# A SURVEY OF BUILDING DAMAGES IN SEPTEMBER 6,1975 LİCE (TURKEY) EARTHQUAKE

by

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## SYNOPSİS

On September 6,1975 the Earthquake in the Turkish town of Lice caused the loss of many lives and considerable material damage. In this report,the building types of the region are classified and damages observed on each type are discussed,the emphasis being on the stone masonry and reinforced concrete buildings. One of the reinforced concrete structures is analysed in detail.

## INTRODUCTION

Lice which is a small town of 14.000 inhabitants located at the south eastern region of Turkey experienced a violent earthquake of 6.9 Richter magnitude on September 6.1975 at 10.20 hours GMT. The epicenter was located at 38.5°N-40,7°E which defines a location at a short distance from Lice in the nort-east direction.

Epicentral intensity was estimated as VIII degree according to the Modified Mercalli Scale. The distribution of the intensity in the quaked area is shown on the isosysmic map. (Figure 1). Regarding the magnitude and intensity factors,this earthquake was at the same scale as Bingöl Earthquake which had occurred also in south eastern Turkey,in 1971. (1)

Paleozoic formations constitute the geological base of the earthquake area. The high mountain ranges of the region extend in the east-west direction.There are some senclines and anticlines in the nort-south direction as a result of the tectonic activities in the Miocenic period. During the September 6,1975 earthquake new fault traces were observed in addition to spectacular rock fall incidents in Lice and Yamaç village.

## SUMMARY OF LOSS AND DAMAGES

2385 people lost their lives in Lice Earthquake. About 8160 building were destroyed or damaged beyond repair. More than 11800 other dwellings were effected to varying degrees. In Lice town itself where the damage to property rose to 95 %,approximately 2580 buildings were ruined or severely damaged during the eartquake. This is the highest degree of

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damage observed during the last several decades in Turkish towns effected by earthquakes. The villages located in the epicentral area were totally destroyed. (2) (3)

## OBSERVATIONS ON STRUCTURAL BEHAVIOR OF DAMAGED DUILDINGS

Town of Lice is located in an economically depressed region of Turkey. There are no recognizable traditions of construction in this particular area. The dwellings are mainly masonery structures with irregular stone walls built by using mud mortar and covered by heavy flat roofs. Only a few dwellings have been constructed with regular,lime mortared stone walls. Other typical Turkish construction methods based on adobe masonry or timber squeleton are not used in this region. The public building were generally built in proper stone or brick masonery. Only seven buildings of reinforced concrete structure could be found in the epicentral area.

As for the earthquake behavior of the buildings; the unmortared,irregular stone masonry dwellings proved to have very little earthquake resistance as could be expected. (Figure 2). Mortared stone walls showed a greater resistance especially when they had continuous concrete or timber lintels (Figure 3). Government buildings of brick construction were not collapsed but received partial damage because of the poor corner detailing of the walls. (Figure 4)

In this particular region,the construction quality of reinforced concrete structures is also inadequate. The connections between columns and beams are poorly constructed. Figure 5 shows the slipping out of a very poorly connected reinforced concrete column in an unfinished public building.

One peculiar behaviour of the reinforced concrete structures was revealed in the State Agricultural Bank Building which at the time of the earthquake as still under construction.

This three storey building (one basement-two floors above ground) suffered serious damages. All the columns of the top floor were ruptured at the head and at the base. (Figure 6) Ruptures occurred under typical tension effect of combined bending and axial load action. No damages were observed at the lower floors of the building. A vertical cross section of the building and a plan showing column locations at the top floor are given in Figure 7.

Only two types of column were used in this floor. Those having a greater stiffnes in the direction of (x) which is parallel to earthquake direction and the others having a greater stiffnes in the direction of (y). The use of correlation of "bending-axial load interaction" permits the

evaluation of the bending moment causing ruptures on these columns.

For an estimated concrete compressive strength of 100 $kg/cm^2$ and steel yield strength of 2400 $kg/cm^2$, these moments were computed as 4.5 tm. and 2.7 tm. respectively for each type of columns.

By application of limit analysis the horizontal load which should create ruptures in all columns of the top floor has been computed as 54 tons. The total weight supported by those columns at the moment of earthquake was estimated as 386 tons. Thus, the lateral collapse force was wound to be 14 % of the vertical lood.

One storey Municipality Building under construction was also affected by similar column ruptures. The ratio of "lateral force/total vertical load" has been computed as 15 %. (3)

These values are close to the static acceleration coefficients computed using amprical magnitude-acceleration relations.

According to the present Turkish Earthquake Code, lateral force design coefficient for Lice region is 6 %. Considering a ductility factor around 2,5-3,0 for the low standard of concrete construction of the region, reinforced concrete structures could withstand a lateral static force approximately 15 % of the vertical load. This indicates that 6 % of present Code would be adequate for this region.

## BİBLİOGRAPHY

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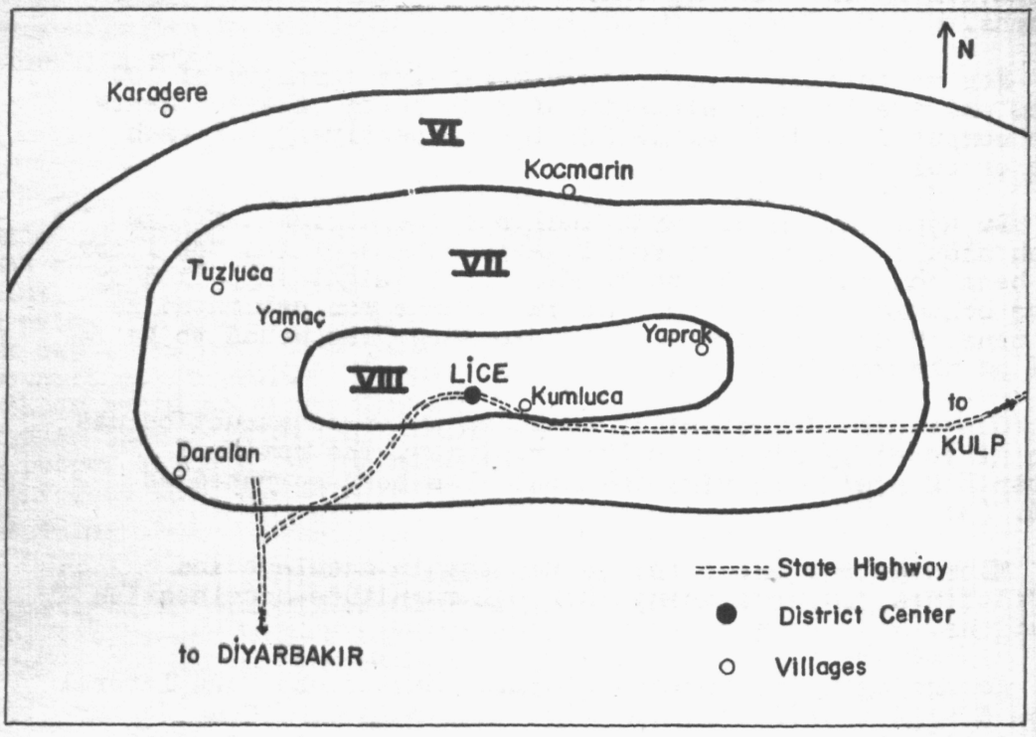


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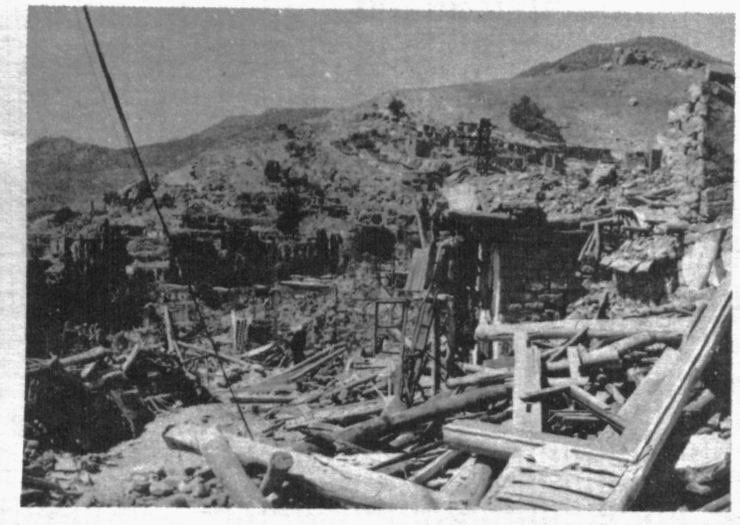

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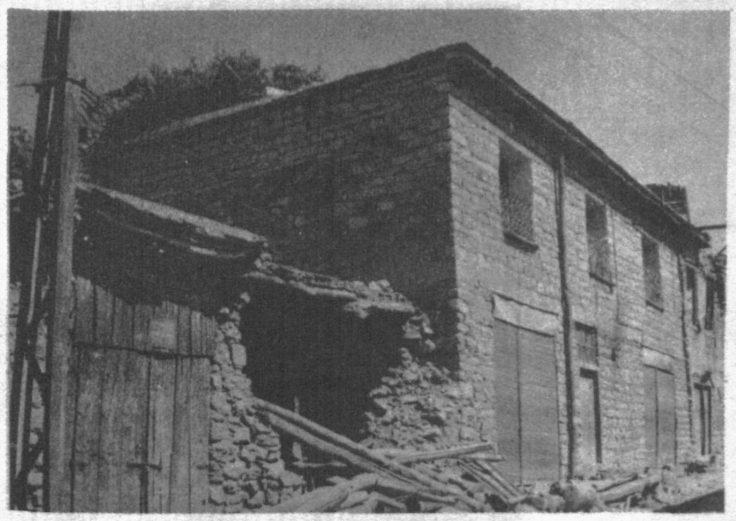

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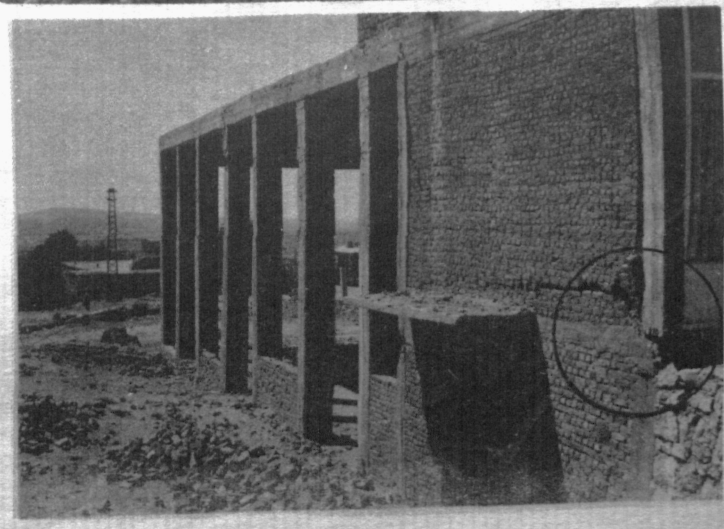

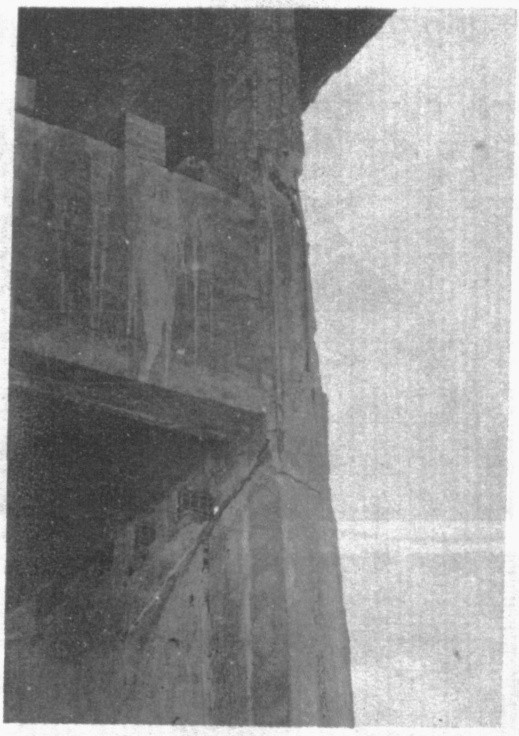

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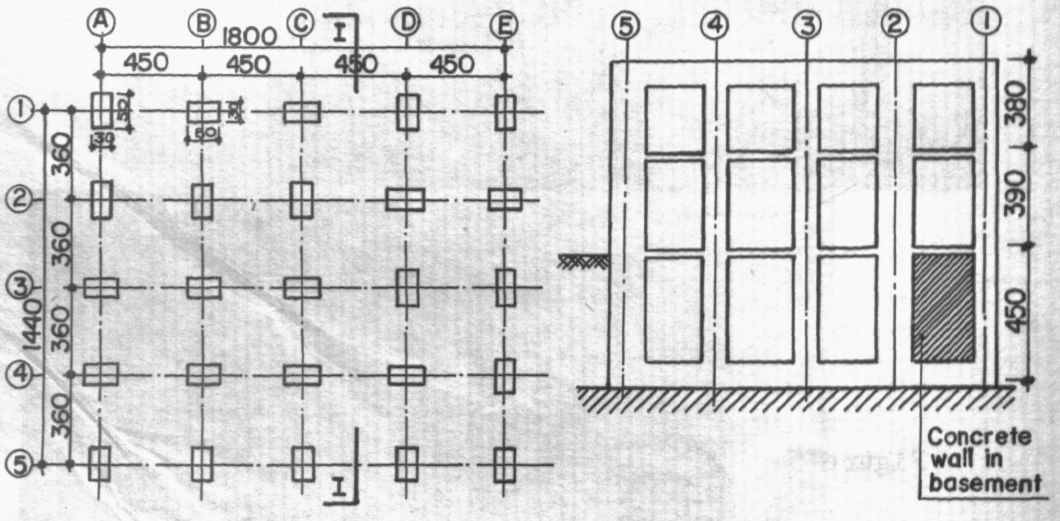


Column location plan of top floor

Schematic vertical section of building (Section I-I)

Figure-7-