



Seismic Retrofit of Industrial Precast Concrete Structures Using Friction Dampers:

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1. ABSTRACT

This paper presents seismic retrofit of one typical single-story industrial-type precast reinforced concrete building structure located in Istanbul Turkey using friction dampers. For structures that are heavily under operation, vacating the structure is not possible that is why conventional retrofitting techniques are not feasible. As an alternate method, this project consist of retrofitting precast reinforced concrete buildings The building consists of two adjacent blocks: B1 (3-storey precast reinforced concrete) and B2 (4-storey cast-in-place monolithic). Although both blocks were retrofitted using friction dampers, this paper focuses solely on B1.

2. INTRODUCTION

In industrial buildings, precast concrete structures are widely used due to their advantages such as low cost, short construction period and availability in rural areas in Turkey. Unfortunately, most of the precast concrete buildings built before Turkish Building Code 2007 is not well engineered or not well constructed in Turkey. There are cases where building owner are willing to proceed with a retrofit option due to high value of building contents or the business conducted. In these cases, however, an important challenge with the retrofitting of the structure is regarding the business downtime. In most cases, classical retrofitting methods, such as column jacketing and adding shear walls, require a major disturbance to the operations including temporary relocating.



1999 Kocaeli Earthquake
Prefabricated Building
Damage
M.H.Arslan, H.H.Korkmaz,
F.G.Gulay December 2004

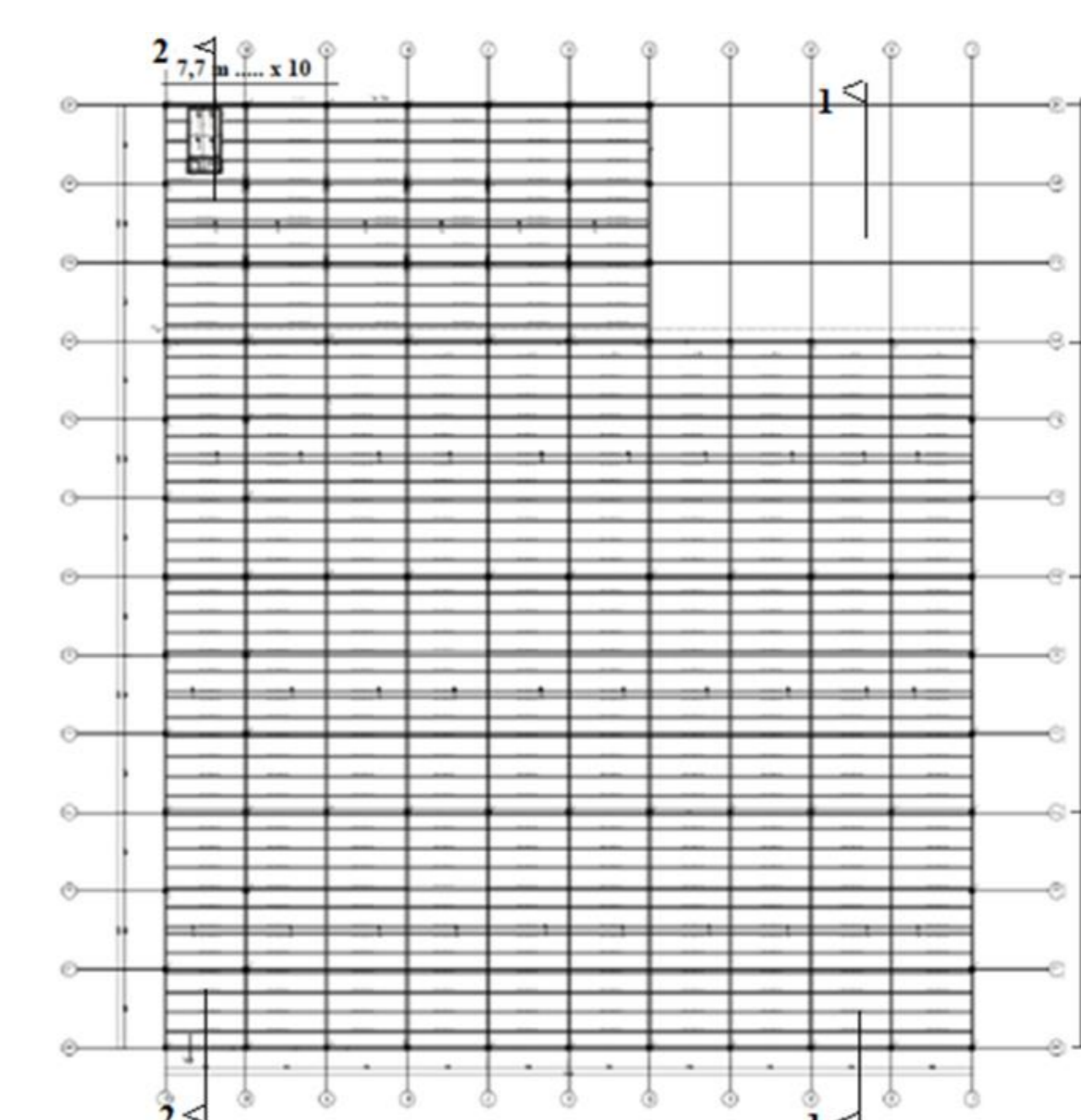
1999 Kocaeli Earthquake
Prefabricated Building
Damage K.A.Korkmaz,
A.E.Karahan June 2011



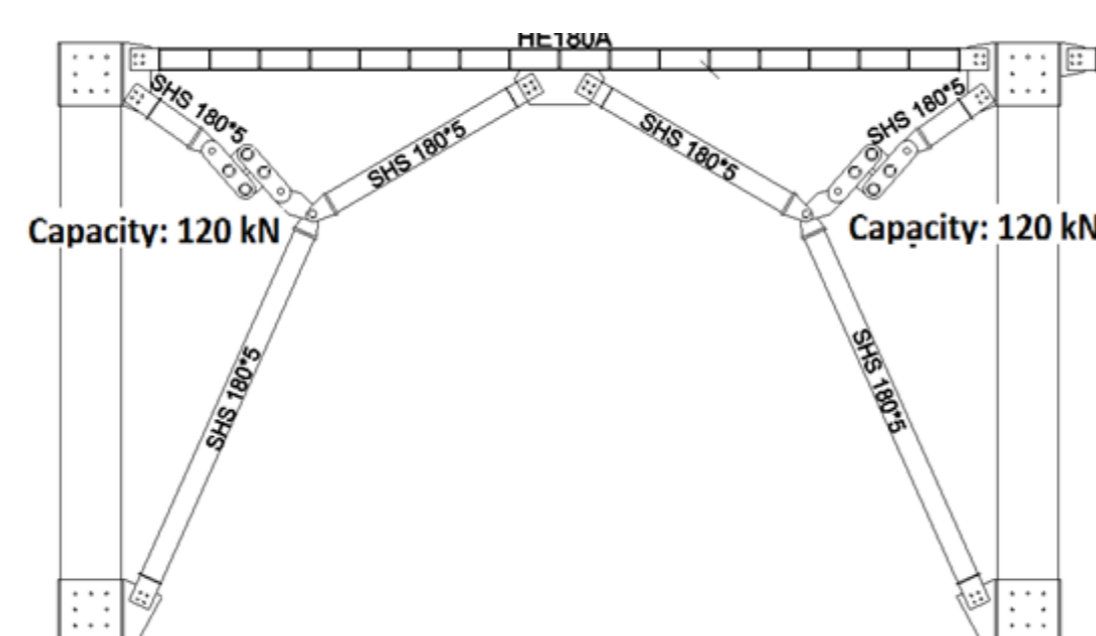
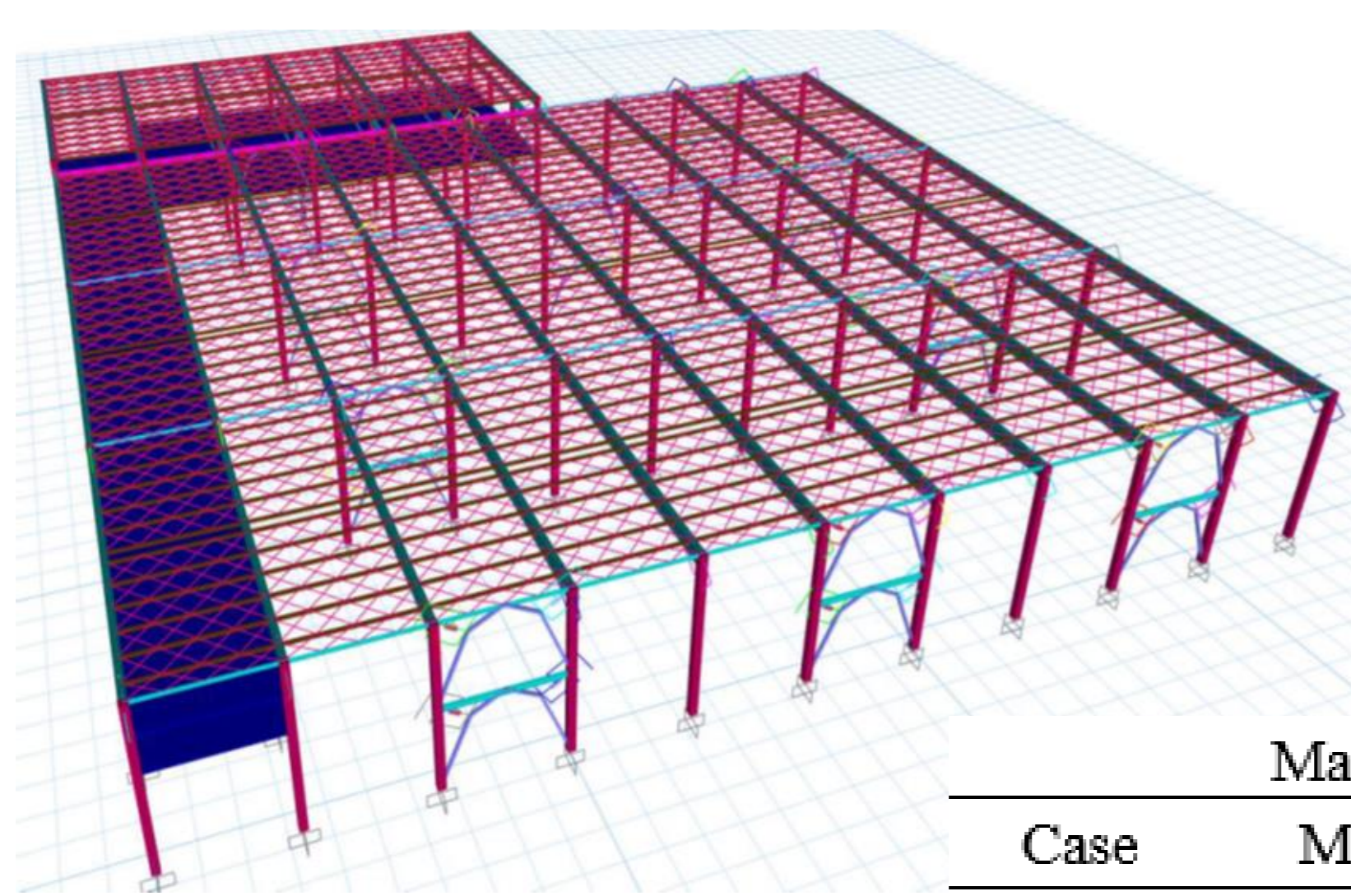
3. EXISTING BUILDING

- Columns satisfy performance requirements per TBDY 2018 (Turkish Building Earthquake Code)
- Performed story drift check, presented in Table 8, revealed that story drifts exceeding the limits for the desired Limited Damage Level
- Secondary beams have a failure potential when the frames in the short direction have out-of-phase behavior due to weak pinned connection and large displacement
- Primary roof beams have potential of overturning over the columns.

Modal Participating Mass Ratios				
Case	Mode	Period (sec)	UX	UY
Modal	1	3,686	0,891	0,0003
Modal	2	3,33	0,0005	0,7789
Modal	3	3,031	3,81E-06	0,1275
Modal	4	2,49	0,0083	0,0002
Modal	5	1,544	0,0016	0,0006
Modal	6	1,247	0,0032	0,0019

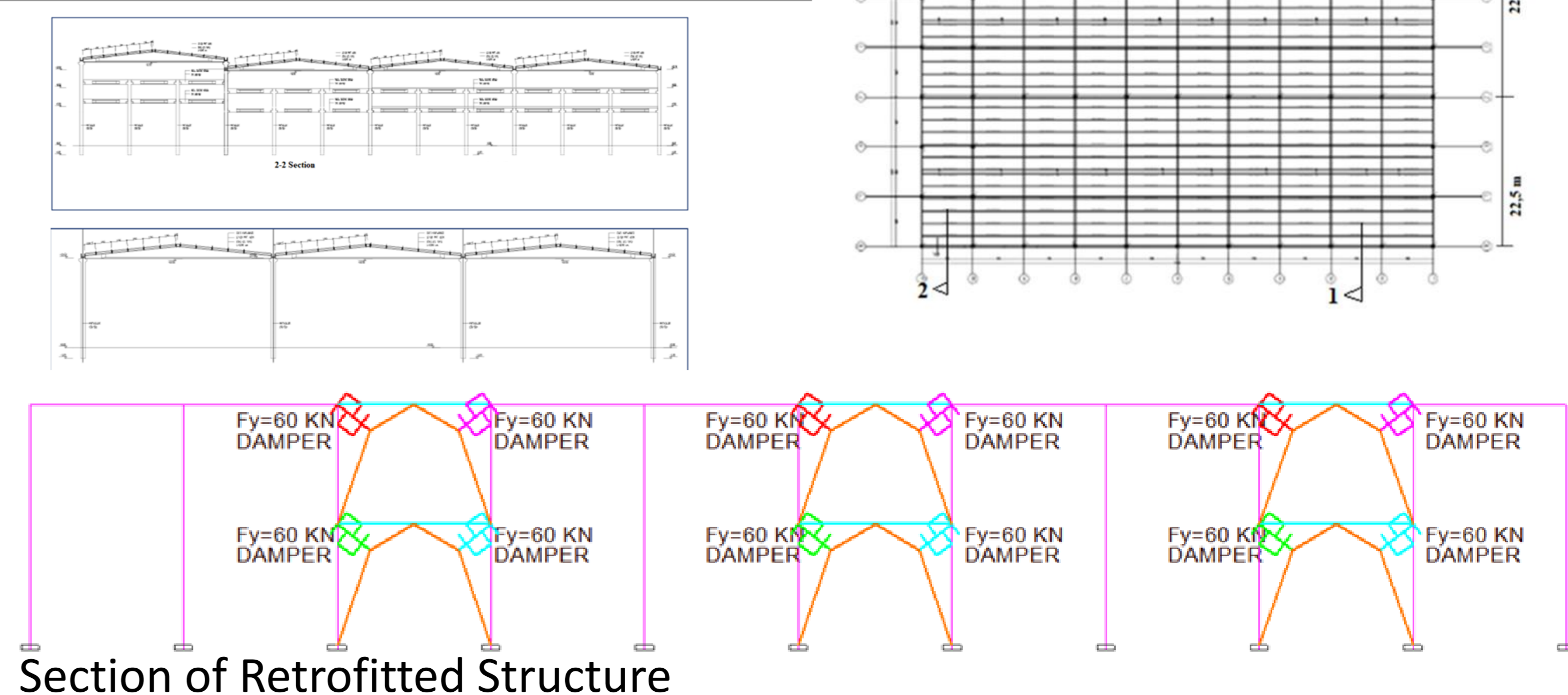


4. RETROFITTING USING FRICTIONAL DAMPERS



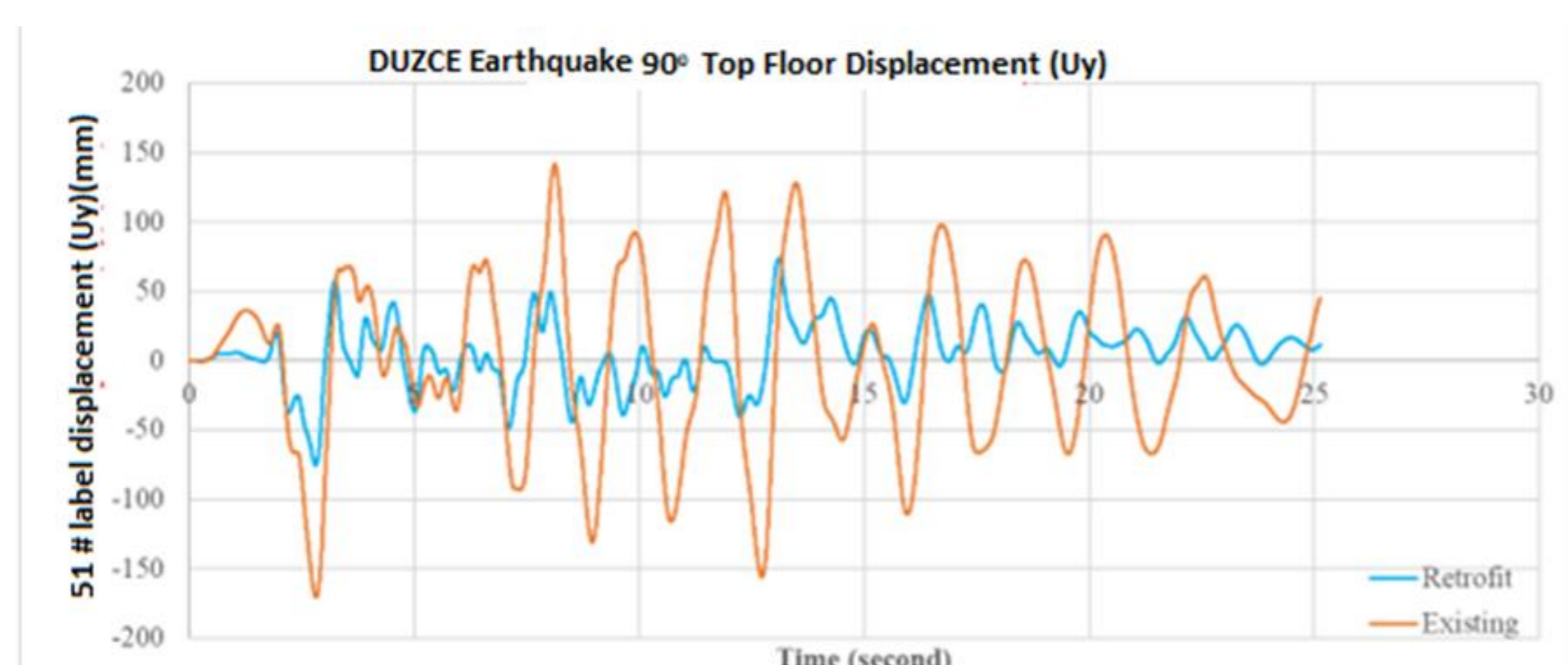
Mass Participation Ratios (non-linear model)				
Case	Mode	Period (sec)	UX	UY
Modal	1	2,407	0,8811	2,01E-05
Modal	2	1,591	0,0012	0,9056

Retrofitted 3D model view



Section of Retrofitted Structure

After retrofitting using dampers, displacement decreased down to 50-70%. Additionally There is no overturning risk of the beams due to decreasing acceleration. Building meet clients's and code's requirements.



Retrofitted and Existing Str. Top Floor Disp. Comparison



Photo 1: Installed Friction Dampers, Application from Outside.

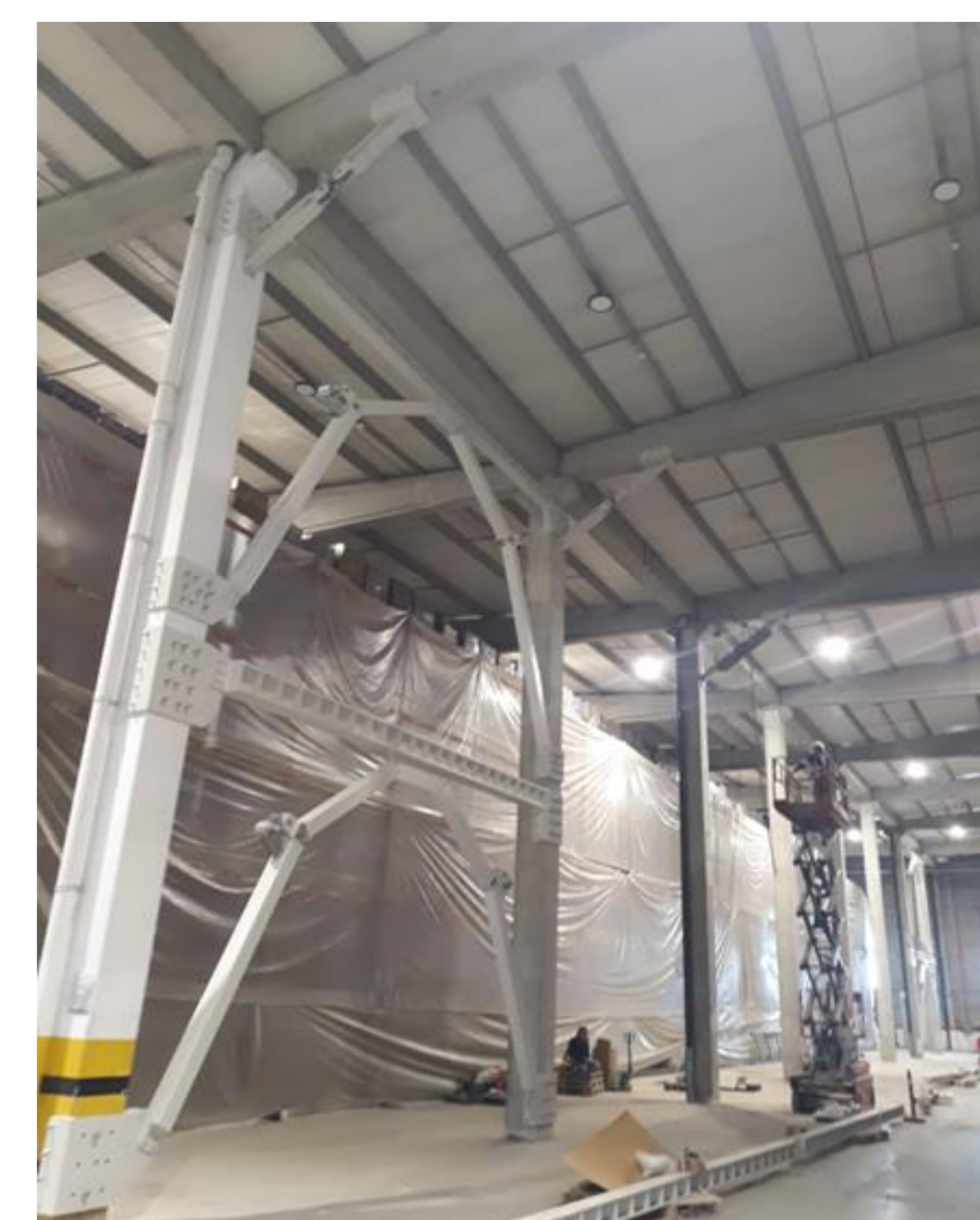


Photo 2: Installed Friction Dampers, For Both Direction