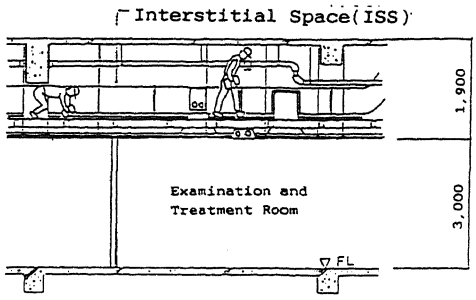

Figure 8. Details of ISS (Hight of ISS: 1,9m)

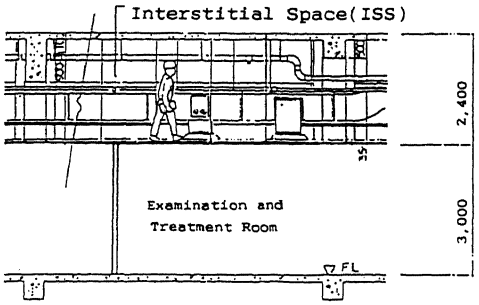

Figure 9. Details of ISS (Hight of ISS: 2.4m)

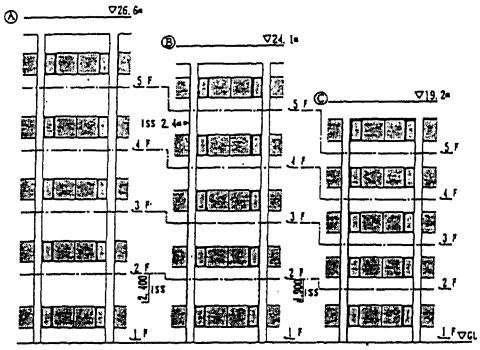

Figure 10. Comparison of floor hight (examination ward and operating ward).

ward, information center, image diagnosis center, and bed wards.

Given these modifications in building, we estimate the response accelerations of less than 30 Gal at the principal rooms exciting by earthquake ground motion of 300 Gal, in opposition to more than 500 Gal at ordinary building without base isolation system as shown in Figuer 7.

4 INTRODUCTION OF INTERSTITIAL SPACE CEILING SYSTEM (ISS)

Ordinary ceiling space in hospitals has about 1.2 m in hight and is difficult to

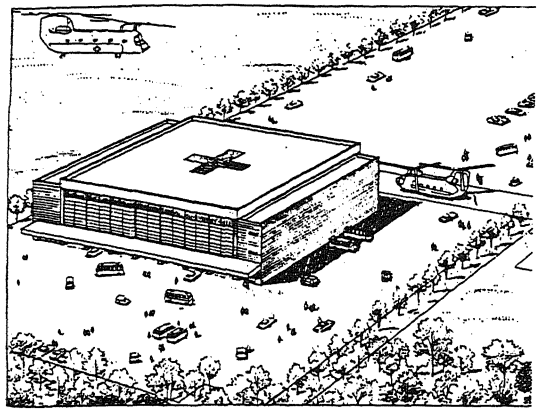

Figure 11. A concept of temporary ward.

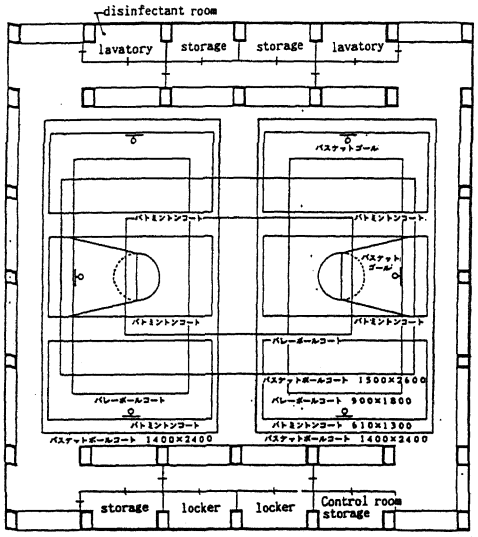

Figure 12. Example of "Sports Hall" functioning as a temporary ward at nomal time.

stand. Interstitial space ceiling system (IS S) has larg space of 1.9 m to 2.4 m in the ceiling as shown in Figuer 8. and Figuer 9. The space of 1.9 m is uncomfortable standing room and the 2.4 m is comfortable one.
In case of 5 stories examination ward and operating ward, as shown in Fig 10, total height of building will be about 19.2 m for ordinary building, 24.1 m, 26.6 m for ISS buildings.

The space with ISS serves to repair service systems of buildings in the event of major earthquake, and also, renovate into latest information systems and make growth service life into intelligent hospital systems. Following wards will be equipped with ISS : image diagnosis centre, information center, outpatient ward, emergency treatment center.

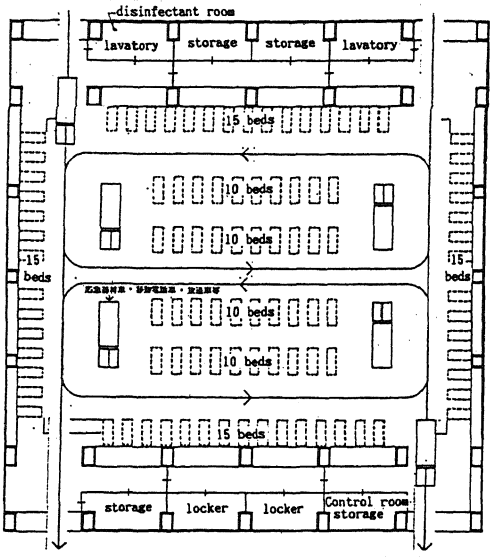

Figure 13. Example of an arrangement of temporary treatment ward in "Sports Hall".

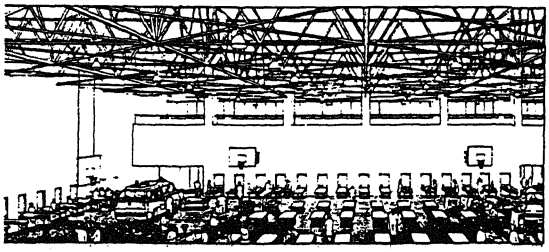

Figure 14. Temporary treatment ward in "Sports Hall".

5 INTRODUCTION OF EMERGENCY TEMPORARY WARD

Figure 11 shows a concept of emergency temporary ward (about 1,000 m²) constructing in the site of major hospitals. It functions as a sports hall (Figuer 12.) or a lecture hall in normal time and will convert into temporary treatment ward in the event of major disaster occuring as shown in Figuer 13. to Figuer 14. Accommodations are 100 beds buried into the wall, medical oxygen, compressed air system, piping system for power supply and necessary goods.

6 CONCLUSION

This proposal establishes a disaster medicine operations center near the designated airport at the periphery of Tokyo metropolitan area (T.M.A.), and developes protective construction engineerings for medical functions such as base isolation systems to prevent damage, interstitial space ceiling

systems to serve easy repairs of service equipments and emergency temporary ward functioning as a sports hall in nomal time. As a result, emergency treatment functions would be able to continue unimpeded at disasters.

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