Incremental Dynamic Analysis (IDA) of Equipped Constructs to Fluid Viscous Dampers and Investigating Responses

Hamidreza Ashrafi1*, Soroush Dadgar2, Peyman Beiranvand2

ABSTRACT: The goal of this research is an utter assessment of steel moment frames equipped with linear and nonlinear fluid viscous damper performance. To achieve this, dampers with powers of smaller attenuation, equal or larger than one have been used. The system has investigated a structure which is obtained from moment frames and fluid viscous damper combination through using incremental dynamic analysis (IDA) and relative movement parameters, the maximum base shear and change the location of construction waste have been obtained through inserting dampers and different percentages of attenuation and have been compared with each other. In order to this, 6 different records of earth quick related to near field have been used and at the end of analyses, a complete image of structure behavior has been drawn by IDA curves in PERFORM3D software.

KEYWORDS: Incremental dynamic analysis, visco damper, additional attenuation, change of the relative position rate within the floor, near field earthquake

INTRODUCTION

Computers these days have the power of necessary process for accomplishing several analyses in a reasonable time. When a structure system's attenuation is studied, a construct's behavior which changes from elastic state to plastic should be considered in a way in analyses that this matter will be likely by accomplishing incremental dynamic analyses.

Based on Vamvatiskos and Cornell studies in 2002, IDA was first discussed in 1977 by Bertero1. IDA is of nonlinear dynamic analyses methods. In this analysis, structure is affected by a series of time history analysis that the severity of these time histories gradually increases. In another word, in time of the analysis that obtained diagram is so-called dynamic pushover chart or curves of push IDA that its general shape is similar to those pushover diagrams in nonlinear static analysis. Different modes of this kind of analysis have been used in recent years. Among these there is a method which is use incremental dynamic analysis curves and was first proposed by Cornell et al for project SAC2. During years, this method has been converted to one of the most popular methods among researchers and was used in studies of people such as Bazzuro and Cornell (1994), Lee and Foutch (2002) and Mehanny and Deierlein (2000)3-5.

As it is stated in studies of Lee and Foutch (2002), a structure model is required in this method which is located under selected records by earth
movement acceleration and is scaled for several times to increase the earthquake severity increases. In order to this the first three or four records should be scaled to a level of earthquake intensity that is adequately low for structure remaining in a state of elastic. Each analysis provides one basis for performance assessment such as relative displacement or damage indicator.

After analyses, results can be shown as some curves where scale coefficient related to each record of earthquake is related to its corresponding response that this response can be construct’s relative change of location. If we choose relative displacement as the basis for performance assessment, organization get unreliable when relative displacement increases severely for a little increase in earth movement acceleration or in a mode that equivalent hardness of building decreases to the value less than 20% hardness in elastic state. As an example, initial hardness for elastic state and equivalent hardness between $S_a=1.3g$ and $S_a=1.4g$ have been shown in figure 1.

According to studies of Vamvatiskos and Cornell (2002), IDA can be implemented for only one earthquake record as well but this cannot give general image of behavior that a building may have in future earthquake. For achieving general range of possible responses, IDA should be done for appropriate number of earthquake records. Through doing this, several curves will be obtained for done analyses which can be shown in one diagram that in this case diagram number 2 will be obtained.

One of the important characteristics of these multi-records diagrams is that if all movements of the earth are scaled via one method, their responses will be equal against a determined intensity of earthquake relatively. As it can be seen after surrender point, there are many differences among diagrams. This dispersion can be an evident for randomness of earthquakes. There is different order of maximum acceleration for each earthquake. Difference among magnitude of these maximum values, the rate of these maximums occurrence and the duration of these maximums occurrence for each earthquake can cause changing in order of structure members’ surrender. One order of being surrender can cause early failure in vital organs toward other organs. As a result for this subject, an earthquake response may be more than other earthquakes’ responses with that intensity that this difference in responses causes creating dispersion in related curves to IDA. If engineers can decrease the value of dispersion in constructs responses can be surer about that construct’s performance against earthquake in a particular intensity. Although the final goal of IDA is determining building’s capacity in order to cope with its overall collapse, Vamvatiskos and Cornell (2002) have clarified below factors as predetermined goals for this kind of analysis:

1. Get a thorough understanding of the range of responses to the intensity of earthquakes.
2. Get a better understanding of the structure response due to the high intensity of earthquake.
3. Get a thorough understanding of the changing nature of response of earthquake with seismic intensity changes.
4. An estimate of the structure dynamic capacity.
5. Performing a full IDA analysis that show the variability or stability of these parameters from one record to the other.

Because the main goal in this project is comprehensive observation of structure responses with different attenuation systems, the ability of IDA to achieve this goal has made this analysis as an appropriate method in this research. This process
let to determine best attenuation system for each movement from the earth.

**INTRODUCING STRUCTURE MODEL**

Instead of designing a new model, used model in studies of Gupta and Krawinkler (1999) have been used in this study. Used system in this model is moment frame. The reason of using this model is that mentioned model has been designed in a way to be able to have nonlinear performance against earthquakes with average to high intensity that this case considering the role of attenuation in reducing the value of wasted hysteretic energy by other structure members is necessary. It is noticeable that, this hysteric energy is because of plastic deformation during the repetitive process of loading. The other reason that can be mentioned here is that we know from experiments and analyses which have been done on this model that it has bad behavior at the time of earthquake and this issue can be used for determining the efficiency of viscose damper in improving the behavior of model, in a way that performance improvement will show the efficiency of attached viscous damper to construct. The last reason for using this model in analyses is that because of not using doubles and mixed sections, introducing used sections in this model in PERFORM software was easier and obtained results will be more reliable.

Used model is two-dimensional frame with five pans. A view of structure plan used in this model has been shown in figure 3. As it was mentioned before for standing lateral loads in designing this construct, moment frame has been used. It should be noticed that existing column in line F under the influence of lateral forces exerted on weak axis get bend and beam to column connection is as joint connection. Other frames have moment frame connections. It is worth noting that this research only investigates one of related moment frame to this building which is shown in figure 3.

Dynamic characteristics of model which is done from Modal analysis in PERFORM software are proposed in table number 1. In this table, T shows periodicity time and \( \varphi_i \) shows moody shapes.

**Table 1. Periodicity time and participation coefficient for first primary models.**

<table>
<thead>
<tr>
<th>Periodicity time</th>
<th>( T_1 )</th>
<th>( T_2 )</th>
<th>( T_3 )</th>
<th>( T_4 )</th>
<th>( T_5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>roof</td>
<td>2.31</td>
<td>0.86</td>
<td>0.49</td>
<td>0.32</td>
<td>0.22</td>
</tr>
<tr>
<td>9th</td>
<td>( \varphi_1 )</td>
<td>( \varphi_2 )</td>
<td>( \varphi_3 )</td>
<td>( \varphi_4 )</td>
<td>( \varphi_5 )</td>
</tr>
<tr>
<td>5th</td>
<td>0.922</td>
<td>0.524</td>
<td>-0.15</td>
<td>0.837</td>
<td>1</td>
</tr>
<tr>
<td>8th</td>
<td>0.821</td>
<td>0.232</td>
<td>-0.93</td>
<td>1</td>
<td>0.108</td>
</tr>
<tr>
<td>7th</td>
<td>-0.71</td>
<td>0</td>
<td>-0.98</td>
<td>-0.11</td>
<td>-0.99</td>
</tr>
<tr>
<td>6th</td>
<td>0.616</td>
<td>-0.40</td>
<td>-0.46</td>
<td>-0.97</td>
<td>-0.25</td>
</tr>
<tr>
<td>5th</td>
<td>0.507</td>
<td>-0.63</td>
<td>0.248</td>
<td>-0.86</td>
<td>0.833</td>
</tr>
<tr>
<td>4th</td>
<td>0.394</td>
<td>-0.73</td>
<td>0.804</td>
<td>0.029</td>
<td>0.632</td>
</tr>
<tr>
<td>3rd</td>
<td>0.282</td>
<td>-0.59</td>
<td>1</td>
<td>0.819</td>
<td>-0.35</td>
</tr>
<tr>
<td>2nd</td>
<td>0.171</td>
<td>-0.39</td>
<td>0.78</td>
<td>0.907</td>
<td>-0.83</td>
</tr>
<tr>
<td>1st</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS OF BEAM ELEMENT**

Utilized beams in this model are made using three components which include: linear elastic section, nonlinear joints and end rigid areas. A view of utilized beam element has been shown in figure 5. Here joints’ position is approximate because based on Gupta and Krawinkler (1999) construct’s behavior isn’t sensitive to joints’ position. Plastic

Yield stress for beam and column respectively is considered equal to 2,500 kilograms per square centimeter and 3500 kilograms per square centimeter and Poisson’s ratio equal to 0.3. In figure 4 a view of frame number 1 and used sections in it have been shown.
The relationship of moment-anchor for nonlinear joints.

The proposed moment-anchor relationship is as three linear and joint also in the last section of this diagram is as complete plastic. In beginning of diagram, the primary hardness of joint is very high until joints run and after that hardness will be decreased dramatically. Therefor till plastic joint develops in beam and beam reaches flowing stage, beam will have linear elastic behavior. Table 2 shows primary hardness parameters, stress anchor and final hardness related to used beams in this research.

Table 2. The values of moment-anchor for plastic joints of beam element.

<table>
<thead>
<tr>
<th>0p (rad)</th>
<th>MP (kN-m)</th>
<th>Kf (kN-m/rad)</th>
<th>My (kN-m)</th>
<th>Ki (kN-m/rad)</th>
<th>Beam</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>4995</td>
<td>11904</td>
<td>3210</td>
<td>Very much</td>
<td>W36x160</td>
</tr>
<tr>
<td>0.15</td>
<td>4048</td>
<td>9564</td>
<td>2614</td>
<td>Very much</td>
<td>W36x135</td>
</tr>
<tr>
<td>0.15</td>
<td>2322</td>
<td>4615</td>
<td>1630</td>
<td>Very much</td>
<td>W30x99</td>
</tr>
<tr>
<td>0.15</td>
<td>1762</td>
<td>3209</td>
<td>1280</td>
<td>Very much</td>
<td>W27x84</td>
</tr>
<tr>
<td>0.15</td>
<td>1231</td>
<td>1972</td>
<td>935</td>
<td>Very much</td>
<td>W24x68</td>
</tr>
</tbody>
</table>

VISCOS DE DAMPER SPECIFICATIONS

Columns modeling except cases which will be stated as following are almost similar to beams. The first difference in modeling column from beam is because of forming plastic joints in on beam-column connections. The other difference is that plastic joints in column are as a combination of anchor-axial force. Columns are expected to tolerate much more values of load than beams and because of that utilized joints in columns will be as a kind of P-M joints. Table number 3 shows related specification to diagram moment-anchor for used sections in columns. Utilized joints in columns can get surrender under the influence of combining loads including anchor and pressure force or anchor and reactive force and because of these related joints to column will have a kind of interactional behavior from anchor-axial force. For inserting the effect of this interaction, plastic joints of column using diagram of P-M interaction similar to what has proposed in figure 7 will be modeled.

Table 3. Values of moment-anchor curve for plastic joints of column element.

<table>
<thead>
<tr>
<th>0p (rad)</th>
<th>MP (kN-m)</th>
<th>Kf (kN-m/rad)</th>
<th>My (kN-m)</th>
<th>Ki (kN-m/rad)</th>
<th>Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>9550</td>
<td>22701</td>
<td>6145</td>
<td>Very much</td>
<td>W14x500</td>
</tr>
<tr>
<td>0.15</td>
<td>8183</td>
<td>13867</td>
<td>6103</td>
<td>Very much</td>
<td>W14x455</td>
</tr>
<tr>
<td>0.15</td>
<td>6543</td>
<td>14552</td>
<td>4360</td>
<td>Very much</td>
<td>W14x370</td>
</tr>
<tr>
<td>0.15</td>
<td>4634</td>
<td>7337</td>
<td>3533</td>
<td>Very much</td>
<td>W14x283</td>
</tr>
<tr>
<td>0.15</td>
<td>4147</td>
<td>6435</td>
<td>3182</td>
<td>Very much</td>
<td>W14x257</td>
</tr>
<tr>
<td>0.15</td>
<td>3702</td>
<td>5696</td>
<td>2847</td>
<td>Very much</td>
<td>W14x233</td>
</tr>
</tbody>
</table>

COLUMN ELEMENT SPECIFICATIONS

Columns modeling except cases which will be stated as following are almost similar to beams. The first difference in modeling column from beam is because of forming plastic joints in on beam-column connections. The other difference is that plastic joints in column are as a combination of anchor-axial force. Columns are expected to tolerate much more values of load than beams and because of that utilized joints in columns will be as a kind of P-M joints. Table number 3 shows related specification to diagram moment-anchor for used sections in columns. Utilized joints in columns can get surrender under the influence of combining loads including anchor and pressure force or anchor and reactive force and because of these related joints to column will have a kind of interactional behavior from anchor-axial force. For inserting the effect of this interaction, plastic joints of column using diagram of P-M interaction similar to what has proposed in figure 7 will be modeled.
dampers and for other values, \( \alpha \) will represent the non-linear dampers. Other values of \( \alpha \) can be obtained by changing the shape of openings that will change the specifications of fluid flow. PERFORM computer program asks us force velocity relationship for one non-linear viscose damper element as the six-piece straight line that after inserting information this relationship will be as shown in figure 8.

**Fig. 8** Force-velocity relationship.

It is worth to note that the diagram of force-velocity for linear viscose damper element forms just by one piece. Viscose rod elements included in the software PERFORM just tolerate axial forces and are formed by one piece of viscose damper and one piece elastic rod which have been located as a series. A view of viscose rod element has been shown in figure (9).

**Fig. 9** Viscose rod elements.

The shown force-velocity relationship for damper in figure 8 is similar for states that the damper is in compression or tension. It has also been noted that damper force will be unloaded along that curve which is loaded there. When a damper element was modeled, it has to be added to constructs. Figure 10 shows the relationship of force-changing of location for linear and nonlinear viscose dampers utilized in this research. By adding these dampers, critical attenuation of structure will reach to 10% of critical attenuation.

**Fig. 10** The relationship of force-velocity for linear and nonlinear dampers.

**THE SPECIFICATIONS OF APPLIED RECORDS AND WORK EXPLANATION**

For investigating construct’s behavior in this research, when we add different kinds of viscose dampers to structure and locate structure under seismic records, incremental dynamic analysis is used. Utilized IDA in this research using nonlinear dynamic analysis in model of 9 floors and in state of presence of a particular viscose damper has been done under 6 seismic records. These 6 records are related to close area records. Related specifications to these accelerogram have been shown in table 4.

**Table 4.** Seismic records which are used

<table>
<thead>
<tr>
<th>Name</th>
<th>Earthquake</th>
<th>Station</th>
<th>PGA</th>
<th>Scale Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF01</td>
<td>Tabas</td>
<td>Tabas station</td>
<td>0.49g</td>
<td>0.546</td>
</tr>
<tr>
<td>NF02</td>
<td>C.Mendocino</td>
<td>Petrolia</td>
<td>0.22g</td>
<td>0.458</td>
</tr>
<tr>
<td>NF03</td>
<td>Erizinican</td>
<td>Erizinican</td>
<td>0.218g</td>
<td>0.505</td>
</tr>
<tr>
<td>NF04</td>
<td>Landers</td>
<td>Lucerne</td>
<td>0.55g</td>
<td>0.772</td>
</tr>
<tr>
<td>NF05</td>
<td>Northridge</td>
<td>Rinaldi</td>
<td>0.506g</td>
<td>0.569</td>
</tr>
<tr>
<td>NF06</td>
<td>Kobe</td>
<td>Takatory</td>
<td>0.204g</td>
<td>0.259</td>
</tr>
</tbody>
</table>

For accomplishing IDA of each earthquake to 20 different levels from scaled intensity that these levels using concerned designing level range velocity in main periodicity period of building and is measured for critical attenuation equal to 10%. Intensity range varies from 0.1g to 2g that will change with minor growth 0.1g. Below information can be obtained from IDA:

- When earthquake intensity changes, system’s behavior will change as well.
- System’s behavior is different under the influence of different records such as near and far field.
- When system’s attenuation changes, system’s behavior will change as well.

IDA is used for state that different kinds of dampers are added to mentioned frame and in conditions that the collection of frame and damper is under the influence of seismic records. The process of accomplishing IDA in this research on structure model has been considered as method of nonlinear time history IDA and in a state that a particular kind of damper has been added to construct, in 6 different seismic records. As previously mentioned, these records are related to near field. Each earthquake is scaled using the acceleration of designing range of main periodicity period and for attenuation equal to 10% to 20 different levels of intensity. Used earthquake
intensity from 0.1g to 2.0g and has been considered with steps with 0.1g distances. For accomplishing IDA, concerned records should be scaled. Vamvatiskos and Cornell (2002) offered that for the steel frames have a period of relative displacement response within floor that are affected by the set of seismic records and these records are located in medium to large range of records in terms of intensity, the best criterion of measurement is the intensity of that first mood spectral acceleration $S_a(T_1)$. The other criterion related to measurement of response can be the maximum peak of ground acceleration. In spite of that, maximum peak of ground acceleration cannot be appropriate criterion for measuring resistance in first mood and aside from that maximum peak of ground acceleration cannot be depended on spectral acceleration because as the intensity of earthquake increases, the ration of earth acceleration will vary to $S_a(T_1)$. Therefore concerned records will be scaled using first mood spectral acceleration and for critical attenuation equal to 10%.

For finding the first mode spectral acceleration of seismic records, software namely NONLIN was used. This software gives user Excel file as output with accomplishing spectral analysis for critical attenuation equal to 10% that contains diagrams of spectral-period acceleration. Spectral replacement after that can be converted to spectral acceleration through equation number 2 and obtained diagrams of spectral-period acceleration.

$$S_a = \omega^2 D$$  \hspace{1cm} (2)

In this equation that $T$ is periodicity and $D$ is displacement, it is worth to note that for obtaining response spectral for critical attenuation 10% of response spectral based on attenuation 5%, based on regulations of chapter 4 related to NEHRP, related values to response spectral 5% should be divided on attenuation coefficient $B_p=1.2$ which has been shown in tables 1-3-3-13 of this regulation. Building's main periodicity which is studied in this research is 2.3 seconds that for this period value of $S_a(T_1, 10\%)$ is equal to 0.217g. as following used records are scaled in a way that have the same value in $T=2.3$ s. In figure 12, scaled response spectral can be seen for mentioned records.

When records were scaled, PERFORM software is able to scale them again in a way that intensity will be variable in 0.1g-2.0g and with growth of 0.1g.

As following obtained results of IDA on frame will be investigated, for each kind of attenuation, structure has been affected by 6 different records of earthquake that these earthquakes cover levels of intensity that have range of $S_a(T_1, 10\%) =2.0g$ to 0.1 with a growth of 0.1g, this means that on each structure for each percentage of attenuation 120 time history dynamic analyses have been done. Concerned dampers for structure in this research includes linear dampers with $\alpha=1$ for ratio of critical attenuation 5, 10, 15 and 20% and also nonlinear dampers with 1.5, are $\alpha=0.5$ that for relative lateral displacements 1% and 5% and critical attenuation percentage is 10 and 20%.

**THE MAXIMUM RELATIVE DISPLACEMENT OF FLOOR AND FLOOR MAXIMUM SHEAR**

Calculating relative displacement and floors’ maximum shear is relatively simple. Relative displacement of each floor is equal to difference of displacements of two floors divided by that floor’s heights. PERFORM software simply calculates the values of relative displacement and whole structure and give it to user. Relative displacement can be used as one of the appropriate criteria for evaluating damage to construct. For showing the effects of using different kinds of dampers and added attenuation percentages on reduction of maximum relative displacement of floor under the effect of near fields’ earthquake, IDA curves have been used. Primary shear is equal to set of lateral forces exposed on the first floor of each construct. In this research dampers are connected to moment frame using Chevron bracing. Figure 13 shows a sample of frame having Chevron bracing and viscose damper and the way of calculating primary shear derived from applied lateral forces to construct.
With a little attention to the charts, the effects of system’s added attenuations change effects can be seen on system’s behavior. It was also observed that obtained diagrams of applying records of near field for different levels are similar for different levels of added attenuations. General structure behavior which is observed in these diagrams represents that with increasing added critical attenuation, base shear will increase in structure while with increasing added critical attenuation, the related values to floor’s relative displacement will reduce. With a deeper look at diagrams of base shear it can be observed that before surrender point, with increasing added critical attenuation, base shear values reduce. After surrender point of curves, with increasing added critical attenuation values, related values to base shear will increase. According to these observations, it can be concluded that dependent on structure is in elastic or plastic mood; linear viscose damper will have different effects on construct. In figures 20 and 21, IDA diagrams under the effect of earthquakes in near fields and for moods that attenuation is 10 and 20% have been shown. As it can be seen in these diagrams, with increasing the percentage of added attenuation, the rate of created dispersion among diagrams will reduce. This reduction in diagrams’ dispersion can be also observed in diagrams related to base shear as well as floors relative displacement diagrams.
WASTE DISPLACEMENT

Waste displacement is created when the structure is affected by seismic forces and moves in one direction and vibrates in new position without returning to the first position. In this research for showing the effect of different kinds of dampers on waste replacement, time history diagrams of first floor structure displacement are proposed under the effect of earthquake NF06 with intensities of 0.1g to 1.5g. These diagrams are drawn for attenuation 20% and for moods of using damper with \( \alpha = 0.5, 1, 1.5 \). Looking these diagrams carefully, it can be observed that with increasing the seismic intensity, lateral displacement in frame of 9 floors has been increased.

With increasing in earthquake's intensity, the performance of different dampers in reducing lateral displacement can be compared to each other. In low intensity of earthquake the performance of dampers is the same and their performance cannot be investigated in reducing displacement. With increasing the intensity of earthquake obtained diagrams get far from each other and provide the opportunity of comparing results. It can be seen that with increasing the intensity of earthquake dampers with \( \alpha = 0.5, \alpha = 1, \alpha = 1.5 \) respectively give the best results. Figures 22 to 29 show Time History diagram of structure displacement for \( S_a = 0.1 \), \( S_a = 0.3 \), \( S_a = 0.5 \), \( S_a = 0.7 \), \( S_p = 0.9 \), \( S_p = 0.11 \), \( S_p = 0.13 \) and \( S_p = 0.15 \).
CONCLUSION

After accomplishing necessary analyses and investigating diagrams, it was observed that with increasing the intensity of applied earthquake, the behavior of structure will change. Changing in behavior can be seen with changing the kind of damper and as well as construct’s added attenuation percentage.

Linear Viscose dampers affected by near field earthquake reduce construct’s relative displacement which is against the claim of researchers who consider the role of viscose damper in reducing constructs’ response trivial.

It can be seen that with increasing system’s attenuation, the values of base cut also increase and it is while in relative displacement diagrams it is vice versa and with increasing system’s attenuation, construct's relative displacement will reduce. With more accurate look at diagrams of IDA of base shear it can be seen that before reaching structure to surrender point (the beginning point of dispersions), with increasing the attenuation, base shear values will reduce. And with the intensity of applied earthquake and passing surrender point, the behavior of diagrams will change in a way that with increasing attenuation, base shear values will increase. Therefor it can be concluded that considering that structure is in elastic or plastic area, linear viscose damper creates different effects on construct’s behavior.

It was seen that under the earthquake near fault field, with increasing attenuation of construct, created dispersion among IDA curves will reduce that this case relatively shows predictability of linear viscose dampers’ behavior. According to proposed time history diagrams, it can be concluded that dampers with $\alpha=0.5$, $\alpha=1$, $\alpha=1.5$ respectively give the best performance in reducing lateral displacement of structure under the effect of near field.

REFERENCES

900028, National Center for Earthquake Engineering.
Research State University, of New York(SUNY) at
Buffalo, N.Y.

Experimental Study of Seismic Response of Buildings
with Supplemental Fluid Dampers. The Structural
Design of Tall Buildings, 2, pp. 93-132.

10. FEMA (2000) NEHRP. Recommended Provisions for
Seismic Regulation for New Buildings and Other
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Council for the Federal Emergency Management
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