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SEISMIC RISK REDUCTION AND DISASTER MANAGEMENT: NATIONAL REPORT OF TURKEY

by

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SUMMARY

This report is the third in a series of national reports prepared for SEISMED workshops. It explains in detail the policy, planning, and implementation phases in Turkey for the mitigation of earthquake risk and disaster management. Each phase is considered within social, technical, administrative, political, legal, and economic criteria. Particular attention is paid to policies formulated by legal documents, but a critical assessment is also provided for the degree of realization of these policies. Annexes are provided for group exercises for estimating earthquake losses.

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A. INTRODUCTION

Turkey ranks high among countries which have suffered significant losses of life and property due to earthquakes and other forms of natural disasters beginning from the earliest recorded times. This is due to the country's geological and tectonic structure, topography and climatic characteristics. In our two earlier SEISMED workshop papers [1,2] we have provided extensive background information on seismic hazard and risk in the country, as well as loss figures; we will therefore refrain from repeating that information, except to the extent of summarizing a few key figures as reminders.

The more reliable statistics of the last 60 years indicate that of the natural disaster forms occurring in Turkey, earthquakes have caused 61 percent of structural damage, with landslides contributing 15 percent, floods 12 percent, rockfalls 7 percent, fires 4 percent, and avalanches, strong winds, heavy rains and ground-water fluctuations the remaining 1 percent. Earthquakes are clearly the prevalent form of natural disaster causing the loss of homes.

There have been 54 major destructive earthquakes during the period between 1903 and 1990. Collectively, they have killed 70 thousand people, injured and impaired another 122 thousand, and destroyed about 410 thousand homes and other buildings. These figures tell us that each year an average of 805 persons have died as a result of earthquakes, 1402 have been injured, and 4712 buildings razed to the ground. Viewed only within the context of loss of life and injury, earthquakes account for 90 percent of such losses.

Statistics of the last 60 years show that earthquakes which have occurred in Turkey have caused direct economic losses equaling on average 0.8 percent of the Gross National Product (GNP) of the country annually, with the other forms of natural disasters accounting for 0.2 percent.

In Table 1 we summarize the distribution of major elements at risk such as population, land size, industrial facilities and major dams with respect to the seismic zones map currently in effect in Turkey. Figure 1 shows the frequency of occurrence of earthquakes in Turkey. Assuming a Poisson-type occurrence model, the figure indicates that there exists a 63 percent annual probability for an intensity-VII earthquake, or for 8 intensity-V earthquakes. Similarly, the probability for an intensity-IX earthquake every 5 years is also 0.63. Given the realization of such a severe earthquake, the replacement of the lost housing stock alone requires expenditures equaling 1 percent of the annual budget, which in 1990 figures is 1 trillion TL, or $200 million.

Table 1. Elements at Risk in Turkey

Earthquake Zone	Population (%)	Surface Area (%)	Major Industry Centers (%)	Dams (%)
Zone I (MMI ≥ IX)	22	14.8	24.7	10.4
Zone II (MMI = VIII)	29	28.4	48.8	20.8
Zone III (MMI = VII)	24	28.8	12.0	33.3
Zone IV (MMI = VI)	20	19.4	12.6	27.1
Zone V (MMI ≤ V)	5	8.6	1.7	8.4

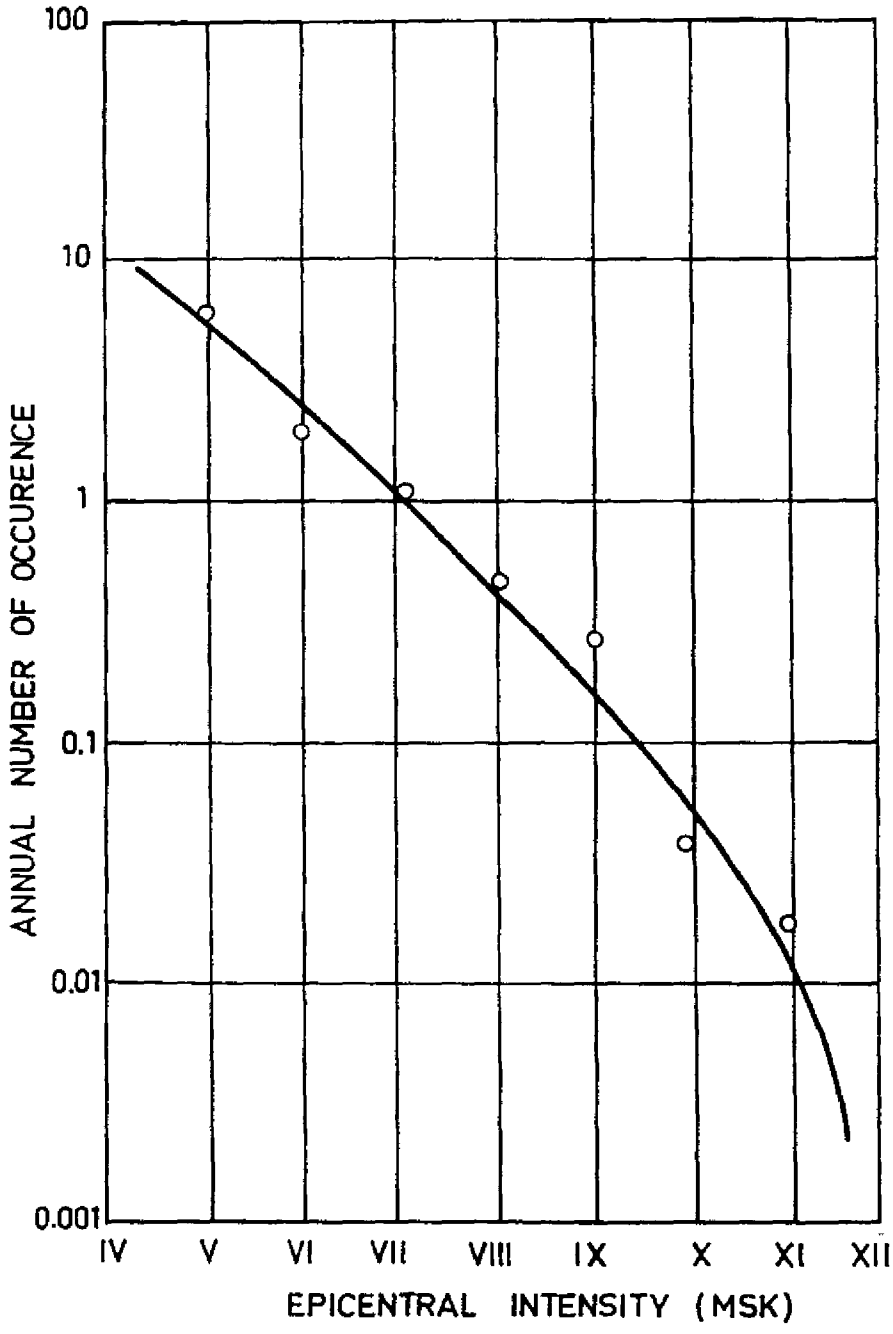

Figure 1. Earthquake Occurrence Frequency in Turkey

B. A HISTORICAL PERSPECTIVE FOR EARTHQUAKE DAMAGE MITIGATION IN TURKEY

The description of mitigation of earthquake damage and management of disasters can be broken down into the following three distinct phases in Turkey:

(1) Pre-1944 era
(2) 1944-1960 period
(3) Post-1960 phase

The Pre-1944 Era

I. Policy

During Ottoman times, the state's official response to mitigating the consequences of earthquakes has been case-specific, and enacted after their occurrence. These have taken the form of providing food and health services, clothing and temporary housing through the Red-Crescent Association, and occasionally postponement of remission of public loans through imperial edicts. Even into the post-republic era, there appears to exist no long-range policy for reduction of earthquake losses. The administrators seem to have faced earthquake disasters with a fatalistic attitude, considering them inevitable, or a form of divine retribution.

II. Planning

Given the absence of policy, there was no planning towards its realization.

III. Implementation

Implementation of mitigative policies have been rapidly enacted countermeasures intended to address the immediate post-disaster period's requirements, such as short-duration assistance, deferment of tax payments, and in a few special cases, building material and financial grants to accelerate replacement of destroyed houses. Indeed, following the Great Istanbul Earthquake of 1509, each household was awarded 22 gold coins, and a central authority was established to organize rebuilding the 1070 houses that had collapsed. It appears that some damage survey was done after this earthquake because an order was passed to prohibit the construction of houses on filled lands, and stone masonry buildings, damaged much more extensively than were wood-frame houses, were banned. These actions cannot be declared to originate from a coherent policy designed to prevent damages from future earthquakes, but were merely in response to dress wounds from a fresh catastrophe. The state's response to the great Erzincan earthquake of 1939 was along

similar lines, and the immediate post-disaster rehabilitative measures were made possible with the instrument of a special law passed for that purpose only.

Physical planning at the urban or regional level dates back to the second half of the 19th century. Possibly the first legal document put into effect in this connection is the "Building Regulation" of 1848. This regulation was concerned with the construction and land-use organization of certain boroughs of Istanbul, and for the first time ever brought some restirctions into these activities. Later, in 1864, "Regulations for Buildings and Roads" for the entire country was enacted. This set of requirements pertained to such items as areal and cadastral mapping, expropriation, determination of property boundaries, roadway widths, and building heights required for physical planning. The "Provincial Municipality Law" enacted in 1877 extended urban municipalities to all parts of the country, and gave them powers and responsibilities in planning and construction activities for infrastructure elements.

These regulations were replaced by the "Construction Law" enacted in 1882; this aimed at not only the improvement and maintenance of basic infrastructure items, but also regulated the provision of new lands for urban development. Physical planning at the urban scale were continued under guidelines of this law and its affiliated regulations until after the establishment of the Republic of Turkey in 1923. The Municipal Law enacted in 1930 was concerned with the development of master plans for cities, and local authorities were required to deal with the complex problems of regulating urban development.

A particular commonality of all of these acts and bye-laws is the absence of requirements concerning the mitigation of the consequences of natural disasters.

The 1944 - 1960 Period

I. Policy

A sustained sequence of disastrous earthquakes occurred between 1939-1944 starting with the 26 December 1939 event in Erzincan (M = 8). With an average period of 7 months between events, major earthquakes occurred in Niksar-Erbaa (M = 7.2), Adapazarı-Hendek (M = 6.8), Tosya-Ladik (M = 7.5), and Bolu-Gerede (M = 7.4), killing 43 319 persons, injuring 75 000 others, and destroying 200 thousand homes. This taught the governments in power that rebuilding collapsed houses did not constitute an adequate form of combating earthquake losses: It was realized that legal and physical preparedness were the essential ingredients in this matter, so a law entitled "Measures to Be Put Into Effect Prior and Subsequent to Ground Tremors", number 4623, was passed on 22 July 1944.

The objective of this law was to minimize the hazard to life

and property of the citizens and the national welfare, and establish an efficient rescue, relief and temporary housing system. The role assumed by the state was to undertake those responsibilities that could not be assumed by individuals. Permanent resettlement for people whose dwellings had been destroyed was to be planned and implemented through issuance of companion legistlation which considered the social and economic situation of the affected area. We describe the major characteristics of the law under the following five subheadings.

(1) Social

For the first time, requirements were stipulated to consider earthquake losses as they affect development and welfare betterment policies. In particular, the earthquake hazard was given greater priority in decisions concerning settlement and development plans.

(2) Technical

The law required that the central governing authority should make an assessment of the earthquake resistance of all public buildings. Foreign experts were invited to avoid problems associated with limited trained personnel and experience, and both the Ministry of Public Works and the technical universities sent personnel abroad for training purposes. Continuing education and training courses were organized by the Ministry of Public Works for other engineers and technical professionals to improve their knowledge in earthquake resistant design.

(3) Administrative

Law No. 4623 charged the Ministry of Public Works to oversee the implementation of all services required by the law. It also carried stipulations requiring the institutions of higher education and the Minerals Research and Exploration Institute (similar to a state geological survey establishment) to provide services for assessing earthquake hazard, and for drawing up of national building codes under the general coordination of the Ministry, which established a technical unit entitled the "Technical Earthquake Services Directorate".

(4) Political

The law brought together a government administrative body, the Ministry of Public Works, and the technical higher education institutions for the first time in an effort to realize its declared objectives.

(5) Legal

In its major outline the Law achieved the following:

- Development of earthquake hazard maps
- Development of earthquake resistant design regulations

- o Introduction of geological investigations prior to land use decisions
- o Establishment and better definition of mandates for provincial and sub-provincial rescue and relief committees
- o Promulgation of auxiliary bye-laws aimed at providing the ground principles for reasearch and training in mitigation activities.
- o Definition of the principles and resources for post-earthquake rescue, relief and housing,
- o Definition of the principles for post-earthquake damage assessment, determination of new settlement areas, expropriation

(6) Economic

The law stipulated the defrayment of the cost of mitigative activities through special allocations to the Ministry of Public Works funds equivalent to 1 percent of the national budget, and also required the Ministry to identify public or other buildings such as civil service facilities, hospitals, conference halls, movie theaters, public baths, hotels where people may gather in large numbers, and to rehabilitate those that would be found insufficient.

II. Planning

During the above period, the Ministry strove to fulfil its mandate by means of the extra 1 percent funds it received from the national budget. Inasmuch as the State Planning Organization had not yet been established, the execution was done according to annual implementation programs defined by the Ministry itself, and the necessary manpower was provided by personnel borrowed from universities and other public institutions.

III. Implementation

(1) Social

During the period between 1944-1950, the earthquake hazard mitigation activities described above were put into effect in an earnest way in spite of significant other national needs in the areas of transportation, communications, education, health, defense, and industrialization. In the post-1950 period pressures brought on by rapid population growth and urbanization, agricultural modernization, and the transformation of the country from an agrarian society to a gradually industrialized one caused also a gradual diminishing of the relative importance of the law, and its related activities.

(2) Technical

Law No. 4623 charged municipal governments with the task of

ensuring implementation of the earthquake resistant building code, as well as construction supervision. The local administrations could not fulfil their mandate, however, because of a multitude of reasons such as lack of sufficiently qualified technical personnel, rapid urbanization (during 1950-55 the rate of urban population growth was 6.3 percent), lack of adequate financial resources or political resolve. The consequence was the building of unsupervised shanty towns around large urban centers, generally over vulnerable land.

(3) Administrative

In addition to responsibilities defined by Law No. 4623, the Ministry of Public Works was also responsible for the construction of all public infrastructure elements belonging to transportation, communications, planning, public facilities, energy structures and the like . The predictable outcome was that the unit charged with earthquake risk reduction grew obsolescent, and became inefficient. It was this development that prompted the establishment of the Ministry of Reconstruction and Resettlement in 1959.

(4) Political

No major earthquakes occurred in Turkey during 1950-60, and the ones that did occur did not cause the kind of widespread destruction which would cause political repercussions. The unfortunate outcome of these facts was that the articles of Law No. 4623 dealing with the assessment of the strength of existing lifelines and public buildings, and their rehabilitation was never put into effect fully.

(5) Legal

In 1945, in accordance with Article 1 of Law No. 4623, several universities and the Ministry of Public Works collaborated in drafting the first mandatory earthquake zonation map and seismic design regulation. The map consisted of two principal areas designated as "earthquake prone" and "less earthquake prone" on the basis of observed past damage. In the 1949 revision of the map three zones were defined on the basis of felt intensities, ranging from VII to IX. The earthquake code was revised twice during the same period, in 1949 and 1953. In the latter revision, earthquake safety was compromised by reducing the basic earthquake zone coefficient from 0.10 to 0.08. This reduction may also be interpreted as an evidence that earthquake damage mitigation no longer occupied a central political theme in the country. The Construction Law of 1956 redefined the principles of structural safety, construction supervision and planning principles.

(6) Economic

Justification for the reduction of the basic zone coefficient in the 1953 revision was the argument that it was

necessary to reduce construction costs in view of the population increase, urbanization tendencies, and better use of resources. It was also argued that the 0.02 reduction in the zones coefficient would lead to a 1 percent decrease in construction costs nationwide.

The Post-1960 Period

I. Policy

Law No.4623 carried stipulations only in relation to earthquakes, and did not contain provisions in conjunction with reconstruction activities. Other forms of natural disasters, such as floods, landslides, rockfalls, and fires became prevalent during the decade from 1950, and in response to that the national assembly passed a law entitled "Measures and Assistances to Be Put into Effect Regarding Natural Disasters Affecting the Life of the General Public", number 7269, which superseded the 1944 law. The basic philosophy of Law No. 4623, which considered only earthquakes was maintained, but its scope was widened to include other forms of natural disasters, and the principles and criteria for allocating state finances to citizens whose homes are damaged are clearly spelled out. The law created a new Ministry called the Ministry of Reconstruction and Resettlement, and charged it with the mandate of coordinating and implementing all of the state's obligations to the citizens of the country in conjunction with natural disasters.

A novel feature of Law No. 7269 was the establishment of a "Disasters Fund" to facilitate the undertaking of all activities required by the law with finances supplementary to the funds made available from the regular budget. An abridged translation of this law is provided in Appendix 1.

(1) Social

The social implication of Law No. 7269 was to correct a basic unfairness in the state's assistance to citizens affected by all forms of natural disasters, rather than only earthquakes. The occurrence of major earthquakes during 1966-1976 has caused a renewed attention to earthquake risk mitigation.

(2) Technical

The post-1960 era has witnessed a rapid increase in the number and technical competence of people trained in disciplines concerned with natural disaster reduction. There has also been an increase in the number of educational institutions providing training in seismology, earthquake engineering, geotechnical engineering, and other related areas. On occasion, some of these persons have served as deputies or ministers, and this has led to better perspectives in natural disaster policies.

(3) Administrative

Establishment in 1959 of the Ministry of Reconstruction and Resettlement, and the execution of all government-level activities in relation to natural disaster reduction through the offices of the General Directorate of Disaster Affairs, and the research and technical policy instrument provided by the Earthquake Research Institute, have proved to be good policy decisions. The Ministry has also established provincial offices to facilitate its own work through civil employees in the provinces, leading to quicker and more effective response to disaster-time needs. An important element in providing interfacing with scientific developments has been the establishment of research and application centers in several technical universities.

(4) Political

Resurgence of earthquake activity during 1966-1976 has once again underscored the importance of earthquake risk mitigation, and has led to important policy revisions.

Whereas in the 1950-1960 period the policy of natural disaster reduction had been to "dispatch various forms of assistance to communities afflicted by disasters, and to replace collapsed homes", that is a policy of providing specific ameliorative actions, this was gradually replaced by one aimed at protection, prevention and mitigation of the consequences of natural disasters through appropriate measures and instruments at minimization of physical losses.

(5) Legal

Law No. 7269 has charged the General Directorate of Disaster Affairs of the Ministry of Reconstruction and Resettlement with the mandate of establishing appropriate policies and revising them when necessary for reducing earthquake and other natural disaster consequences.

(6) Economic

In the introductory part of this section we have presented the background statistics for the earthquake problem in Turkey: 92 percent of the land area has witnessed at least one intensity-VI earthquake in the past, and the average annual number of deaths has been 804, with injuries totaling 1402, and collapsed or heavily damaged buildings 4712. The direct annual economic losses attributable to earthquakes is 0.8 percent of the GNP. This perspective confirms that virtually any measure for reducing earthquake damage will provide economic benefits.

II. Planning

A comprehensive and multifaceted social development was

given the appropriate framework for realization when the State Planning Organization (SPO) was established in 1961. This body has prepared 5-year development plans since that time. The mitigation of earthquakes and other natural disasters has been realized on the one hand through the finances accumulated in the Disasters Fund, equivalent to 1.5 percent of the GNP, and in conformity with projects formulated in accordance with the objectives set out in the plan on the other.

Currently, the Sixth Five-Year Plan is in effect, and like most of its predecessors, it foresees the replacement and rehabilitation of all weak forms of construction located within earthquake zones, and the establishment of an effective building supervision organization at urban centers. Active earthquake zones account for 44 percent of the land of Turkey, and the estimated number of inadequate construction within these zones is 1.3 million. The physical countermeasures stipulated in the plans have therefore not been put into effect. The legal, administrative and technical capacity for realizing the objectives spelled out in the plans exists, but the ever continuing rapid population increase (annually about 2.1 percent), and the unabating priorities relating to health, education, transportation, defense, communications, etc. keep requirements related to natural disaster mitigation to more modest scales.

III. Implementation

(1) Social

As has been the case in many other countries in the world, the few years immediately following a large earthquake witness a strong interest for hazard mitigation in the public opinion, and is therefore accorded political and financial priority. Such activities become blurred and seemingly less important as memories fade, and fatalistic or even apathetic attitudes begin to prevail. This explanation is a plausible, though not necessarily acceptable, social fact for a country with a dynamic and young population on the development path.

(2) Technical

The necessary technical manpower required for natural hazard mitigation exists today in Turkey, in both educational institutions and in the civil service. The same does not hold, however, at local administration level where land use decisions are taken and where scientific earthquake mitigative measures need to be implemented. This situation continues to cause major problems in construction supervision.

(3) Administrative

Although the duties, responsibilities and powers of establishments which will participate directly in earthquake and

other natural disaster mitigation activities have been defined clearly, there exist shortages of well trained and equipped rescue and relief units. On a country-wide basis, the Civil Defense Organization, established in 1958, has not yet established rescue teams. In actual practice this work is carried out by military units and temporary civil defense employees, but the level of their performance is not satisfactory.

(4) Political

It is self evident that passing laws and regulations and establishing government agencies for earthquake hazard reduction are by themselves not the ultimate solution. As with any other type of undertaking it is necessary that these agencies be accorded sufficient financial means for performing their mandates. In Turkey, there exists a second fund called the "Earthquake Fund" created in 1971, in addition to the "Disasters Fund" created in connection with Law No. 7269. The financial resources of the former are taxes levied against alcoholic beverages and tobacco. Given the size of the earthquake hazard mitigation undertaking of the country, the flow of funds into this fund are still very modest.

The 1975 revision of the earthquake resistant building design code foresaw strengthening of important structures such as hospitals, courthouses and other government agency buildings, post offices, firehouses, energy distribution centers built before the promulgation of that code, and judged to possess insufficient strength. The annual implementation programs of the then in effect Five Year Plans also required the replacement of 1.3 million weak rural houses. Neither of these could be fully executed due to the tremendous costs involved; during the period 1960-1990, only an estimated 175 000 rural houses have been upgraded.

(5) Legal

As we have described in the foregoing paragraphs, there exist currently in Turkey sufficiently numerous laws and regulations concerning planning and actions to be taken in the response, recovery, reconstruction, mitigation and preparedness phases of national, regional or local disaster management. Furthermore, these legal documents are continuously being reviewed, revised and evaluated as new problems are encountered or technological advances are made. The earthquake zones map has been revised in 1972, and the building code in 1968 and 1975. A new version is currently under review, and is anticipated to become official in early 1992. This new code contains elements which are certain to ensure a more rational safety basis in seismic design, and the companion earthquake zones map will be elaborated according to probabilistic concepts. A full listing of other related building standards may be found in [3].

A major deficiency which needs to be addressed is the lack

of national microzonation maps for a better evaluation of the earthquake hazard on local scale, and the generally prevalent attitude of local municipal administrations to overlook this component when reaching decisions regarding land use in their jurisdictions. Other problem areas which need to be addressed include the establishment of an effective building supervision system, and a mandatory earthquake insurance scheme. Both require political will of considerable magnitude.

(6) Economic

At the present time Turkey is a country which must maintain an annual growth rate of 7 percent until the year 2000 because of its high rate of population growth. Though no destructive earthquakes have occurred in the rapidly developing cities in the Marmara and Aegean regions, the average economic loss figures due to earthquakes have equaled 0.8 percent of the GNP. It is estimated that within the next 20 years the population will reach 84 million, and population density 109 persons per km2. Assuming that earthquake mitigation activity expenditures remain at current levels, the expected annual direct losses due to earthquakes may reach 1.5 - 2 percent of the GNP in the post-2000 period. If, in accordance with pessimistic scenarios, great earthquakes were to occur in industrial centers such as Istanbul, Izmir, Kocaeli, and Bursa then this figure could reach 7 - 10 percent of the GNP.

A plan prepared with the objective of keeping direct expected earthquake losses to about 0.6 percent of the GNP is described in Appendix 2. This plan was drawn up by the Earthquakes subcommittee of the Turkish National Committee for the International Decade for Natural Hazard Reduction. Its realization during the period between 1990 - 2000 calls for annual expenditures equivalent to 0.1 percent of the GNP. With current rates this translates approaximately to 400 billion TL, or $80 million.

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