√ مشخصات پروژه

مشخصات عمومی این پروژه بصورت زیر است: موقعیت: تبریز،کاربری: مسکونی، تعداد طبقات:۵ طبقه، سیستم مقاوم جانبی: قاب خمشی بتنآرمه، شکل پذیری متوسط، نوع سقفها: تیرچه بلوک، نوع خاک: III، ارتفاع طبقات: ۳٫۲ متر، طول دهانهها در جهت X و Y: ۵، طول دهانهها در جهت X و Y: ۵ متر.

| یلی مصالح           | مشخصات تحل             | مشخصات طراحي              |                         |  |  |  |  |
|---------------------|------------------------|---------------------------|-------------------------|--|--|--|--|
| جرم واحد حجم M      | 240 kg /m <sup>3</sup> | مقاومت فشاری ۲۸ روزه بتن  | $210 \text{ kg/cm}^2$   |  |  |  |  |
| مدول الاستيسيته بتن | $4700\sqrt{f_c}$       | تنش تسلیم آرماتورهای طولی | 4000 kg/cm <sup>2</sup> |  |  |  |  |
| ضریب پواسون بتن ۷   | 0.15                   | تنش تسلیم آرماتورهای عرضی | 4000 kg/cm <sup>2</sup> |  |  |  |  |

مشخصات میلگردها بر اساس مبحث نهم

| Rebar | E(kg/cm2) | F <sub>y</sub> (kg/cm2) | F <sub>u</sub> (kg/cm2) | Fye(kg/cm2) | Fue(kg/cm2) |
|-------|-----------|-------------------------|-------------------------|-------------|-------------|
| S400  | 3 e6      | 4000                    | 6000                    | 5000        | 7500        |

√ بارگذاری ثقلی و جانبی

Dead=600 kg/m<sup>2</sup>, Live=250 Kg/m<sup>2</sup>

| K      | $C = \frac{ABI}{R}$ | Ι | А    | В       | Ν      | B <sub>1</sub> | زمان تناوب سازه |
|--------|---------------------|---|------|---------|--------|----------------|-----------------|
| 1.1289 | 0.1799              | 1 | 0.35 | 2.57134 | 1.0122 | 2.5402         | 0.6062 Sec      |

✓ مقاطع تيرها و ستونها

|           |        | ·     |
|-----------|--------|-------|
| ستون      | تير    | طبقه  |
| C60-16T28 | B45×50 | اول   |
| C55-12T25 | B45×50 | دوم   |
| C50-12T25 | B45×50 | سوم   |
| C45-8T25  | B40×45 | چهارم |

مقاطع تیرها و ستونهای طبقات

ر C45-8T25 B40×45 پنجم

✓ اختصاص مفاصل پلاستیک تیرها

بعد از انتخاب تیرهای بتنی، مفاصل تیرهای بتنی مطابق اشکال زیر تنظیم خواهد گردید.

| ×                |          |           |        |          | 1                |               |               |             |          |        | SAP2000      | ) v20.0  | 0.0 Ultim   | nate 3  | 32-b     | oit -             | concrete-Pushover                       |        |
|------------------|----------|-----------|--------|----------|------------------|---------------|---------------|-------------|----------|--------|--------------|----------|-------------|---------|----------|-------------------|---|--------|
| Fil              | e Edit   | View      | Define | Draw     | Selec            | t Assign      | Analyze       | Display     | <u> </u> | esign  | Options      | Tools    | ; Help      |         |          |                   |   |        |
|                  | <b>\</b> | l 🔒 🛛     | 201    | / 🔒      | * ⊳              | Select        |               | 2           | •        | Č2     | Pointer/Win  | dow      |             |         |          | § 🔽               | I I → T → T → T → T → T → T → T → T → T | nd - I |
|                  | 🛛 🎉 X-7  | Z Plane ( | ⊉ Y=0  |          | ×                | Deselect      |               |             | •        | 4      | Poly         |          | Ctrl+Shift- | +0      |          |                   | 3-D View                                |        |
| -0-              |          |           |        |          |                  | Select Usin   | g Tables      |             |          | 2      | Intersecting | Poly     | Ctrl+Shift  | + P     |          |                   |   |        |
| 8                |          |           |        |          | E GER            | Invent Cala   | -             | Challe K    |          | 1      | Intersecting | Line     | Ctrl+Shift  | +L      |          |                   |   |        |
| Ŀ                |          |           |        |          | LOST             | Invert Sele   |               | CUITR       |          | ta₽    | Coordinate S | Specific | ation       |         |          |                   |   |        |
| >                |          |           |        | $\frown$ | PS               | Get Previo    | us Selection  | Ctrl+J      |          |        |              |          | -           | -       |          | đ.                |   |        |
| $\mathbf{N}$     |          |           |        |          | clr <sup>₽</sup> | Clear Selec   | tion          | Ctrl+Q      |          | 1/2    | Select Lines | Parallel | ITo 🧯       | 5       | <u>۲</u> | 10                | Click Straight Line Object              |        |
| $\mathbb{X}$     |          | Ŷ         |        | Ŷ        |                  | $\neg \gamma$ |               | Y           |          | Р₿     | Properties   |          |             |         | ۰Ľ       | 0. <sup>1</sup> 8 | Coordinate Axes or Plane                | 4      |
|                  |          | Ē         |        | -        |                  | ×             |               |             | Se       | lect L | ines Paralle | el to (  | Coordina    | ate A   |          | pr F              | Plane                                   | ×      |
|                  |          |           |        |          |                  | Select        | Lines That a  | Are         |          |        |              |          | Select A    | xes a   | d Pla    | anyes             |   |        |
|                  |          |           |        |          |                  | ۲             | Parallel to S | pecified It | ems      |        |              |          | Coord       | l Syste | $\sim$   | 1                 | GLOBAL                                  | ~      |
|                  |          |           |        |          |                  | 0             | NOT Paralle   | l to Specif | ied It   | ems    |              |          | - 🖂         | X Axi   | is       |                   |   |        |
| -                |          |           |        |          |                  |               |               |             |          |        |              |          | _<br>       | Y Axi   | is       |                   |   |        |
|                  |          |           |        |          |                  | Comp          | are Line Ori  | entation I  | 0        |        |              |          |             | Z Axi   | is       |                   |   |        |
| -0-4             |          |           |        |          |                  |               | .oordinate    | Axes and I  | lane     | s      |              |          |             | XY PI   | lane     |                   |   |        |
| ~~~              |          |           |        |          |                  |               | Ine Objects   | •           |          |        |              |          |             | XZ PI   | lane     |                   |   |        |
| $\approx$        |          |           |        |          |                  | 0,            | Area Object   | s           |          |        |              |          |             | YZ PI   | lane     |                   |   |        |
|                  |          |           |        |          |                  | Tolera        | nce Angle     |             |          |        |              |          |             |         |          |                   |   |        |
| 2                |          |           |        |          |                  | ۲             | Default (0.0  | 57 deg)     |          |        |              |          |             |         |          |                   |   |        |
| 0.4              |          |           |        |          |                  | 0             | Jser Angle    |             |          |        | deg          |          |             |         |          |                   |   |        |
| · · · · ·        |          |           |        |          |                  |               |               |             |          |        |              |          |             |         |          |                   |   |        |
| all              |          |           |        |          |                  |               |               |             |          |        | Reset F      | orm to   | Default V   | alues   |          |                   |   |        |
| PS               |          |           |        |          |                  |               |               |             |          | 6 Г    | Select       | Dee      | alact       |         | less     |                   |   |        |
| clr <sup>₽</sup> |          |           |        |          |                  |               |               |             |          | ۰L     | Select       | Des      | elect       |         | lose     |                   |   |        |
| S.D              |          |           |        |          |                  |               |               |             |          |        |              |          |             |         | 1        |                   |   |        |
|                  |          |           |        |          |                  |               |               | رها         | ب تي     | تخاب   | مسير ان      |          |             |         |          |                   |   |        |

| File       Edit       View       Define       Draw       Select       Assign       Analyze       Display       Design       Options       Tools       Help         Image: Solid Structure       Image: S   | - <b>-</b>          |  |  |  |  |  |
|--|---------------------|--|--|--|--|--|
| Image: Solution of the section of t                                | <u>- Г</u>          |  |  |  |  |  |
| X-Z Plane @ Y=0       Frame       Z       I*       Frame Sections         Cable       I*       Property Modifiers       Property Modifiers         I*       Tendon       I*       Material Property Overwrites         I*       Area       I*       Releases/Partial Fixity         I*       I*       Solid       I*       Local Axes         I*       I*       I*       I*       Reverse Connectivity         I*       Joint Loads       I*       End (Length) Offsets  |                     |  |  |  |  |  |
| Image: Cable       Image: Cable <td< th=""><th></th></td<>   |                     |  |  |  |  |  |
| Image: Constraint of the second se                                | .                   |  |  |  |  |  |
| 1       1       1       Area       Releases/Partial Fixity         Solid       Link/Support       Keverse Connectivity         Joint Loads       End (Length) Offsets  |                     |  |  |  |  |  |
| 1     1     Image: Solid     <   |                     |  |  |  |  |  |
| Image: Construction of the second                   |                     |  |  |  |  |  |
| Joint Loads  |                     |  |  |  |  |  |
|  |                     |  |  |  |  |  |
| Frame Loads  |                     |  |  |  |  |  |
| Cable Loads  |                     |  |  |  |  |  |
| Tendon Loads   |                     |  |  |  |  |  |
| Area Loads   |                     |  |  |  |  |  |
| Bolid Loads Path   |                     |  |  |  |  |  |
| Link/Support Loads > 🏑 Tension/Compression Limits.   |                     |  |  |  |  |  |
| Joint Patterns 1   |                     |  |  |  |  |  |
| OT Direction of the state of th |                     |  |  |  |  |  |
| مسير اختصاص مفاصل پلاستيک  |                     |  |  |  |  |  |
| Assign Frame Hinges  | ×                   |  |  |  |  |  |
| Frame Hinge Assignment Data  |                     |  |  |  |  |  |
| Hinge Property Distance<br>Auto V 0.95 3 From Tables in ASCE 41-13   | ~                   |  |  |  |  |  |
| 1 Auto M3 0.05 2   | Select a Hine Table |  |  |  |  |  |
| Auto Mis 0.99 Add Hinge 4 Table 10-7 (Concrete Beams - Flexure) Item i   | ¥                   |  |  |  |  |  |
| Modify/Show Auto Hinge Degree of Freedom V Value From V Value From   | _                   |  |  |  |  |  |
| Delete Hinge M2<br>5 الس M3 G Case/Combo DEAD  | ~                   |  |  |  |  |  |
| Current Hinge Information  |                     |  |  |  |  |  |
| Type: From Tables In ASCE 41-13 Table: Table 10-7 (Concrete Beams - Flexure) Item i Transverse Reinforcing Reinforcing Reinforcing Ratio (p - p') / pbalanced  |                     |  |  |  |  |  |
| Options User Value (for positive bending)  |                     |  |  |  |  |  |
| Add Specified Hinge Assigns to Existing Hinge Assigns  |                     |  |  |  |  |  |
| Replace Existing Hinge Assigns with Specified Hinge Assigns     Deformation Controlled Hinge Load Carrying Capacity  |                     |  |  |  |  |  |
| Number of Selected Frame Objects: 300<br>Total Number of Hinges on All Selected Frame Objects: 0 Starapolated After Point E  |                     |  |  |  |  |  |
| Fill Form with Hinges on Selected Frame Object   |                     |  |  |  |  |  |
| OK Cancel  |                     |  |  |  |  |  |
| OK Close Apply   |                     |  |  |  |  |  |

تنظيمات مفاصل تيرهاي بتني

🗸 اختصاص مفاصل پلاستیک ستونها

با انتخاب ستونهای بتنی همانند ستونهای فولادی، مفاصل ستونهای بتنی نیز تنظیم خواهد شد.

| ×            |          |            |           |               | 1          |                  |                   |               |                   | SAP2000      | 0 v20.0  | 0.0 Ultimate 32   | 2-bit - concrete-Pushover    |
|--------------|----------|------------|-----------|---------------|------------|------------------|-------------------|---------------|-------------------|--------------|----------|-------------------|------------------------------|
| File         | e Edit   | View       | Define    | Draw          | Sele       | t Assign         | Analyze           | Display       | Design            | Options      | Tools    | s Help            |                              |
|              | <b>\</b> | - <b>a</b> | 20        | / 🔒           | *          | Select           |                   | 2             | Ľ₿                | Pointer/Win  | ndow     |                   | 監 ☑   ☆ ・ □ カァ ☆- nd   •     |
|              | 🔀 Fra    | me Hing    | ges       |               | ×          | Deselect         |                   | )             |                   | Poly         |          | Ctrl+Shift+O      | 🔀 3-D View                   |
| -2-          |          |            |           |               |            | Select Using     | Tables            |               | <b>N</b> B        | Intersecting | Poly     | Ctrl+Shift+P      |                              |
| •            |          |            |           |               |            | Invert Selec     | tion              | Ctrl+K        | N                 | Intersecting | Line     | Ctrl+Shift+L      | _                            |
| $\sim$       |          | $\square$  |           |               | PS         | Get Previou      | s Selection       | Ctrl+J        | Į <u>₽</u> ₽      | Coordinate   | Specific | tation •          |                              |
| $\mathbf{N}$ |          | Ä          |           | B             |            | Clear Select     | ion               | Ctrl+Q        | 11                | Select Lines | Paralle  | ITo <b>3</b> →    | Click Straight Line Object   |
| $\mathbf{X}$ |          | Ť          | 511H1(Au) | 0 M3)_511H2(  | Autonala   | Auto M3)_512H2(A | 16 139(1(Auto M3) | 513H2(Aut61MB | no P <sup>®</sup> | Properties   |          | •                 | € Coordinate Axes or Plane 4 |
|              |          |            |           |               |            | )¥(              |                   | Se            | elect Lin         | nes Parallel | to Co    | ordinate Axes     | or Plane                     |
| $\square$    |          |            |           |               |            | Select Lin       | es That Are       |               |                   |              |          | Select Axes and P |                              |
|              |          |            | Calle 104 | - Mal         | - Constant | Para             | IIIel to Spec     | ified Items   |                   |              |          | Coord System      | GLOBAL V                     |
|              |          |            |           |               |            | 0 NO             | Parallel to       | Specified I   | tems              |              |          | X Axis            |                              |
| •            |          | - F        | 391H1(Au  | 6 M3) 391142( | Aut 2 5635 | Compare          | Line Orienta      | ation To      |                   |              |          | Y Axis            |                              |
| 19           |          |            |           |               |            | Cod              | rdinate Axe       | s and Plane   | 25                |              |          | 5 🗹 Z Axis        |                              |
| -9-4         |          |            | 331H1(Au  | to M3)_331H2( | Auto 32    | ⊖ Line           | Objects           |               |                   |              |          | XY Plane          |                              |
| $\sim$       |          |            |           |               |            | ⊖ Are            | a Objects         |               |                   |              |          | XZ Plane          |                              |
|              |          |            | -27181/44 | M31-2711-2/   | Auto 191   | Tolerance        | Angle             |               |                   |              |          | YZ Plane          |                              |
| -y•<br>54    |          |            |           |               | -          | Def              | ault (0.057 c     | lec)          |                   |              |          |                   |                              |
|              |          |            |           |               |            | O Use            | r Angle           | icg)          |                   | deg          |          |                   |                              |
|              |          |            | → ×       |               | _          |                  | , angle           |               |                   | deg          |          |                   |                              |
|              |          |            |           |               |            |                  |                   |               | [                 | Porot Fo     | rm to D  | of sult \/slues   |                              |
|              |          |            |           |               |            |                  |                   |               |                   | Reset Fol    | 111 to D |                   |                              |
| PS<br>, ₪    |          |            |           |               |            |                  |                   |               | 6 5               | Select       | Desel    | ect Close         |                              |
| cir<br>en    |          |            |           |               |            |                  |                   |               |                   |              |          |                   |                              |

### مسير انتخاب ستونها

| X   |                                   |                  |            |               |                  | 1          |                |          |                            | SAP200  | 0 v2 | 0.0.0 Ultimate 32-bit - concrete-Pus |
|-----|-----------------------------------|------------------|------------|---------------|------------------|------------|----------------|----------|----------------------------|---------|------|--------------------------------------|
| Fi  | le Edit                           | View             | Define     | Draw          | Select           | Assig      | in Analyze     | Display  | Design                     | Options | То   | ols Help                             |
|     | ) 💊   🔚                           | a 🖉              | 201        | / 🔒           | ▶ 💽              | *          | Joint          |          |                            | •       | nv   | ් දේ 🛉 🐳 🔛 🔀 🔹 🗖                     |
|     | 🔀 Fra                             | me Hing          | ges        |               |                  | *          | Frame          |          | 2                          | 2 +     | I.   | Frame Sections                       |
| -0- |                                   |                  |            |               |                  | ب          | Cable          |          |                            | •       | 1    | Property Modifiers                   |
|     |                                   |                  |            |               |                  | ~*         | Tendon         |          |                            | •       | 125  | Material Property Overwrites         |
| Ľ.  |                                   |                  |            |               |                  | 1          | Area           |          |                            | •       | d.   | Releases/Partial Fixity              |
|     |                                   | - (1)            |            | - 1           |                  |            | Solid          |          |                            | •       | 1    | Local Axes                           |
|     |                                   | - (4)            |            | P             |                  | ×          | Link/Support   |          |                            | ۲       | 1    | Reverse Connectivity                 |
| X   |                                   |                  | 511H1(Auto | M3) 511H2(    | Auto Auto        | <b>:</b>   | Joint Loads    |          |                            | ۲.      | Ţ.   | End (Length) Offsets                 |
|     |                                   |                  |            |               |                  | in.        | Frame Loads    |          |                            | ۲       | Ŀ    | Insertion Point                      |
|     |                                   |                  | 451H1(Auto | M3)_45112(/   |                  | C+*        | Cable Loads    |          |                            | •       | 1    | Output Stations                      |
|     |                                   |                  |            |               |                  | ~          | Tendon Loads   | ;        |                            | •       | ч.   |                                      |
|     |                                   |                  |            |               |                  | <u>111</u> | Area Loads     |          |                            | •       | PS R | P-Delta Force                        |
|     | 391H1(Auto M3)_391H2(Auto2039)(Au | Auto State (Auto | #          | Solid Loads   |                  |            | •              | <b>H</b> | Path                       |         |      |                                      |
| 10  |                                   |                  |            | Link/Support  | Loads            |            | •              | 4        | Tension/Compression Limits |         |      |                                      |
| 2   |                                   |                  | 331H1(Aut  | o M3)_33142(/ | Auto 309(1 (Auto |            | Joint Patterns |          |                            |         | 1.   | Hinges 3 🔊                           |
| 0   |                                   |                  |            |               |                  |            |                |          |                            |         | 012  | Hinge Overwrites                     |

مسير اختصاص مفاصل پلاستيک

| X Assign Frame Hinges   | Auto Hinge Assignment Data   | × |
|---|--|---|
| Frame Hinge Assignment Data           Hinge Property         Distance           Auto         v         0.95           1         Auto         P-M2-M3         0.05           Auto         P-M2-M3         0.95           Auto         P-M2-M3         0.95           Auto         P-M2-M3         0.95           Auto         P-M2-M3         0.95           Auto         P-M2-M3         0.95 | Auto Hinge Type<br>3 From Tables in ASCE 41-13<br>Select a Hinge Table<br>4 Table 10-8 (Concrete Columns)<br>Degree of Freedom   | > |
| Current Hinge Information       Type: From Tables In ASCE 41-13       Table: Table 10-8 (Concrete Columns)       DOF: P-M2-M3       Options       Options       Add Specified Hinge Assigns to Existing Hinge Assigns   | M2       P.M2       Parametric P-M2-M3       6       Case/Combo       DEAD         M3       P.M3       W2-M3       0       User Value       V2       V3         Concrete Column Failure Condition       Condition iv - Development       Shear Reinforcing Ratio p = Av / (bw * s)       Shear Reinforcing Ratio p = Av / (bw * s)         Condition i - FlexureShear       Condition iii - Shear       Suser Value       V3 | ~ |
| OK       Close       Apply  | Deformation Controlled Hinge Load Carrying Capacity  |   |

تنظيمات مفاصل ستونهاى بتنى

🗸 محاسبه تغییر مکان هدف

مقدار  $T_i$  با استفاده از تحلیل مودال برای راستای X برابر ۸/۹۶۸۶ ثانیه و برای راستای y برابر  $T_i$  ثانیه برابر  $T_i$  مقدار  $T_i$  مقدار  $T_i$  مقدار  $T_i$  مقدار تقریبی ضریب  $C_0$  برای سازه ۵ طبقه برابر ۱/۴ و مقدار ضریب  $C_1$  هم ابتدا برابر ۱ بدست آمده است. مقدار تقریبی ضریب  $S_a$  برای سازه ۵ طبقه برابر میگردد. مقدار  $S_a$  برای این پروژه با توجه به قرار گرفتن سازه در شهر تبریز و در روی خاک نوع سه بصورت زیر محاسبه می شود.

#### $S_a = ABI$

$$\delta_{\rm i} = C_0 C_1 S_a \frac{T_e^2}{4\pi^2} g$$

| S <sub>ax</sub> | $\delta_{ix}$ | $\delta_{ix} 	imes 1.5$ | S <sub>ax</sub> | $\delta_{ix}$ | $\delta_{ix} \times 1.5$ |
|-----------------|---------------|-------------------------|-----------------|---------------|--------------------------|
| 0.8999          | 0.2937 m      | 0.44056 m               | 0.8999          | 0.2937 m      | 0.44056 m                |

الگوهای بارگذاری

## √ الگوی بارگذاری ثقلی

بر اساس استاندارد ۲۸۰۰ قبل از انجام تحلیل غیرخطی میباید بار ثقلی مطابق با ضرایب ترکیب بار مربوطه به مدل سازه اعمال گردد. ترکیب بارهای ثقلی در استاندارد ۲۸۰۰ عبارت است از:

 $Q_{G1} = 1.2 Q_D + Q_L$  $Q_{G2} = 0.9 Q_D$ 

### که در آن $Q_{\scriptscriptstyle \rm L}$ بار مرده و $Q_{\scriptscriptstyle \rm L}$ بار زنده است.



مسیر تعریف الگوی بار ثقلی

| X |  |   | Load Cas                   | e Data - Nonlinear Stat                   | tic                                    |             | × |  |  |  |  |
|---|--|---|----------------------------|---|--|-------------|---|--|--|--|--|
| 1 | Load Case Name<br>PG1  | Set De  | f Name                     | Notes<br>Modify/Show                      | Load Case Type<br>Static               | ✓ Design    |   |  |  |  |  |
|   | Initial Conditions<br>Zero Initial Condition<br>Continue from State  | ns - Start from Unstressed Si<br>at End of Nonlinear Case | ate                        |   | Analysis Type<br>Linear<br>2 Nonlinear |             |   |  |  |  |  |
|   | Important Note:       Loads from this previous case are included in the current case       O Nonlinear Staged Construction         Modal Load Case       All Modal Loads Applied Use Modes from Case       MODAL       Geometric Nonlinearity Parameters         Loads Applied       Important Note:       P-Delta       O P-Delta |   |                            |   |  |             |   |  |  |  |  |
| 4 | Load Type<br>Load Pattern v<br>Load Pattern<br>Load Pattern  | Load Name<br>Live<br>DEAD<br>Live                         | Scale Fac<br>1<br>1.2<br>1 | Add<br>Modify<br>Delete                   | Mass Source<br>Previous                |             |   |  |  |  |  |
| 5 | Other Parameters<br>Load Application<br>Results Saved<br>Nonlinear Parameters  | Full Load<br>Final State Only<br>Default                  | Ū.                         | Modify/Show<br>Modify/Show<br>Modify/Show | Ca                                     | 0K<br>ancel |   |  |  |  |  |

### $P_{G1}$ تنظيمات الگوى بار ثقلى

| L   | oad Appl        | ication Control fo     | or Nonlinear | Static Analysis | > |
|-----|-----------------|------------------------|--------------|-----------------|---|
| Loa | d Application   | Control                |              |                 |   |
| ۲   | Full Load       |                        |              |                 |   |
| 0   | Displaceme      | nt Control             |              |                 |   |
| Cor | ntrol Displace  | ment                   |              |                 |   |
| ۲   | Use Conjug      | ate Displacement       |              |                 |   |
|     | Use Monitor     | red Displacement       |              |                 |   |
| Lo  | ad to a Monit   | ored Displacement Magr | nitude of    |                 |   |
| Mor | nitored Displa  | cement                 |              |                 |   |
| ۲   | DOF             | U1 🗸                   | at Joint     | 6               |   |
|     | Generalized     | d Displacement         |              | $\sim$          |   |
| Ado | ditional Contro | lled Displacements     |              |                 |   |
| Г   |                 |                        |              | Modify/Show     |   |
|     |                 |                        |              |                 |   |
|     |                 | OK                     | Cancel       |                 |   |
|     |                 | ÖK                     | Cancer       |                 |   |
|     |                 |                        |              |                 |   |

 $P_{G1}$  تنظیمات Load Applications بار ثقلی

| × | Results Saved for Nonlinear Static Load Cases  | × |
|---|--|---|
|   | Final State Only     Multiple States   |   |
|   | For Each Stage       Minimum Number of Saved States       Maximum Number of Saved States       1 |   |
|   | Save positive Displacement Increments Only   |   |
|   | Cancer   |   |

 $P_{G1}$  تنظیمات Results saved بار ثقلی

سپس برای اضافه نمودن الگوی دوم بار ثقلی(P<sub>G2</sub>)، مطابق شکل زیر گزینه Add Copy of Load Cases انتخاب می کنیم.

| ×  | Define Load Cases  |    |  |  |  |  |  |  |
|--|--|----|--|--|--|--|--|--|
| Load Cases<br>EXP+0.3EY<br>EXP+0.3EY<br>EXP+0.3EY<br>EXN+0.3EY<br>EXN+0.3EX<br>EY+0.3EX<br>EYP+0.3EX<br>EYP+0.3EX<br>EYP+0.3EX<br>EYP+0.3EX<br>EYN+0.3EX<br>SPX<br>PG1 | Load Case Tyr<br>Linear Static<br>Linear Static<br>Response Spectrum<br>Response Spectrum<br>Nonlinear Static | pe | Click to:<br>Add New Load Case<br>Add Copy of Load Case<br>Modify/Show Load Case<br>Delete Load Case<br>Display Load Cases<br>Show Load Case Tree<br>OK Cancel |  |  |  |  |  |

مسیر تعریف الگوی بار ثقلی

| oad Case Name                                  |                      | Notes                   | Load Case Type            |             |
|--|----------------------|-------------------------|---------------------------|-------------|
| PG2 Se   | t Def Name           | Modify/Show             | Static                    | ✓ Design    |
| nitial Conditions                              |                      |                         | Analysis Type             |             |
| Zero Initial Conditions - Start from Unstresse | ed State             |                         | Linear                    |             |
| O Continue from State at End of Nonlinear Case |                      | ~                       | Nonlinear                 |             |
| Important Note: Loads from this previous       | case are included in | the current case        | O Nonlinear Staged Co     | nstruction  |
| Iodal Load Case                                |                      |                         | Geometric Nonlinearity Pa | rameters    |
| All Modal Loads Applied Use Modes from Case    | M                    | IODAL 🗸                 | None                      |             |
| oads Applied                                   |                      |                         | O P-Delta                 |             |
| Load Type Load Name                            | Scale Facto          | r                       | P-Delta plus Large Dis    | splacements |
| Load Pattern v DEAD                            | ♥ 0.9                |                         | Mass Source               |             |
| Load Pattern DEAD                              | 0.9                  | Add<br>Modify<br>Delete | Previous                  | ~           |
| Other Parameters                               |                      |                         |                           |             |
| Load Application Full Load                     |                      | Modify/Show             | Of                        |             |
| Results Saved Final State 0                    | Only                 | Modify/Show             | Can                       | cel         |
| Nonlinear Parameters Default                   |                      | Modify/Show             |                           |             |

تنظيمات الگوى بار ثقلى P<sub>G1</sub>

# √ الگوی بار جانبی طیفی

گام اول: ابتدا تعداد مودهای سازه را تنظیم مینماییم. برای اینکه تعداد مودهای لازم در سازه بر اساس ضوابط

استاندارد ۲۸۰۰ تامین گردد، تعداد مودها سه برابر تعداد طبقات انتخاب می گردد.

| × <u>1</u>                               | SAP2000 v20.0.0 Ultimate 32-bit - concrete-Pushover                    |
|--|--|
| File Edit View Define Draw Select Assign | Analyze Display Design Options Tools Help                              |
| 🗈 🦴 🔚 💼 🕞 🞼 Materials                    | € Q 🕲 🐏 3-d xy xz yz nv 🤉 63 🛧 🐺 🗹 🖾 - 🔲 📅 ☆ - nd - I - 🔲 -            |
| Section Properties                       | → X X 3-D View   |
| -C Mass Source                           | Define Load Cases  |
| Coordinate Systems/Grids                 | Load Cases   |
| Joint Constraints                        | Load Case Name Load Case Type Add New Load Case                        |
| Joint Patterns                           | Tive Linear Static Add Copy of Load Case                               |
| Groups                                   | EX Linear Static<br>EY Linear Static                                   |
| Section Cuts                             | EXP Linear Static Delete Load Case Delete Load Case                    |
| Generalized Displacements                | EYP Linear Static<br>EYN Linear Static Display Load Cases              |
| *f <sub>x</sub> Functions                | P-DELTA Nonlinear Static<br>EX+0.3EY Linear Static Show Load Case Tree |
| Load Patterns                            | EX-0.3EY Linear Static<br>EXP+0.3EY V Linear Static                    |
| 10 D Load Cases 2                        | OK Cancel  |
|  |  |

مسیر تنظیم مودهای سازه

| ×      |              | 1              |                           | E Define Load Cases  | ×        |
|--------|--------------|----------------|---------------------------|--|----------|
| File   | Edit View    | Defir          | ne Draw Select Assign     | Anal   |          |
|        | 🍆   🔚 🚔   🗸  | K.             | Materials                 | Click to:  | 1        |
|        | 🔀 Analysis M | IJ             | Section Properties        | Load Case Name Load Case Type Add New Load Case  |          |
| -0-    |              | •?             | Mass Source               | Live Linear Static Add Copy of Load Case      Modal Linear Static Add Copy of Load Case      Modal Linear Static Add Copy of Load Case |          |
| •      |              | (****)         | Coordinate Systems/Grids  | Ev Linear Static Load Case Data - Modal  | ×        |
| >      |              | ÷              | Joint Constraints         |  |          |
| $\sum$ |              |                | Joint Patterns            | Load Case Name Notes Load Case Type  |          |
| X      | Ÿ            | 7              | Groups                    | MODAL Set Det Name Modify/Snow Modal   | V Design |
|        | Г            | 88             | Section Cuts              | Zara lažial Condžiana I lastranad State     Sican Vestore     Sican Vestore  |          |
|        |              | ~              | Generalized Displacements | ○ Etto minar Continuois - Onsuressed state     ○ Etgen vectors       ○ Stiffness at End of Nonlinear Case     ✓                        |          |
|        |              | *fx            | Functions                 | Important Note: Loads from the Nonlinear Case are NOT included in the current case   |          |
| -      |              | ¥D<br>¥E       | Load Patterns             | Number of Modes 5  |          |
|        | - F          | 1.0 D<br>1.5 E | Load Cases 2              | Maximum Number of Modes 15   |          |
| -0-1   |              | D+L<br>+E      | Load Combinations         | Minimum Number of Modes 3  |          |
| est.   | Ļ            | <u>111</u>     | Moving Loads              | Loads Applied  |          |
| ×      |              |                | Named Property Sets       | Chow Advanced Load Parameters Other Parameters Other Parameters  |          |

تنظيم مودهاي سازه

گام دوم: طیف استاندارد طراحی بر اساس خطر نسبی و نوع خاک ساختگاه در نرمافزار فراخوانی شده و الگوی طیفی تعریف شده و سازه تحلیل طیفی می گردد.

طیف طراحی آئیننامه بر اساس نوع خاک و لرزهخیزی منطقه از آئیننامه انتخاب می شود. بر اساس اینکه نوع خاک انتخابی در این پروژه خاک نوع III و محل ساختگاه منطقه با خطر نسبی خیلی زیاد است، لذا طیف انتخابی بصورت شکل زیر می باشد.



طیف مربوط به خاک نوع III در منطقه با خطر نسبی خیلی زیاد

بعد از انتخاب طیف طرح، این طیف در نرم افزار به صورت اشکال زیر فراخوانی می شود. فایل طیف باید در فرمت text ذخیره گردد.

| ×                       | 1                            | SAP2000 v20.0.0 Ultimate 32-bit - concrete-Pushover                     |
|-------------------------|------------------------------|---|
| File Edit View          | Define Draw Select Assign An | ilyze Display Design Options Tools Help                                 |
| 🗈 💊 🔚 🚔                 | Ì∕Ē Materials                | €. Q. 😻 💱 3-d xy xz yz nv 🗵 60   🛧 🐺 🗹 🖾 - 🛛 📅 ☆ - nd   - 🛛 I - 🔲 -   - |
| Analysis M              | Section Properties           | ✓ X X 3-D View  |
| -0-20                   | •? Mass Source               |   |
| $\overline{\mathbf{O}}$ | Coordinate Systems/Grids     |   |
| 1                       | Joint Constraints            | (1) (1) 🔀 Define Response Spectrum Functions 🗴                          |
|                         | Joint Patterns               |   |
| $\times$                | 🔂 Groups                     | Response Spectra Choose Function Type to Add                            |
|                         | Section Cuts                 | 4 UNIFRS 5 From File V  |
|                         | Generalized Displacements    | Click to:   |
|                         | $f_x$ Functions 2            | C Response Spectrum 3   |
|                         | VD Load Patterns             | Time History Modify/Show Spectrum                                       |
|                         | 10 D<br>15 E Load Cases      | Power Spectral Density Delete Spectrum                                  |
|                         | D+L<br>+E Load Combinations  | Steady State  |
| Se.                     | HII Moving Loads             | OK Cancel   |
| ×                       | Named Property Sets          |   |
|                         |                              | مسير فراخواني طيف طراحي   |



تنظيمات طيف طراحي فراخواني شده

بعد از فراخوانی طیف الگوی بار برای راستای X و Y تعریف می گردد.

| × 1                                      | SAP2000 v20.0.0 Ultimate 32-bit - concrete-Pushover                            |             |
|--|--|-------------|
| File Edit View Define Draw Select Assign | Analyze Display Design Options Tools Help                                      |             |
| 🗋 🥎 🔚 💼 🖌 🖆 Materials                    | €, Q, 💓 💱 3-d xy xz yz nv 🧿 60   ♠ ♣ 🌇 🗹 🖾 • 🔲 أת אין • I I                    | •   🔲 •   • |
| Analysis M J Section Properties          | → × 🕅 3-D View   |             |
| •? Mass Source                           | Define Load Cases  | ×           |
| Coordinate Systems/Grids                 |  |             |
| Joint Constraints                        | Load Cases Click to:<br>Load Case Name Load Case Type 3 Add New Load Case      | _           |
| Joint Patterns                           | DEAD         Linear Static         Add Copy of Load Case.                      |             |
| Groups                                   | MODAL Modal<br>Ex Linear Static Modify/Show Load Case.                         |             |
| Section Cuts                             | EV Linear Static<br>EXP Linear Static<br>Evn Linear Static<br>Delete Load Case |             |
| Generalized Displacements                | EVP Linear Static  |             |
| *fx Functions                            | P-DELTA Nonlinear Static Display Load Cases                                    |             |
| Se Load Patterns                         | EX+0.3EY Linear Static Snow Load Case Tree                                     |             |
| 10 D<br>15 E Load Cases 2                | CAP+U.JEY V Linear Static V  | zel         |
|  |  |             |
| A Moving Loads                           |  |             |

مسير تنظيم الگوي بار طيفي

| Load Case Data - Response Spectr  | rum 🛛 🔍  |
|---|--|
| Load Case Name         Notes           1         SPX         Set Def Name         Modify/Show | 2 Response Spectrum v Design   |
| Modal Combination   | Directional Combination<br>SRSS<br>CQC3<br>Absolute<br>Scale Factor<br>Mass Source<br>Previous (MSSSRC1)<br>Diaphragm Eccentricity<br>Eccentricity Ratio<br>Override Eccentricities<br>Override<br>$r = \frac{A*I*g}{R}$ |
| Other Parameters Modal Damping Constant at 0.05 Modify/Show                                   | OK<br>Cancel   |

تنظیمات الگوی بار طیفی راستای X

| bad Case Name                           | Load Case Type        |             |                         |          |
|---|-----------------------|-------------|-------------------------|----------|
| SPY SPY                                 | Set Def Name          | Modify/Show | Response Spectrum       | ✓ Design |
| odal Combination                        |                       |             | Directional Combination |          |
| ● cac                                   | GMC f1                | 1.          | SRSS                    |          |
| ⊖ srss                                  | 0110 60               | 0           | CQC3                    |          |
| O Absolute                              | GMC 12                | U.          | Absolute                |          |
| О дмс                                   | Periodic + Rigid Type | SRSS V      | Scale Factor            |          |
| NRC 10 Percent                          |                       |             | Mass Source             |          |
| O Double Sum                            |                       |             | Previous (MSSSRC1)      |          |
| odal Load Case                          |                       |             | Diaphragm Eccentricity  |          |
| Use Modes from this Modal Load Case     | MC                    | DAL V       | Eccentricity Ratio      | 0        |
| Standard - Acceleration Loading         |                       |             | Looonanoky Hallo        | <b>.</b> |
| Advanced - Displacement Inertia Loading |                       |             | Override Eccentricities | Override |
| oads Applied                            |                       |             |                         |          |
| Load Type Load Name Function            | on Scale Factor       |             |                         |          |
| Accel U2 v 2800-III                     | ♥ 0.6867              |             |                         |          |
| Accel U2 2800-III                       | 0.6867                | Add         |                         |          |
| <b>X7</b> 14 1                          |                       |             |                         |          |
| Cimelo Y                                |                       | Modify      |                         |          |
|   |                       | Delete      |                         |          |
|   |                       |             |                         |          |
| Show Advanced Load Parameters           |                       |             |                         |          |
| ther Parameters                         |                       |             |                         |          |
|   |                       |             | 01/                     |          |

تنظیمات الگوی بار طیفی راستای y

گام سوم: استخراج نیروی جانبی طبقات بر اساس تحلیل حاصل از طیف. برای انجام این کار باید از روش Section Cut استفاده نمود. ابتدا باید از مسیر زیر دیاگرام نیروی برشی المانها نمایش داده شود.

| 1 SAP2000 v20.0.0 Ultimate 32-bit - concrete-Pushover – 🗖 📑 |  |                                       |  |  |  |  |  |  |
|---|--|---------------------------------------|--|--|--|--|--|--|
| File Edit View Define Draw Select Assign Analyze            | Display Design Options Tools Help  | Display Frame Forces/Stresses         |  |  |  |  |  |  |
| 🗋 🔖 🔚 🚔 🕫 🐼 🖌 🔒 🕨 🕑 🔍 🔍 🔍                                   | 🕻 🗖 Show Undeformed Shape 🛛 F4 🕈 🚆 🗹 🖾 🔹 🗖 🃅   | Case/Combo                            |  |  |  |  |  |  |
| 📉 🔀 Deformed Shape (DEAD)                                   | 🗞 Show Misc Object Assigns 🔹 👻 🔀 3-D View  | Case/Combo Name 4 SPX ~               |  |  |  |  |  |  |
|   | Show Misc Element Assigns  |                                       |  |  |  |  |  |  |
|   | Show Object Load Assigns 🔸   | Multiplied Options                    |  |  |  |  |  |  |
|   | Show Element Load Assigns  | Fourier (Marco Min)                   |  |  |  |  |  |  |
| 6-1   | Show Paths   | Step                                  |  |  |  |  |  |  |
|   | Show Load Case Tree  |                                       |  |  |  |  |  |  |
|   | T Show Deformed Shape F6   | Display Type                          |  |  |  |  |  |  |
|   | ₩ Show Forces/Stresses 2 → 4. Joints   | Force     O Stress                    |  |  |  |  |  |  |
|   | Show Virtual Work Diagram Soil Pressure  | Component                             |  |  |  |  |  |  |
|   | Show Influence Lines Frames/Cables/Tendons   | Axial Force     Torsion               |  |  |  |  |  |  |
| •   | Mathematical M | Shear 2-2     S     Moment 2-2        |  |  |  |  |  |  |
|   | Show Plot Functions F12 Planes   | O Shear 3-3 O Moment 3-3              |  |  |  |  |  |  |
| -¢4   | Asolids  | Scaling for Diagram                   |  |  |  |  |  |  |
|   | Solids F   | Automatic                             |  |  |  |  |  |  |
| ×   | Show Tables Ctrl+T   | O User Defined                        |  |  |  |  |  |  |
| -44   | Crue Manual Direlay  | Options for Diagram                   |  |  |  |  |  |  |
| R4  | Ind Save Named Display   | Fill Diagram     Show Values          |  |  |  |  |  |  |
|   | nu Show Named Visua  |                                       |  |  |  |  |  |  |
|   | nv snowivarneu view  | Reset Form to Default Values          |  |  |  |  |  |  |
| all <sup>e</sup>  |  | Reset Form to Current Window Settings |  |  |  |  |  |  |
| PS <sup>4</sup>   |  |                                       |  |  |  |  |  |  |
| ch <sup>R</sup>   |  | OK Close Apply                        |  |  |  |  |  |  |
| 28  |  |                                       |  |  |  |  |  |  |

مسیر نمایش دیاگرام نیروی برشی المانها در راستای X

دیاگرام نیروی برشی المانها مطابق شکل زیر میباشد. برای انجام section cut باید محیط xz را در برنامه انتخاب نماییم تا قابها نمایش داده شوند. با انتخاب گزینه section cut از منوی Draw و انتخاب ستونهای هر طبقه، مجموع برش ستونها برای هر سه راستا نمایش داده خواهد شد.



نمایش دیاگرام نیروی برشی المانها در راستای X

| ×    |          |          |            | 1    |            |             |              |         |        | SAP2000  | ) v20.0. | 0 Ultimat |
|------|----------|----------|------------|------|------------|-------------|--------------|---------|--------|----------|----------|-----------|
| File | e Edit   | View     | Define     | Draw | Select     | Assign      | Analyze      | Display | Design | Options  | Tools    | Help      |
| i 🗅  | <b>\</b> | - 🖶 🕒    | 201        |      | Set Select | Mode        |              |         | 3-d >  | xy xz yz | nv 🧿     | ତ୍ୟେ 📥    |
|      | 🔀 Sh     | ear Ford | e 2-2 Diag | -    | Set Reshap | pe Element  | Mode         |         |        |          |          | -         |
|      |          |          |            | •    | Draw Spec  | ial Joint   |              |         |        |          |          |           |
|      |          |          |            | ~    | Draw Fram  | ne/Cable/1  | endon        |         |        |          |          |           |
|      |          |          |            |      | Quick Dra  | w Frame/C   | able/Tendo   | on      |        |          |          |           |
| 5-1  |          |          |            |      | Quick Dra  | w Braces    |              |         |        |          |          |           |
|      |          |          |            |      | Quick Dra  | w Seconda   | ry Beams     |         |        |          |          |           |
|      |          | ្រ       |            |      | Draw Poly  | Area        |              |         |        | 1        |          |           |
|      |          |          |            |      | Draw Rect  | angular Ar  | ea           |         |        |          |          |           |
|      |          | L L      |            |      | Quick Dra  | w Area      |              |         |        |          |          |           |
|      |          |          |            | ~    | Draw 1 Joi | nt Link     |              |         |        |          |          |           |
| -    |          |          |            | ×    | Draw 2 Joi | nt Link     |              |         |        | ┓┏┹╼╼╼╼  |          |           |
|      |          |          |            |      | Quick Dra  | w Link      |              |         |        |          |          |           |
|      |          | -        |            | Ø    | Draw Sect  | ion Cut     | 1            | 2       |        | ┑┝═┵───  |          |           |
| 294  |          |          |            | 2    | Draw Deve  | eloped Elev | ation Defini | ition   |        |          |          |           |

مسیر انتخاب section cut



نیروهای مقطع برش راستای X در قاب ۱ طبقه اول

همچنان که مشاهده میشود مقدار برش قاب ۱ از طبقه اول ۵۹۵۲۳ کیلوگرم است. این پروژه در راستای  $x \ section$  cut قاب دارد. لذا section cut باید برای پنج قاب دیگر نیز انجام شود. سپس مجموع برشهای حاصله از شش قاب بعنوان برش طبقه اول خواهد بود. بعد از انجام این کار برای هر ۶ قاب که نتایج آنها در شکل زیر آورده شده است، مقدار برش طبقه اول برابر ۳۵۶۶۰۷/۶۹ کیلوگرم بدست آمده است. برای اینکه برش در سایر طبقات در راستای X در راستای X نیز تعیین گردد، این کار برای سرت آمده است. این برش در سایر طبقات در راستای که نتایج آنها در شکل زیر آورده شده است، مقدار برش طبقه اول برابر ۹۵۶۶۰۷/۶۹ کیلوگرم بدست آمده است. برای اینکه برش در سایر طبقات در راستای X نیز تعیین گردد، این کار برای سایر طبقات نیز انجام خواهد شد.

# الگوهای بار جانبی در پوش آور

| X Section Cut Stresse  | Section Cut Stresses   | Section Cut Stresses & Forces   |
|--|--|---|
| قاب 1  | قاب 2  | قاب 3   |
| Section Cutting Line   | Section Cutting Line   | Section Cutting Line  |
| X Y  | X Y  | X Y Z   |
| Start Point -1.2602 0.   | Start Point -1.10/6 5.   | Start Point -1.3111 10. 1.0054  |
| End Point 26.3111 0.   | End Point 26.1076 5.   | End Point 26.362 10. 0.9037   |
| Resultant Force Location and Angle   | Resultant Force Location and Angle   | Resultant Force Location and Angle  |
| X Y<br>12,5254 0.  | X Y<br>12.5 5.   | X Y Z Angle (X to 1)<br>12,5254 10. 0,9546 0.   |
|  | Include I France I Shalls I Assist   |   |
|  |  |   |
| Integrated Forces<br>Dight Side  | Integrated Forces<br>Right Side  | Integrated Forces Right Side  |
| 1 2 Z  | 1 2 Z  |   |
| Force 59523. 1.1084 1.6201   | Force 59486.86 1.2541 0.2304   | Force 59451.96 1.2473 0.1549 59451.96 1.2473 0.1549   |
| Moment 1.5858 648070. 813.4713   | Moment 1.4268 638511.1 913.8803  | mument 1.2384 62956.6 909.7084 1.2384 62956.6 909.7084  |
| Save Cut   | Save Cut   | Save Cut  |
| Example 2 Section Cut Stresse  | Section Cut Stresses &   | X Section Cut Stresses & Forces X   |
| قاب 1  | قاب 5  | 6,13  |
| Contine Outline Line   | - •  | 0 +-  |
| Section Cutting Line X Y   | Section Cutting Line X Y   | Section CL, X Y Z   |
| Section Cutting Line X Y<br>Start Point 1.1076 15.   | X         Y           Start Point         -0.9041         20.  | X         Y         Z           Start Point         -0.8533         25.         0.9037  |
| Section Cutting Line         X         Y           Start Point         -1.1078         15.           End Point         27.125         15.  | Section Cutting Line         X         Y           Start Point         -0.9041         20.           End Point         26.4128         20.   | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546   |
| Section Cutting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle   | Section Cutting Line X Y Start Point 0.9041 20. End Point 26.4128 20. Resultant Force Location and Angle   | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle  |
| Section Cutting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           X         13.0027         15.   | Section Cutting Line X Y<br>Start Point 0.9041 20.<br>End Point 26.4128 20.<br>Resultant Force Location and Angle X Y  | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle         X         Y         Z         Angle (X to 1)   |
| Section Cuting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           13.0087         15.         15.  | Section Cutting Line         X         Y           Start Point         -0.9041         20.           End Point         26.4128         20.           Resultant Force Location and Angle         X         Y           12.7543         20.  | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle           X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.   |
| Section Cuting Line X Y<br>Start Point -1.1076 15.<br>End Point 27.125 15.<br>Resultant Force Location and Angle X Y<br>13.0087 15.<br>Include V Frames Shells V Asol  | Section Cutting Line X Y<br>Start Point -0.9041 20.<br>End Point 26.4128 20.<br>Resultant Force Location and Angle X Y<br>12.7543 20.<br>Include V Frames Shelts V Asolids   | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle         X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.         Include         Y         Frames         Y Banes         Y Dialos         Y Links   |
| Section Cuting Line     X     Y       Start Point     -1.1076     15.       End Point     27.125     15.       Resultant Force Location and Angle     X     Y       13.0087     15.       Include     ✓ Frames ✓ Shells     ✓ Asol       Integrated Forces     Bioth Side  | Section Cutting Line X Y<br>Start Point 0.9041 20.<br>End Point 28.4128 20.<br>Resultant Force Location and Angle X Y<br>12.7543 20.<br>Include V Frames Shells Asolids<br>Integrated Forces   | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle         X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.         Include         Y         Frames Integrated Forces  |
| Section Cutting Line     X     Y       Start Point     -1.1076     15.       End Point     27.125     15.       Resultant Force Location and Angle     X     Y       X     15.     15.       Include     ✓ Frames     Shells     ✓ Asol       Integrated Forces     Right Side     1     2     Z   | Section Cutting Line X Y<br>Start Point 0.9041 20.<br>End Point 28.4128 20.<br>Resultant Force Location and Angle X Y<br>12.7543 20.<br>Include V Frames Shelis Asolids<br>Integrated Forces<br>Right Side 2 Z   | Section CL, X Y Z<br>Start Point 0.8533 25. 0.9037<br>End Point 26.6163 25. 0.9546<br>Resultant Force Location and Angle<br>X Y Z Angle (X to 1)<br>12.8815 25. 0.9291 0.<br>Include V Frames Shells V Asolids V Planes V Solids V Links<br>Integrated Forces<br>Right Side Left Side Left Side   |
| Section Cuting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           X         13.0087         15.           Include         ✓         Frames         Shells         ✓           Include         ✓         Frames         Shells         ✓         Asol           Integrated Forces         1         2         Z         59417.14         1.2474         0.1677  | Section Cutting Line X Y<br>Start Point 0.9041 20.<br>End Point 28.4128 20.<br>Resultant Force Location and Angle X Y<br>12.7543 20.<br>Include V Frames Shelis Asolids<br>Integrated Forces<br>Right Side<br>Force 1 2 Z<br>Force 1 2 Z   | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle         X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.         Include         Frames         Shells         ✓ Asolids         Planes         ✓ Solids         Links           Include         Frames         Shells         ✓ Asolids         ✓ Planes         ✓ Solids         ✓ Links           Include         Image: Solids         Image: Solids         ✓ Links         Image: Solids         ✓ Links           Include         Image: Solids         ✓ Solids         ✓ Image: Solids         ✓ Links  |
| Section Cutting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           13.087         15.         15.           Include         ✓         Frames         Shells         ✓           Noter Frames         ✓         Shells         ✓         Asol           Include         ✓         Frames         ✓         Shells         ✓           Noment         1.3629         635309.6         909.6025         909.6025  | Section Cutting Line         X         Y           Start Point         -0.9041         20.           End Point         28.4128         20.           Resultant Force Location and Angle         X         Y           12.7543         20.           Include         ✓         Frames         Shells         ✓           Include         ✓         Frames         Shells         ✓         Asolids           Integrated Forces         1         12541         0.1895         Moment         1.4267         638081.7         913.7167 | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle         X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.         Include         Frames         Shells         Ø solds         Unixs           Include         Frames         Shells         Ø solds         Ø Planes         Solds         Links           Include         Force         1         2         Z         1         2         Z           Moment         1.2551         630451.         813.2771         1.2551         630451.         813.2771   |
| Section Cutting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           X         15.         15.           Include         ✓         Frames         Shells         ✓           Include         ✓         Frames         Shells         ✓         Asol           Integrated Forces         1         2         Z         59417.14         1.2474         0.1677           Moment         1.3629         635309.6         909.6025         Save Cut         Save Cut | Section Cutting Line         X         Y           Start Point         -0.9041         20.           End Point         28.4128         20.           Resultant Force Location and Angle         X         Y           12.7543         20.           Include         Include         Y rames           Include         Frames         Shelis           Proce         12.59382.32         1.2541           Moment         1.4267         638081.7           Save Cut         Save Cut  | X         Y         Z           Start Point         -0.8533         25.         0.9037           End Point         26.6163         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle           X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.           Include         Frames         Shells         Ø Asolds         Planes           Include         Frames         Shells         Ø Asolds         Planes         Solds         Links           Include         Force         1         2         Z         1         2         Z           Moment         1.2551         630451.         813.2771         1.2551         630451.         813.2771           Save Cut         Save Cut         Save Cut         Save Cut         Save Cut  |
| Section Cutting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           13.067         15.         15.           Include         ✓         Frames         Shells         ✓           Include         ✓         Frames         Shells         ✓         Asol           Integrated Forces         1         2         Z           1.677           Moment         1.3629         635309.6         909.6025           909.6025  | Section Cutting Line X Y<br>Start Point 0.9041 20.<br>End Point 28.4128 20.<br>Resultant Force Location and Angle X Y<br>12.7543 20.<br>Include V Frames Shells V Asolids<br>Integrated Forces<br>Right Side Z<br>Force 1 22<br>Force 39382.32 1.2541 0.1895<br>Moment 1.4267 633081.7 913.7167<br>Save Cut  | X         Y         Z           Start Point         0.8533         25.         0.9037           End Point         26.6163         25.         0.9546           Resultant Force Location and Angle         X         Y         Z         Angle (X to 1)           12.8815         25.         0.9291         0.         Include         Frames         Shells         Ø solds         Links           Include         If Frames         Shells         Ø solds         Ø lanes         Solds         Links           Include         If 2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         2         Z         1         1         2 </td |
| Section Cutting Line         X         Y           Start Point         -1.1076         15.           End Point         27.125         15.           Resultant Force Location and Angle         X         Y           13.067         15.         15.           Include         Include         Frames         Shells         Asol           Integrated Forces         1         2         Z         59417.14         1.2474         0.1677           Moment         1.3629         635309.6         909.6025         Save Cut         Close   | Section Cutting Line X Y<br>Start Point 0.9041 20.<br>End Point 28.4128 20.<br>Resultant Force Location and Angle X Y<br>12.7543 20.<br>Include V Frames Shells V Asolids<br>Integrated Forces Right Side Z<br>Force 1259382.32 1.2541 0.1895<br>Moment 1.4267 638061.7 913.7167<br>Save Cut<br>Close F  | X       Y       Z         Start Point       0.8533       25.       0.9037         End Point       0.8533       25.       0.9037         End Point       26.6163       25.       0.9546         Resultant Force Location and Angle         X       Y       Z       Angle (X to 1)         12.8815       25.       0.9291       0.         Include       V       Frames       Shells       V       Solds       Links         Include       V       Frames       Shells       V       0.9291       0.       Include         Force       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       Z       1       2       2       2       1       2       2       2       1       2       2       2       3       3       0.262  |

نیروهای مقطع برش راستای X در طبقه اول تمام قابها

 $F_i = V_i - V_{i+1}$ 

F<sub>i</sub>: نیروی جانبی طبقه V<sub>i</sub>: برش طبقه

برش طبقه بالاتر:  $V_{i+1}$ 

نیروی جانبی و برش طبقات در راستای X

| طبقه | برش طبقه(kg) | نیروی جانبی(kg) |
|------|--------------|-----------------|
| 1    | 356607.69    | 22701.65        |
| 2    | 333906.04    | 47795.58        |
| 3    | 286110.46    | 69201.98        |
| 4    | 216908.48    | 90281.57        |
| 5    | 126626.91    | 126626.9        |

برای بدست آوردن برش و نیروی جانبی طبقات برای راستای Y، دقیقا مثل راستای X عمل می کنیم.

| <u>R</u>  | SAP2000 v20.0.0 Ultimate 32-bit - concrete-Pushov | Display Frame Forces/Stresses         |
|---|---|---------------------------------------|
| File Edit View Define Draw Select Assign Analyze Di | splay Design Options Tools Help                   | Const Country                         |
| □♥ \  | Show Undeformed Shape F4 🚽 📲 🗹 📩 🗖 🏹              | Case/Combo                            |
| 📉 🔀 Analysis Model - X-Z Plane @ Y=25               | Show Misc Object Assigns 🔸 👻 📜 🔀 3-D View         |                                       |
| <u>₹</u>  | Show Misc Element Assigns                         |                                       |
| <u> </u>  | Show Object Load Assigns                          | Multivalued Options                   |
| 2   | Show Element Load Assigns                         | Envelope (Max or Min)                 |
| 6 6 6   | Show Paths  | Step                                  |
|   | Show Load Case Tree                               |                                       |
|   | Show Deformed Shape F6                            | Display Type                          |
|   | Show Forces/Stresses 2 + 4 Joints                 | Force     O Stress                    |
|   | Show Virtual Work Diagram Soil Pressure           | Component                             |
|   | Show Influence Lines Frames/Cables/Tendons        | O Axial Force O Torsion               |
|   | Show Response Spectrum Curves Shells 3            | O Shear 2-2 O Moment 2-2              |
|   | Show Plot Functions F12 Planes                    | S Sinear 5-5                          |
| - et  | Show Static Pushover Curve Asolids                | Scaling for Diagram                   |
| Se E  | Show Hinge Results F                              | Automatic     User Defined            |
| ×   | Show Tables Ctrl+T                                |                                       |
| -44   | Save Named Display                                | Fill Diagram     Show Values          |
| No. Inc.  | Show Named Display                                | O the blogden O block Values          |
|   | Show Named View                                   | Reset Form to Default Values          |
|   |   | Reset Form to Current Window Settings |
| aii<br>   |   |                                       |
| -   |   | OK Close Apply                        |
| cr  |   |                                       |

مسیر نمایش دیاگرام نیروی برشی المانها در راستای Y



نمایش دیاگرام نیروی برشی المانها در راستای Y

| ×     |          |          |            | 1          |            |             |             |         |        | SAP20   | 00 v20.0 | 0 Ultimat |
|-------|----------|----------|------------|------------|------------|-------------|-------------|---------|--------|---------|----------|-----------|
| File  | Edit     | View     | Define     | Draw       | Select     | Assign      | Analyze     | Display | Design | Options | Tools    | Help      |
|       | <b>\</b> | a        | 200        | <b>k</b> 9 | Set Select | Mode        |             |         | 3-d    | xy xz y | z nv 🧿   | ର୍ଯ୍ୟ 📥   |
| ····· | 🔀 Sh     | ear Ford | e 2-2 Diag | <b>*</b> • | et Resha   | pe Element  | Mode        |         |        |         |          | •         |
|       |          |          |            | •          | Draw Spec  | ial Joint   |             |         |        |         |          |           |
| n l   |          |          |            | <b>\</b> [ | Draw Fran  | ne/Cable/1  | endon       |         |        |         |          |           |
|       |          |          |            | $\sum$     | Quick Dra  | w Frame/C   | able/Tendo  | on      |        |         |          |           |
| R-1   |          |          |            | 8          | Quick Dra  | w Braces    |             |         |        |         |          |           |
|       |          |          |            |            | Quick Dra  | w Seconda   | iry Beams   |         |        |         |          |           |
|       |          | ្រ       |            |            | Draw Poly  | Area        |             |         |        | 1       |          | h         |
|       |          |          |            | <u> </u>   | Draw Rect  | angular Ar  | ea          |         |        |         |          |           |
|       |          |          |            | •          | Quick Dra  | w Area      |             |         |        | -       |          |           |
|       |          |          |            | ×, (       | Draw 1 Joi | nt Link     |             |         |        |         |          |           |
|       |          | 4        |            | × [        | Draw 2 Joi | nt Link     |             |         |        |         |          |           |
|       |          |          |            | 8          | Quick Dra  | w Link      |             |         |        |         |          |           |
|       |          | f        |            |            | Draw Sect  | ion Cut     |             | 2       |        | ┑┏┹╌╴   |          |           |
| 89    |          |          |            | ^~ [       | Draw Deve  | eloped Elev | ation Defin | ition   |        |         |          |           |

مسیر انتخاب section cut



## الگوهای بار جانبی در پوش آور

| Section Cut Stresse   | Section Cut Stresses                | X Section Cut Stresses & Forces X   |
|---|-------------------------------------|---|
|   | Bula                                |   |
| Section Cutting Line  | Section Cutting Line                | Section Cutting Line  |
| Х Ү   | Х Ү                                 | X Y Z   |
| Start Point 01.3111   | Start Point 50.8533                 | Start Point 101.1076 1.158  |
| End Point 0. 26.4128  | End Point 5. 26.4128                | End Point 10. 26.4637 1.0563  |
| Resultant Force Location and Angle                              | Resultant Force Location and Angle  | Resultant Force Location and Angle  |
| X Y<br>0. 12.5509   | 5. 12.7798                          | X Y Z Angle (X to 1)<br>10. 12.678 1.1072 90.   |
| Include of Ecomes of Shalls of Applic                           | Include Common Challes Applide      |   |
|   |                                     |   |
| Integrated Forces<br>Right Side                                 | Integrated Forces<br>Right Side     | Integrated Forces Right Side Left Side  |
| 1 2 Z   | 1 2 Z                               | 1 2 Z 1 2 Z   |
| Force 59363.99 1.1085 0.2191<br>Moment 1.5582 646581.8 650.6859 | Force 59392.72 1.2542 0.1866        | Force 59420.58 1.2475 0.1191 59420.58 1.2475 0.1191<br>Moment 1.0528 620660.7 727 8072 1.0528 620660.7 727 8072 |
| Save Cut  | Sava Cut                            | Sava Cut  |
| Section Cut Stresses  |                                     |   |
| قابD  | Section Cut Stresses                | Section Cut Stresses & Forces   |
| Section Cutting Line  | فابE<br>Section Cutting Line        |   |
| Y X   | X Y                                 |   |
| Start Point 151.056/  | Start Point 201.5654                | Start Point 251.1076 1.0563   |
| End Point 15. 20.302  | End Point 20. 26.2093               | End Point 25. 26.2602 1.0563  |
| Resultant Force Location and Angle                              | Resultant Force Location and Angle  | Resultant Force Location and Angle  |
| 15. 12.6526   | X Y<br>20. 12.322                   | X Y Z Angle (X to 1)<br>25. 12.5763 1.0563 90.  |
| Include 🗸 Frames 🗹 Shells ✔ Asolid                              | Include V Frames V Shells V Asolids | Include V Frames V Shells V Asolids V Planes V Solids V Links   |
| Integrated Forces   | Internated Forces                   | Integrated Econom   |
| Right Side  | Right Side                          | Right Side Left Side  |
| Force 59448.44 1.2476 0.1309                                    | 1 2 Z<br>Force 59476 35 12543 17237 | 1 2 Z 1 2 Z<br>Force 50505.26 1.1085 1.7173 50505.26 1.1085 1.7173  |
| Moment 1.2384 629556. 727.8097                                  | Moment 1.5211 642892.6 731.0806     | Moment         1.1186         623098.3         650.8086         1.1186         623098.3         650.8086        |
| Save Cut  | Save Cut                            | Save Cut Save Cut   |
| Close   | Close                               | Close Refresh   |

نیروهای مقطع برش راستای Y در طبقه اول تمام قابها

| فيروى بالبي وبرش طبتك فرارشتاني أ |              |                 |  |  |  |  |
|-----------------------------------|--------------|-----------------|--|--|--|--|
| طبقه                              | برش طبقه(kg) | نیروی جانبی(kg) |  |  |  |  |
| 1                                 | 356607.34    | 22701.3         |  |  |  |  |
| 2                                 | 333906.04    | 47795.57        |  |  |  |  |
| 3                                 | 286110.47    | 69201.97        |  |  |  |  |
| 4                                 | 216908.50    | 90281.55        |  |  |  |  |
| 5                                 | 126626.95    | 126627          |  |  |  |  |

نیروی جانبی و برش طبقات در راستای Y

گام چهارم: بعد از آنکه مقدار نیروهای جانبی طبقات در راستای X و Y تعیین شد، نیروهای جانبی در قسمت

Load Patterns تعریف میگردد تا نحوه پخش بار جانبی طیفی مشخص گردد.

| ×            |        |          | 1                  |             |           |        |    |       |                       |      |                          | S   | AP20    | 00 v20.0 |
|--------------|--------|----------|--------------------|-------------|-----------|--------|----|-------|-----------------------|------|--------------------------|-----|---------|----------|
| File         | e Edit | View     | Define             | Draw        | Select    | Assign | An | alyze | Dis                   | play | Design                   | •   | Options | Tools    |
| . D          |        | a   •    | KE. N              | Aaterials   |           |        |    | Ð,    | $\Theta_{\mathbf{k}}$ | Ľ    | <sup>စို</sup> ဖို   3-d | ху  | xz y    | z nv 🔮   |
|              | 🔣 Ana  | ilysis M | J S                | ection Pro  | perties   |        | ►  |       |                       |      |                          |     |         |          |
| -7           |        |          | •? N               | Aass Sourc  | e         |        |    |       |                       |      |                          |     |         |          |
| [ <b>•</b> ] |        |          | C                  | Coordinate  | Systems/  | Grids  |    |       |                       |      |                          |     |         |          |
| >            |        | (1)      | ر 🔶 ا              | oint Const  | raints    |        |    |       | 4                     | >    |                          | 5   | >       | ¢        |
|              |        | Þ        |                    | oint Patter | ns        |        |    |       |                       | >    |                          | Ć   | 5       | C        |
| $\mathbf{X}$ |        |          | 7. 0               | iroups      |           |        |    | -     |                       |      |                          |     |         |          |
|              |        |          | ala s              | ection Cut  | s         |        |    |       |                       |      |                          | - 1 |         |          |
|              |        |          | <u>~</u> •         | Generalized | Displace  | ments  |    |       |                       |      |                          |     |         |          |
|              |        |          | * <i>f</i> * F     | unctions    |           |        | ►  |       |                       |      |                          |     |         |          |
|              |        | _ L      | ₩ <sup>P</sup> E L | oad Patter  | ns        | 2      |    |       |                       |      |                          |     |         |          |
|              |        |          | 1.0 D<br>1.5 E     | oad Cases   |           |        |    |       |                       |      |                          |     |         |          |
| -0-4         |        |          | B+L<br>+E          | oad Comb    | inations. |        |    |       |                       |      |                          |     |         |          |





### X تعریف بار جانبی طیفی طبقات در راستای

|         | Diapinaginz        | FA       | FT | MZ | ~ | Y |
|---------|--------------------|----------|----|----|---|---|
| D1_16.  | 16.                | 126626.9 | 0. | 0. | 0 | 0 |
| D1_12.8 | 12.8               | 90281.57 | 0. | 0. | 0 | 0 |
| D1_9.6  | 9.6                | 69201.98 | 0. | 0. | 0 | 0 |
| D1_6.4  | 6.4                | 47795.58 | 0. | 0. | 0 | 0 |
| D1_3.2  | 3.2                | 22701.65 | 0. | 0. | 0 | 0 |
| D1_0.   | 0.                 | 0.       | 0. | 0. | 0 | 0 |
|         |                    |          |    |    |   |   |
|         | cified Application | Point    |    |    |   |   |

پخش بار جانبی طیفی راستای X در ارتفاع

|                                     |  | Define Load               | d Patterns   |   |  |
|-------------------------------------|--|---------------------------|--|---|--|
| oad Patterns<br>1 Load Pattern Name | <b>2</b> Type                                    | Self Weight<br>Multiplier | Auto Lateral<br>Load Pattern 3                           |   | Click To:<br>Add New Load Pattern                    |
| SQY                                 | Quake  | ✓ 0                       | User Loads 🗸 🗸   |   | Modify Load Pattern                                  |
| DEAD<br>Live<br>EX<br>EY<br>EXP     | Dead<br>Live<br>Quake<br>Quake<br>Quake<br>Quake | 1<br>0<br>0<br>0<br>0     | User Coefficient<br>User Coefficient<br>User Coefficient |   | 5 Modify Lateral Load Pattern<br>Delete Load Pattern |
| EXN<br>EYP<br>EYN                   | Quake<br>Quake<br>Quake                          | 0<br>0<br>0               | User Coefficient<br>User Coefficient<br>User Coefficient | • | Show Load Pattern Notes                              |
| SQY                                 | Quake  | 0                         | User Loads<br>User Loads                                 |   | OK<br>Cancel   |

### تعریف بار جانبی طیفی طبقات در راستای Y



پخش بار جانبی طیفی راستای Y در ارتفاع

گام پنجم: در این مرحله نوبت تعریف الگوی بار جانبی طیفی در راستای X و Y است.

## الگوهای بار جانبی در پوش آور



#### مسير تعريف الگوي بار

| ×   | Load Ca   | ase Data - Nonlinear Stati | c   |
|---|---|----------------------------|---|
| Load Case Name<br>1 SPQX-PG1                            | Set Def Name  | Notes<br>Modify/Show       | Load Case Type Static  V Design   |
| Initial Conditions<br>Zero Initial Conditions - Sta     | art from Unstressed State                               |                            | Analysis Type O Linear 2  |
| 3 Continue from State at End<br>Important Note: Loads f | of Nonlinear Case<br>from this previous case are includ | PG1 v                      | Nonlinear     Nonlinear Staged Construction                                 |
| Modal Load Case<br>All Modal Loads Applied Use          | Modes from Case   | MODAL 🗸                    | Geometric Nonlinearity Parameters <ul> <li>None</li> <li>P-Delta</li> </ul> |
| Load Spplied<br>Load Type<br>Load Pattern V SQX         | Load Name Scale   | Factor                     | O P-Delta plus Large Displacements Mass Source                              |
| Load Pattern SQX  | 1   | Add                        | Previous v  |
| Other Parameters  |   | Delete                     |   |
| Load Application  | Displ Control   | Modify/Show                | ОК  |
| Results Saved   | Multiple States   | Modify/Show                | Cancel  |
| Nonlinear Parameters                                    | Default   | Modify/Show                |   |

تعريف الگوى بار طيفى SPQX-PG1

| × | Load Application Control for Nonlinear Static Analysis  |
|---|---|
|   | Load Application Control     Full Load     Displacement Control   |
|   | Control Displacement         Use Conjugate Displacement            • Use Monitored Displacement         Load to a Monitored Displacement Magnitude of |
|   | Monitored Displacement<br>ODF     U1     at Joint 132     Generalized Displacement     X رکز جرم بام     Additional Controlled Displacements          |
|   | None Modify/Show  |
|   | OK Cancel   |

تنظیمات Load Application برای بار

| × | Results Saved for Nonlinear Static Load Cases  | × |
|---|--|---|
|   | C Final State Only   Multiple States   |   |
|   | For Each Stage       Minimum Number of Saved States       Maximum Number of Saved States       100 |   |
|   | Save positive Displacement Increments Only     OK Cancel   |   |

SPQX-PG1 برای بار Results saved تنظیمات

تنظیمات لازم برای ساختن الگوی بار طیفی SPQX-PG2 مطابق شکلهای زیر انجام می گیرد. بقیه موارد همانند الگوی بار طیفیSPQX-PG1 خواهد بود که نیازی به اصلاح آنها نمی باشد.

| Load Case Name     Load Case Type     Add N       EY+0.3EX     A     Linear Static     Add Co       EYP-0.3EX     Linear Static     Add Co       EYP-0.3EX     Linear Static     Modify/3       EYP-0.3EX     Linear Static     Modify/3       EYN-0.3EX     Linear Static     Del       EYN-0.3EX     Linear Static     Del   |  |
|--|--|
| EY+0.3EX Linear Static<br>EY-0.3EX Linear Static<br>EYP+0.3EX Linear Static<br>EYP-0.3EX Linear Static<br>EYP-0.3EX Linear Static<br>EYN-0.3EX Linear Static | Add New Load Case  |
| SPY Response Spectrum  | dd Copy of Load Case<br>odify/Show Load Case<br>Delete Load Case |
| PG1 Nonlinear Static Display Load C<br>PG2 Nonlinear Static<br>SQX Linear Static Show<br>SQY Linear Static   | oad Cases<br>how Load Case Tree                                  |

# اضافه نمودن الگوی بار طیفی SPQX-PG2

| X   | Load Ca  | se Data - Nonlinear Stati            | c   | × |
|---|--|--------------------------------------|---|---|
| Load Case Name 1 SPQX-PG2 Initial Conditions                                    | Set Def Name   | Notes<br>Modify/Show                 | Load Case Type<br>Static ✓ Design<br>Analysis Type                                |   |
| 2 Continue from State at Env<br>Important Note: Loads<br>Modal Load Case        | d of Nonlinear Case<br>from this previous case are include | PG2 v                                | Nonlinear     Nonlinear Staged Construction     Geometric Nonlinearity Parameters | _ |
| All Modal Loads Applied Use<br>Loads Applied<br>Load Type<br>Load Pattern V SQX | Load Name Scale F  | Factor Add Modify                    | None     P-Delta     P-Delta plus Large Displacements  Mass Source  Previous      |   |
| Other Parameters<br>Load Application<br>Results Saved<br>Nonlinear Parameters   | Displ Control<br>Multiple States<br>Default                | Delete<br>Modify/Show<br>Modify/Show | OK<br>Cancel  |   |

تنظيمات الكوى بار طيفي SPQX-PG2

# برای راستای Y نیز به همین ترتیب عمل میکنیم.

|                |        | Define Loa       | d Cas  | es       |                       |   |
|----------------|--------|------------------|--------|----------|-----------------------|---|
| Load Cases     |        |                  |        |          | Click to:             |   |
| Load Case Name |        | Load Case Type   |        |          | Add New Load Case     | L |
| DEAD           | ~      | Linear Static    | ~      |          | -                     | 4 |
| Live           |        | Linear Static    |        |          | Add Copy of Load Case |   |
| MODAL          |        | Modal            |        |          |                       | 1 |
| Ex             |        | Linear Static    |        |          | Modify/Show Load Case |   |
| EY             |        | Linear Static    |        |          |                       |   |
| EXP            |        | Linear Static    |        | <b>+</b> | Delete Load Case      |   |
| Exn            |        | Linear Static    |        |          |                       |   |
| EYP            |        | Linear Static    |        |          |                       |   |
| EYN            |        | Linear Static    |        | •        | Display Load Cases    |   |
| P-DELTA        |        | Nonlinear Static |        |          |                       |   |
| EX+0.3EY       |        | Linear Static    |        |          | Show Load Case Tree   |   |
| EX-0.3EY       |        | Linear Static    |        |          |                       | 1 |
| EXP+0.3EY      | $\sim$ | Linear Static    | $\sim$ |          |                       |   |
|                |        |                  |        |          | OK Cancel             | 1 |
|                |        |                  |        |          | Calicer               |   |
|                |        |                  |        |          |                       |   |

مسير تعريف الگوي بار

| ×   | Load C  | ase Data - Nonlinear Stati | ic ×  |
|---|---|----------------------------|---|
| Load Case Name           I         SPQY-PG1           Initial Conditions         Sector Sect | Set Def Name  | Notes<br>Modify/Show       | Load Case Type<br>Static  V Design Analysis Type  |
| Centinue from State at End  | of Noplinger Case   | PG1 V                      | O Linear  |
| Important Note: Loads f   | from this previous case are includ                              | ded in the current case    | Nonlinear Staged Construction   |
| Modal Load Case<br>All Modal Loads Applied Use I<br>Loads Applied<br>Load Type<br>4 Load Pattern V SQY<br>Load Pattern SQY  | Modes from Case       Load Name     Scale       V     1       1 | Factor<br>Add              | Geometric Nonlinearity Parameters  None  P-Delta  P-Delta plus Large Displacements  Mass Source  Previous |
|   |   | Modify<br>Delete           |   |
| Uner Parameters   | Displ Control   | Modifu/Show                | ОК  |
| Results Saved   | Multiple States   | Modify/Show                | Cancel  |
| Nonlinear Parameters  | Default   | Modify/Show                |   |

تعريف الگوى بار طيفى SPQY-PG1

| X | Load Application Control for Nonlinear Static Analysis   | × |
|---|--|---|
|   | Load Application Control     Full Load     Displacement Control  |   |
|   | Control Displacement       δ <sub>iy</sub> ×1.5         Image: Use Monitored Displacement       0.4406   |   |
|   | Monitored Displacement <ul> <li>DOF</li> <li>U2</li> <li>Generalized Displacement</li> </ul> <ul> <li>Additional Controlled Displat</li> </ul> |   |
|   | None Modify/Show OK Cancel   |   |
|   |  |   |

تنظیمات Load Application برای بار

| X | Results Saved for Nonlinear Static Load Cases  | × |
|---|--|---|
|   | C Final State Only   Multiple States   |   |
|   | For Each Stage         Minimum Number of Saved States         Maximum Number of Saved States         100 |   |
|   | Save positive Displacement Increments Only OK Cancel   | _ |

تنظیمات Results saved برای بار SPQY-PG1

تنظیمات لازم برای ساختن الگوی بار طیفی SPQY-PG2 مطابق شکلهای زیر انجام میگیرد. بقیه موارد همانند الگوی بار طیفیSPQY-PG1 خواهد بود که نیازی به اصلاح آنها نمی باشد.

|  | €.  | Define  | Load Cases   | ×   |
|--|---|---|--|---|
| Load Cases       Load Case Name       Load Case Type         EYP+0.3EX       Linear Static       Add New Load Case         EYP+0.3EX       Linear Static       Inear Static         EYN+0.3EX       Linear Static       Modify/Show Load Case         EYN-0.3EX       Linear Static       Modify/Show Load Case         SPX       Response Spectrum       Delete Load Case         SPX       Nonlinear Static       Delete Load Case         SP3       Nonlinear Static       Delete Load Case         SP4       Nonlinear Static       Delete Load Case         SP3       Nonlinear Static       Delete Load Case         SP4       Nonlinear Static       Sequence         SP3       Nonlinear Static       Sequence         SP4       Nonlinear Static       Sequence         SP4       Nonlinear Static       Sequence         SP0X-PG1       Nonlinear Static       Show Load Case Tree         SP0X-PG2       Nonlinear Static       Show Load Case Tree         SP0X-PG3       Nonlinear Static       Show Load Case Tree         SP0X-PG3       Nonlinear Static       Show Load Case Tree | Load Cases<br>Load Case Name<br>EYP+0.3EX<br>EYP-0.3EX<br>EYN+0.3EX<br>EYN-0.3EX<br>SPX<br>SPX<br>SPY<br>PG1<br>PG2<br>SQX<br>SQY<br>SPQX-PG1<br>SPQX-PG1<br>SPQY-PG1 | Load Case Ty<br>Linear Static<br>Linear Static<br>Linear Static<br>Linear Static<br>Linear Static<br>Response Spectrum<br>Nonlinear Static<br>Linear Static<br>Linear Static<br>Linear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static | Click to:<br>Add New<br>2 Add Copy<br>Modify/Sh<br>Delete<br>Display Load Cas<br>Show Lo | w Load Case<br>y of Load Case<br>ow Load Case<br>a Load Case<br>ses<br>ad Case Tree<br>Cancel |

اضافه نمودن الگوي بار طيفي SPQY-PG2

| X  | Load C  | ase Data - Nonlinear Stat                 | ic  | × |
|--|---|---|---|---|
| Load Case Name<br>SPQY-PG2<br>Initial Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditions<br>Conditio | Set Def Name  | Notes<br>Modify/Show                      | Load Case Type<br>Static   Design  Analysis Type  |   |
| 2 Continue from State at Enc<br>Important Note: Loads<br>Modal Load Case   | I of Nonlinear Case<br>from this previous case are includ | PG2  v  ded in the current case           | Nonlinear     Nonlinear Staged Construction     Geometric Nonlinearity Parameters     T |   |
| Loads Applied<br>Load Type<br>Load Pattern V SQY<br>Load Pattern SQY   | Load Name Scale   | Factor<br>Add<br>Modify<br>Delete         | None     P-Delta     P-Delta plus Large Displacements  Mass Source  Previous            |   |
| Other Parameters<br>Load Application<br>Results Saved<br>Nonlinear Parameters  | Displ Control<br>Multiple States<br>Default               | Modify/Show<br>Modify/Show<br>Modify/Show | OK<br>Cancel  |   |

تنظيمات الگوى بار طيفى SPQY-PG2

# √ الگوی بار توزیع یکنواخت

|   |  | Define l   | .oad Cas | es |   | × |
|---|--|--|----------|----|---|---|
| Load Cases<br>Load Case Na  | ame  | Load Case Type   |          |    | Click to:<br>Add New Load Case  |   |
| EYP-0.3EX<br>EYN+0.3EX<br>EYN-0.3EX<br>SPX<br>SPY<br>PG1<br>PG2<br>SQX<br>SQY<br><b>1</b><br>SPQX-PG1<br>SPQX-PG1<br>SPQY-PG1<br>SPQY-PG2 | Lind     Lind     Lind     Lind     Lind     Ress     Nor     Nor     Lind     Nor     Nor     Nor     Nor     Nor     Nor | ear Static<br>ear Static<br>ear Static<br>sponse Spectrum<br>sponse Spectrum<br>nlinear Static<br>ear Static<br>ear Static<br>ear Static<br>nlinear Static<br>nlinear Static<br>nlinear Static<br>nlinear Static |          |    | 2 Add Copy of Load Case<br>Modify/Show Load Case<br>Delete Load Case<br>Display Load Cases<br>Show Load Case Tree |   |
| 01411102  |  |  |          |    | OK Cancel   |   |

# افزودن الگوی بار جانبی با توزیع یکنواختUniform X-PG1

| Load Case Data - Nonlinear Static   | c ×   |
|---|---|
| Load Case Name       Notes         1       UniformX-PG1       Set Def Name       Modify/Show         Initial Conditions       Continue from Unstressed State       Modify/Show         © Continue from State at End of Nonlinear Case       PG1       V         Important Note:       Loads from this previous case are included in the current case         Modal Load Case       MODAL       V         Loads Applied       Load Type       Load Name       Scale Factor         Accel       VIX       -1       Add         Modify       Delete       Delete | Load Case Type         Static <ul> <li>Design</li> </ul> Analysis Type <li>Linear</li> <li>Nonlinear</li> <li>Nonlinear Staged Construction</li> Geometric Nonlinearity Parameters <ul> <li>None</li> <li>P-Delta</li> <li>P-Delta plus Large Displacements</li> </ul> Mass Source <ul> <li>Previous</li> <li> </li></ul> |
| Other Parameters       Load Application     Displ Control       Results Saved     Multiple States       Nonlinear Parameters     Default  | OK<br>Cancel  |

الگوی بار جانبی با توزیع یکنواختUniform X-PG1

| oad Cases   |   |  |   | Click to:   |
|---|---|--|---|---|
| Load Case Name  |   | Load Case Type   |   | Add New Load Case   |
| EYN+0.3EX<br>EYN-0.3EX<br>SPX<br>PG1<br>PG2<br>SQX<br>SQY<br>SPQX-PG1<br>SPQX-PG1<br>SPQX-PG2<br>SPQY-PG1<br>SPQY-PG2 | ^ | Linear Static<br>Linear Static<br>Response Spectrum<br>Response Spectrum<br>Nonlinear Static<br>Nonlinear Static<br>Linear Static<br>Linear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static | ^ | 2 Add Copy of Load Case<br>Modify/Show Load Case<br>Delete Load Case<br>Display Load Cases<br>Show Load Case Tree |
| UniformX-PG1  |   | Nonlinear Static   | × |   |

افزودن الگوی بار جانبی با توزیع یکنواختUniform X-PG2

| ×   | Load C   | ase Data - Nonlinear Stati | c                                      | × |
|---|--|----------------------------|--|---|
| Load Case Name 1 UniformX-PG2   | Set Def Name                                   | Notes<br>Modify/Show       | Load Case Type Static                  |   |
| Initial Conditions<br>Zero Initial Conditions - Sta<br>Continue from State at End | art from Unstressed State<br>of Nonlinear Case | 2<br>PG2 V                 | Analysis Type<br>O Linear<br>Nonlinear |   |
| Important Note: Loads   | from this previous case are inclue             | ded in the current case    | O Nonlinear Staged Construction        |   |
| Modal Load Case<br>All Modal Loads Applied Use                                    | Modes from Case                                | MODAL                      | Geometric Nonlinearity Parameters      |   |
| Loads Applied<br>Load Type  | Load Name Scale                                | Factor                     | P-Delta plus Large Displacements       |   |
| Accel VX<br>Accel UX  | <ul> <li>✓ -1.</li> <li>-1.</li> </ul>         | Add                        | Mass Source Previous                   |   |
|   |  | Modify                     |  |   |
|   |  | Delete                     |  |   |
| Other Parameters  |  |                            |  |   |
| Load Application  | Displ Control                                  | Modify/Show                | ок                                     |   |
| Results Saved   | Multiple States                                | Modify/Show                | Cancel                                 |   |
| Nonlinear Parameters  | Default  | Modify/Show                |  |   |
|   |  |                            |  |   |

الگوی بار جانبی با توزیع یکنواختUniform X-PG2

| oad Cases  |   |   |   | Click to:  |
|--|---|---|---|--|
| Load Case Name   |   | Load Case Type  |   | Add New Load Case  |
| EYN-0.3EX<br>SPX<br>PG1<br>PG2<br>SQX<br>SQY<br>SP0X-PG1         | ^ | Linear Static<br>Response Spectrum<br>Response Spectrum<br>Nonlinear Static<br>Nonlinear Static<br>Linear Static<br>Linear Static<br>Nonlinear Static | ^ | 2 Add Copy of Load Case<br>Modify/Show Load Case<br>Delete Load Case |
| SPQX-PG2<br>SPQY-PG1<br>SPQY-PG2<br>UniformX-PG1<br>UniformX-PG2 |   | Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static<br>Nonlinear Static  | - | Display Load Cases Show Load Case Tree                               |

افزودن الگوی بار جانبی با توزیع یکنواختUniform Y-PG1

| Load Case Data - Nonlinea  | r Static ×  |
|--|---|
| Load Case Data - Nonlinea   Load Case Name     I Uniform Y-PG1     Initial Conditions     Zero Initial Conditions - Start from Unstressed State     Continue from State at End of Nonlinear Case     PG1     Important Note:   Loads from this previous case are included in the current case     Modal Load Case     All Modal Loads Applied     Load Type     Load Name     Scale Factor     Accel     UY     Add     Modify | r Static ×<br>Load Case Type<br>Static ↓ Design<br>Analysis Type<br>↓ Linear<br>● Nonlinear<br>● Nonlinear Staged Construction<br>Secometric Nonlinearity Parameters<br>● None<br>● P-Detta<br>● P-Detta<br>● P-Detta plus Large Displacements<br>Mass Source<br>Previous ↓ |
| Other Parameters       Load Application     Displ Control       Results Saved     Multiple States       Nonlinear Parameters     Default   | OK<br>Cancel  |

الگوى بار جانبى با توزيع يكنواخت Uniform Y-PG1

| .oad Cases     |          |                   |     |          | Click to:             |
|----------------|----------|-------------------|-----|----------|-----------------------|
| Load Case Name |          | Load Case Type    |     |          | Add New Load Case     |
| SPX            | ~        | Response Spectrum | ~   |          |                       |
| SPY            |          | Response Spectrum |     |          | Add Copy of Load Case |
| PG1            |          | Nonlinear Static  |     |          | 4                     |
| PG2            |          | Nonlinear Static  |     |          | Modify/Show Load Case |
| SQX            |          | Linear Static     |     |          | -                     |
| SQY            |          | Linear Static     |     | <b>+</b> | Delete Load Case      |
| SPQX-PG1       |          | Nonlinear Static  |     |          |                       |
| SPQX-PG2       |          | Nonlinear Static  |     |          |                       |
| SPQY-PG1       |          | Nonlinear Static  |     | •        | Display Load Cases    |
| SPQY-PG2       |          | Nonlinear Static  |     |          |                       |
| UniformX-PG1   |          | Nonlinear Static  |     |          | Show Load Case Tree   |
| UniformX-PG2   | _        | Nonlinear Static  |     |          |                       |
| Uniform Y-PG1  | <b>~</b> | Nonlinear Static  | × 1 |          |                       |

افزودن الكوى بار جانبى با توزيع يكنواختUniform Y-PG2

| Load Case Data - Nonlinear Stati   | ic ×   |
|--|--|
| Load Case Name       Notes         1       Uniform Y-PG2       Set Def Name       Modify/Show         Initial Conditions       O       Zero Initial Conditions - Start from Unstressed State       2         Important Note:       Loads from this previous case are included in the current case       PG2       v         Modal Load Case       Modal Loads Applied       Load Name       Scale Factor         Load Type       Load Name       Scale Factor       Add         Accel       UY       -1.       Add | Load Case Type<br>Static   Design  Analysis Type Linear  Nonlinear Nonlinear Staged Construction  Geometric Nonlinearity Parameters None P-Delta P-Delta P-Delta P-Delta Previous   Previous |
| Other Parameters     Delete       Load Application     Displ Control     Modify/Show       Results Saved     Multiple States     Modify/Show       Nonlinear Parameters     Default     Modify/Show  | OK<br>Cancel   |

الگوى بار جانبى با توزيع يكنواختUniform Y-PG2

✓ الگوی بارگذاری مثلثی(EQ)

برای تعریف الگوی بار EQ در راستای X و Y بصورتی که در اشکال زیر نشان داده شده است اقدام می گردد.



|                                      |                                  | Define Load               | d Patterns   |   |                                     |   |
|--------------------------------------|----------------------------------|---------------------------|--|---|-------------------------------------|---|
| Load Patterns<br>Load Pattern Name 1 | <sub>Type</sub> 2                | Self Weight<br>Multiplier | Auto Lateral<br>Load Pattern   | 3 | Click To:<br>Add New Load Pattern 4 | 4 |
| EX1                                  | Quake                            | v 0                       | User Coefficient   | ~ | Modify Load Pattern                 |   |
| DEAD<br>Live<br>EX<br>EY             | Dead<br>Live<br>Quake<br>Quake   | 1<br>0<br>0<br>0          | User Coefficient<br>User Coefficient   |   | Modify Lateral Load Pattern         | 5 |
| EXP<br>EXN<br>EYP<br>EYN             | Quake<br>Quake<br>Quake<br>Quake | 0<br>0<br>0               | User Coefficient<br>User Coefficient<br>User Coefficient<br>User Coefficient |   | Show Load Pattern Notes             |   |
| EX1                                  | Quake                            | 0                         | User Coefficient   |   | OK                                  |   |

تعريف بار EX1



مشخصات بار EX1

| Load Patterns           |           |                           |                                |   | Click To:                     |   |
|-------------------------|-----------|---------------------------|--------------------------------|---|-------------------------------|---|
| Load Pattern Name $ 1 $ | Туре 2    | Self Weight<br>Multiplier | Auto Lateral<br>Load Pattern 3 |   | 4 Add New Load Pattern        |   |
| EY1                     | Quake 🗸 🗸 | 0                         | User Coefficient               | ~ | Modify Load Pattern           |   |
| DEAD                    | Dead      | 1                         | 1                              |   |                               | _ |
| Live                    | Live      | 0                         |                                |   | 5 Modify Lateral Load Pattern |   |
| EX                      | Quake     | 0                         | User Coefficient               |   |                               | - |
| EY                      | Quake     | 0                         | User Coefficient               |   | Delete Load Pattern           |   |
| EXP                     | Quake     | 0                         | User Coefficient               |   |                               |   |
| EXN                     | Quake     | 0                         | User Coefficient               |   | Charus Land Dattage Mater     | - |
| EYP                     | Quake     | 0                         | User Coefficient               |   | Show Load Pattern Notes       |   |
| EYN                     | Quake     | 0                         | User Coefficient               |   |                               |   |
| EX1                     | Quake     | 0                         | User Coefficient               |   | OK                            |   |
| EV1                     | Ouake     | 0                         | User Coefficient               |   | UK                            |   |

#### تعريف بار EY1



مشخصات بار EY1

سپس نوبت تعریف الگوی بار مثلثی جهت X (EQX) و الگوی بار مثلثی جهت Y (EQY) میباشد.



مسير تعريف الگوي بار

| Load Case Name 1<br>EQX  | Set Def Name   | Notes<br>Modify/Show       | Load Case Type 2<br>Static V Design   |
|--|--|----------------------------|---|
| Initial Conditions     Zero Initial Conditions - S     Continue from State at En     Important Note: Loads | tart from Unstressed State<br>d of Nonlinear Case<br>from this previous case are inc | cluded in the current case | Analysis Type<br>Linear<br>Nonlinear 3<br>Nonlinear Staged Construction   |
| Modal Load Case<br>All Modal Loads Applied Us<br>Loads Applied   | e Modes from Case  | MODAL V                    | Geometric Nonlinearity Parameters <ul> <li>None</li> <li>P-Delta</li> <li>P-Delta plus Large Displacements</li> </ul> |
| Load Pattern v EX1<br>Load Pattern EX1   | v 1  | Add<br>Modify<br>Delete    | Mass Source Previous  |
| Other Parameters<br>Load Application<br>Results Saved  | Displ Control<br>Multiple States   | Modify/Show                | OK<br>Cancel  |
|  |  |                            |   |

مسیر تعریف الگوی بار EQX

| K Load Application Control for Nonlinear Static Analysi  | s ×              |
|--|------------------|
| Load Application Control     Full Load     Displacement Control  |                  |
| Control Displacement         Ο Use Conjugate Displacement         Image: State of the stat | 5                |
| Monitored Displacement<br>ODF U1 م at Joint 132<br>Generalized Displacements<br>Additional Controlled Displacements<br>None Modify/Show  | <b>]</b><br>مرکز |
| OK Cancel  |                  |

EQX تنظیمات Load Application برای بار

| × | Results Saved for Nonlinear Static Load Cases  |
|---|--|
|   | C Final State Only   Multiple States   |
|   | For Each Stage       Minimum Number of Saved States       Maximum Number of Saved States |
|   | Save positive Displacement Increments Only OK Cancel                                     |

تنظیمات Results saved برای الگوی بار جانبی EQX

برای تعریف الگوی بار جانبی EQY مطابق زیر عمل میگردد.

| oad Cases   |            |  |   | Click to:  |
|---|------------|--|---|--|
| Load Case Name  |            | Load Case Type   |   | Add New Load Case  |
| MODAL<br>Ex<br>EY<br>EXP<br>EXP<br>EXN<br>EYP<br>EYN<br>P-DELTA<br>SPX<br>SPY | ^          | Modal<br>Linear Static<br>Linear Static<br>Linear Static<br>Linear Static<br>Linear Static<br>Linear Static<br>Nonlinear Static<br>Response Spectrum |   | 2 Add Copy of Load Case<br>Modify/Show Load Case<br>Delete Load Case<br>Display Load Cases |
| EX1<br>EY1<br>EQX   | <b>-</b> ~ | Linear Static<br>Linear Static<br>Nonlinear Static   | v | Show Load Case Tree  |

مسير تعريف الگوي بار

| X Load  | d Case Data - Nonlinear Stat      | ic ×  |
|---|-----------------------------------|---|
| Load Case Name 1 EQY Set Def Name   | Notes<br>Modify/Show              | Load Case Type Static  V Design   |
| Initial Conditions<br>Zero Initial Conditions - Start from Unstressed State<br>Continue from State at End of Nonlinear Case<br>Important Note: Loads from this previous case are in | v<br>Included in the current case | Analysis Type C Linear Nonlinear Nonlinear Staged Construction  |
| Modal Load Case<br>All Modal Loads Applied Use Modes from Case<br>Loads Applied   | MODAL Y                           | Geometric Nonlinearity Parameters <ul> <li>None</li> <li>P-Delta</li> <li>P-Detta plus Large Displacements</li> </ul> |
| 2 Load Pattern V EY1 V 1.<br>Load Pattern EY1 I.  | Add                               | Mass Source Previous  |
| Other Parameters  | Delete                            | OK  |
| Joad Application         Displic ontrol           Results Saved         Multiple States           Nonlinear Parameters         Default  | Modify/Show<br>Modify/Show        | Cancel  |
|   |                                   |   |

تعريف الكوى بار EQY

| محمدپور |
|---------|
|---------|

| Load Application Control for Nonlinear Static Analysis   | × |
|--|---|
| Load Application Control     Full Load     Displacement Control  |   |
| Control Displacement       δ <sub>iy</sub> ×1.5         Image: Use Monitored Displacement       0.4406     |   |
| Monitored Displacement<br>DOF U2 at Joint 132<br>Generalized Displacement<br>Additional Controlled Displat | ٩ |
| None Modify/Show   |   |
| OK Cancel  |   |

تنظیمات Load Application برای بار

√ الگوی بارگذاری متناسب با مود

قبل از تعریف الگوی بارگذاری متناسب با مودها، باید اولین مود فعال برای راستای X و Y مشخص گردد. بدین منظور مطابق شکلهای زیر اقدام می گردد.

| ×      |            | 1                            |                                    |      | E Define Load Cases   | × |          |
|--------|------------|------------------------------|------------------------------------|------|---|---|----------|
| File   | Edit View  | Defi<br>M                    | ne Draw Select Assign<br>Materials | Anal | Land Grane PErkiter   |   |          |
|        | Analysis M | E.<br>I                      | Section Properties                 | Ļ,   | Load Cases Name Load Case Type Add New Load Case                                      |   |          |
|        |            | •?                           | Mass Source                        |      | 3 MODAL Modal   |   |          |
| •      |            | ()                           | Coordinate Systems/Grids           |      | EX Linear Static 4 Modify/Show Load Case  |   | ×        |
|        |            | ÷                            | Joint Constraints                  |      |   |   |          |
| N.     |            |                              | Joint Patterns                     |      | Load Case Name Load Case Type MODAL Set Def Name Modifu/Show Modal                    |   | V Design |
| X      | Ť          | 7.                           | Groups                             |      |   |   | + Dougn  |
|        | Г          | 88                           | Section Cuts                       |      | Zero Initial Conditions - Unstressed State     Eigen Vectors     Eigen Vectors        |   |          |
|        |            | ~                            | Generalized Displacements          |      | ○ Life minute of Nonlinear Case         ✓         ○ Ritz Vectors                      |   |          |
|        | ŀ          | <sup>\$</sup> f <sub>x</sub> | Functions                          | •    | Important Note: Loads from the Nonlinear Case are NOT included in the current<br>case |   |          |
|        |            | ✓D<br>✓E                     | Load Patterns                      |      | Number of Modes 5 Mass Source   |   |          |
|        |            | 1.0 D<br>1.5 E               | Load Cases 2                       | Н    | Maximum Number of Modes 15  |   |          |
| -0-1   |            | D+L<br>+E                    | Load Combinations                  |      | Minimum Number of Modes 3   |   |          |
|        |            | <u>111</u>                   | Moving Loads                       | • -  | Loads Applied   |   |          |
| ≫<br>⊸ |            |                              | Named Property Sets                | •    | Show Advanced Load Parameters  Other Parameters                                       |   |          |

تنظیم مودهای موثر



مسير نمايش خروجي تحليل مودال

| X       | Modal Participating Mass Ratios – 🗆 🗙 |                   |                |             |                |                |                    |               |           |                   | ×              |   |
|---------|---------------------------------------|-------------------|----------------|-------------|----------------|----------------|--------------------|---------------|-----------|-------------------|----------------|---|
| File    | View Edit                             | Format-Filter     | -Sort Select   | Options     |                |                |                    |               |           |                   |                |   |
| Units:  | As Noted                              |                   | x              | ال ر استای  | و نین مو د فع  | J [            | Modal Participatin | g Mass Ratios |           |                   |                | ~ |
| Filter: |                                       |                   |                | Ň           |                | <u> </u>       |                    |               |           |                   |                |   |
|         | OutputCase                            | Step Type<br>Text | Unitless       | Sec         | UX<br>Unitless | UY<br>Unitless | UZ<br>Unitless     | Unitless      | Unitless  | SumUZ<br>Unitless | RX<br>Unitless | Ĥ |
| •       | MODAL                                 | Mode              | 1              | 0.968694    | 0.429          | 0.327          | 5.361E-12          | 0.429         | 0.327     | 5.361E-12         | 0.03           |   |
|         | MODAL                                 | Mode              | 2              | 0.968694    | 0.327          | 0.429          | 6.837E-11          | 0.757         | 0.757     | 7.373E-11         | 0.039          |   |
|         | MODAL                                 | Mode              | 3              | 0.849801    | 3.049E-08      | 2.463E-08      | 8.168E-12          | 0.757         | 0.757     | 8.19E-11          | 1.717E-07      |   |
|         | MODAL                                 | Mode              | Y <sub>0</sub> | فعال راستاء | اولين مود أ    | 0.052          | 1.933E-12          | 0.837         | 0.808     | 8.383E-11         | 0.044          |   |
|         | MODAL                                 | Mode              | 5              | 0.330177    | 0.052          | 0.081          | 2.757E-11          | 0.889         | 0.889     | 1.114E-10         | 0.068          |   |
|         | MODAL                                 | Mode              | 6              | 0.292492    | 1.519E-08      | 9.719E-09      | 4.007E-12          | 0.889         | 0.889     | 1.154E-10         | 5.519E-10      |   |
|         | MODAL                                 | Mode              | 7              | 0.168504    | 0.035          | 0.022          | 1.196E-12          | 0.924         | 0.912     | 1.166E-10         | 0.012          |   |
|         | MODAL                                 | Mode              | 8              | 0.1685      | 0.022          | 0.035          | 1.623E-11          | 0.947         | 0.947     | 1.328E-10         | 0.019          |   |
|         | MODAL                                 | Mode              | 9              | 0.150754    | 4.833E-07      | 3.093E-07      | 2.869E-12          | 0.947         | 0.947     | 1.357E-10         | 3.988E-08      |   |
|         | MODAL                                 | Mode              | 10             | 0.108402    | 0.017          | 0.011          | 2.396E-11          | 0.964         | 0.957     | 1.597E-10         | 0.009483       |   |
|         | MODAL                                 | Mode              | 11             | 0.108398    | 0.011          | 0.017          | 1.88E-10           | 0.975         | 0.975     | 3.477E-10         | 0.015          |   |
|         | MODAL                                 | Mode              | 12             | 0.097769    | 1.487E-06      | 9.516E-07      | 4.228E-11          | 0.975         | 0.975     | 3.9E-10           | 9.11E-07       |   |
|         | MODAL                                 | Mode              | 13             | 0.075371    | 2.601E-16      | 4.069E-18      | 0.451              | 0.975         | 0.975     | 0.451             | 5.701E-06      |   |
|         | MODAL                                 | Mode              | 14             | 0.074791    | 9.048E-07      | 1.077E-06      | 1.125E-09          | 0.975         | 0.975     | 0.451             | 0.1            |   |
|         | MODAL                                 | Mode              | 15             | 0.074791    | 1.084E-06      | 9.096E-07      | 9.307E-17          | 0.975         | 0.975     | 0.451             | 0.084          | ~ |
| <       |                                       |                   |                |             |                |                |                    |               |           |                   | ,              | , |
| Record  | t: << <                               | 1 ;               | >>> of 15      | 5           |                |                |                    |               | Add Table | S                 | Done           |   |

نمايش خروجى تحليل مودال

مطابق شکل بالا مشاهده می شود که اولین مود فعال راستای X، مود اول و اولین مود فعال راستای Y، مود دوم می باشد. الگوی بار گذاری جانبی متناسب با مودهای سازه برای راستای X همانند اشکال زیر تعریف می شوند.

| Edit View   | 1   | ne Draw Select Assign   | Analyze Display  | SA<br>Design Ontion  | AP2000 v20.0.0   | Ultimate 32-bit -   | Loadcases  |
|---|---|---|--|--|--|---|--|
|   | 1 IC  | Materials   |  | 3-d xy xz y  | z nv 🧿 🔂 🖓   |   | I. I To to to a laboration I   |
| 🔀 Analysis  | M   | Section Properties  |  |  |  | ▼ X X 3-D   | View   |
|   | •?  | Mass Source   | ×  |  | C  | Define Load Cases   |  |
|   | (0000)  | Coordinate Systems/Grids  | Load Cases   | 3  |  |   | Click to:  |
| 5   | ₽   | Joint Constraints   | Loa  | d Case Name  | Load C<br>Linear Static  | Case Type   | 3 Add New Load Case  |
| 0   | 2   | Joint Patterns  | Live   | i i i  | Linear Static<br>Modal   |   | Add Copy of Load Case  |
|   | 7   | Groups  | Ex<br>EY   |  | Linear Static  |   | Modify/Show Load Case  |
|   | ØØ  | Section Cuts  |  |  | Linear Static  |   | Delete Load Case   |
|   | ~   | Generalized Displacements   | EYP  |  | Linear Static  |   | Pinter Land Group  |
|   | *fx   | Functions   | P-DELTA     SPX  |  | Nonlinear Static<br>Response Spectr  | rum   | Display Load Cases     Show Load Case Tree   |
|   | ✓D<br>✓E  | Load Patterns   | PG1  |  | <ul> <li>Response Spectr</li> <li>Nonlinear Static</li> </ul>  | rum 🗸   |  |
|   | 1.0 D<br>1.5 E  | Load Cases 2  |  |  |  |   | OK Cancel  |
|   | D+L<br>+E   | Load Combinations   |  |  |  |   |  |
| Load<br>1 Mod<br>Initial                          | Case N<br>e_X<br>Conditio<br>Zero Ini   | ame<br>Ins<br>ial Conditions - Start from Uns   | بار<br>Load Cas<br>Set Def Name<br>essed State   | بريف الكوى<br>e Data - No<br>Notes<br>Modify                           | مسیر نع<br>onlinear Stati<br>/Show   | C<br>Load Case Type<br>Static<br>Analysis Type<br>O Linear  | V Design   |
| Load  | Case N<br>le_X<br>Conditio<br>Zero Ini<br>Continue<br>portant I<br>I Load (<br>Modal L<br>s Applie  | ame<br>Ins<br>tial Conditions - Start from Uns<br>trom State at End of Nonlinea<br>Note: Loads from this pre<br>Case<br>oads Applied Use Modes from<br>d  | بار<br>Load Ca:<br>Set Def Name<br>essed State<br>Case<br>ious case are included   | ie Data - No<br>Notes<br>Modify<br>d in the current o                  | مسیر نع<br>ponlinear Stati<br>/Show  | C<br>Load Case Type<br>Static<br>Analysis Type<br>Linear<br>Nonlinear St<br>Geometric Nonline<br>P-Detta<br>Data atra   | × Design<br>2<br>aged Construction<br>earity Parameters                                |
| Load  | Case N<br>e_X<br>Conditio<br>Zero Ini<br>Continue<br>Dortant I<br>Load (<br>Modal L<br>s Applie<br>Load   | ame<br>Ins<br>tial Conditions – Start from Uns<br>from State at End of Nonlinea<br>lote: Loads from this pre<br>lase<br>oads Applied Use Modes from<br>d<br>Type Load Na  | بار<br>Load Ca:<br>Set Def Name<br>ressed State<br>Case<br>ious case are included<br>Case  | e Data - No<br>Notes<br>Modify<br>d in the current of<br>MODAL         | onlinear Stati   | C Load Case Type Static Analysis Type Linear Nonlinear Nonlinear St Geometric Nonline P-Delta P-Delta P-Delta plus I  | Design  2 aged Construction earity Parameters Large Displacements                      |
| Load<br>I Mod<br>Initial<br>Moda<br>All<br>Load   | Case N<br>e_X<br>Conditio<br>Zero Ini<br>Continue<br>Dortant I<br>I Load (<br>Modal L<br>s Applie<br>Load<br>de<br>de                             | ame<br>Ins<br>tial Conditions - Start from Uns<br>tial Conditions - Start from Uns<br>from State at End of Nonlinea<br>tote: Loads from this pre<br>Case<br>oads Applied Use Modes from<br>d<br>Type Load Na<br>v 1   | بار<br>Load Cas<br>Set Def Name<br>ressed State<br>Case<br>ious case are included<br>Case  | وريف الخوى<br>se Data - No<br>Modify<br>d in the current of<br>MODAL   | onlinear Stati   | C<br>Load Case Type<br>Static<br>Analysis Type<br>Linear<br>Nonlinear<br>Nonlinear St<br>Geometric Nonline<br>P-Delta<br>P-Delta<br>P-Delta plus I<br>Mass Source<br>Previous | × Design 2 aged Construction earity Parameters Large Displacements                     |
| I Load<br>I Mod<br>Initial<br>Moda<br>All<br>Load | Case N<br>e_X<br>Condition<br>Zero Inii<br>Continue<br>Soortant I<br>I Load d<br>Modal L<br>Load<br>de<br>de                                      | ame<br>Ins<br>tial Conditions - Start from Uns<br>from State at End of Nonlines<br>Note: Loads from this pro<br>Loads Applied Use Modes from<br>d<br>Type Load Na<br>Type Load Na<br>Type Load Na<br>Loads Na<br>Type Load Na<br>Type Load Na<br>Loads Na<br>Load Na<br>Loads Na<br>L | بار<br>Load Ca:<br>Set Def Name<br>ressed State<br>Case<br>rious case are included<br>Case   | se Data - No<br>se Data - No<br>Modify<br>d in the current of<br>MODAL | Add<br>Add<br>Add<br>Add<br>Add<br>Add<br>Add<br>Add   | C<br>Load Case Type<br>Static<br>Analysis Type<br>Linear<br>Nonlinear<br>Nonlinear St<br>Geometric Nonline<br>P-Delta<br>P-Delta<br>P-Delta plus I<br>Mass Source<br>Previous | ×<br>Design<br>2<br>aged Construction<br>earity Parameters<br>Large Displacements<br>v |
| I Load<br>I Mod<br>Initial<br>Moda<br>All<br>Load | Case N<br>e_X<br>Condition<br>Continue<br>Sortant I<br>Load 0<br>Modal L<br>Load<br>de<br>de  | ame<br>ins<br>tial Conditions - Start from Uns<br>tial Conditions - Start from Uns<br>from State at End of Nonlines<br>Vote: Loads from this pro-<br>case<br>oads Applied Use Modes from<br>d<br>Type Load Na<br>Type Load Na<br>Type Load Na<br>Type Load Na<br>ters   | بار<br>Load Ca:<br>Set Def Name<br>ressed State<br>Case<br>rious case are included<br>Case<br>1<br>1<br>1  | se Data - No<br>se Data - No<br>Modify<br>d in the current of<br>MODAL | add  | C<br>Load Case Type<br>Static<br>Analysis Type<br>Linear<br>Nonlinear St<br>Geometric Nonline<br>P-Delta<br>P-Delta<br>P-Delta plus I<br>Mass Source<br>Previous              | Design 2 aged Construction earity Parameters Large Displacements                       |
| I Load<br>I Mod<br>Initial<br>Moda<br>All<br>Load | Case N<br>e_X<br>Condition<br>Zero Init<br>Continue<br>Soortant I<br>Load d<br>de<br>de<br>de<br>de   | ame<br>ins<br>tial Conditions - Start from Uns<br>tial Conditions - Start from Uns<br>tote: Loads from this pro-<br>case<br>.oads Applied Use Modes from<br>d<br>Type Load Na<br>Type Load Na<br>Load Na<br>ters<br>ation Fu  | بار<br>Load Ca:<br>Set Def Name<br>ressed State<br>Case<br>rous case are included<br>Case<br>ne Scale Fa<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1   | se Data - No<br>se Data - No<br>Modify<br>d in the current of<br>MODAL | anlinear Stati   | C Load Case Type Static Analysis Type Linear Nonlinear Nonlinear St Geometric Nonline P-Delta P-Delta P-Delta Previous  | Design  2 aged Construction earity Parameters Large Displacements                      |
| Load<br>Initial<br>Moda<br>All<br>Load<br>3<br>Mo | Case N<br>e_X<br>Condition<br>Zero Init<br>Continue<br>Soportant I<br>Load (<br>Modal L<br>Load<br>de<br>de<br>e<br>Param<br>d Applic<br>uits Sav | ame<br>ins<br>tial Conditions - Start from Uns<br>tial Conditions - Start from Uns<br>from State at End of Nonlinea<br>Note: Loads from this pro-<br>case<br>.oads Applied Use Modes from<br>d<br>Type Load Na<br>Type Load Na<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I   | بار<br>Load Ca:<br>Set Def Name<br>ressed State<br>Case<br>rious case are included<br>Case<br>ne Scale Fa<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | se Data - No<br>se Data - No<br>Modify<br>d in the current of<br>MODAL | Add<br>Add<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bility<br>bili | C<br>Load Case Type<br>Static<br>Analysis Type<br>Linear<br>Nonlinear<br>Nonlinear St<br>Geometric Nonline<br>P-Detta<br>P-Detta<br>P-Detta plus I<br>Mass Source<br>Previous | Design 2 aged Construction earity Parameters Large Displacements V                     |

تنظيمات بار Mode\_X

| × | Load Application Control for Nonlinear Static Analysis   |
|---|--|
|   | Load Application Control     Full Load     Displacement Control  |
|   | Control Displacement         Ο Use Conjugate Displacement         O Use Monitored Displacement         Load to a Monitored Displacement Magnitude of         0.44056 |
|   | Monitored Displacement<br>ODF     U1     at Joint     132     Generalized Displacement     X راستای X     Additional Controlled Displacements                        |
|   | None Modify/Show OK Cancel   |

Mode\_X برای بار Load Application تنظیمات

| X | Results Saved for Nonlinear Static Load Cases  | × |
|---|--|---|
|   | C Final State Only   Multiple States   |   |
|   | For Each Stage       Minimum Number of Saved States       Maximum Number of Saved States       100 |   |
|   | Save positive Displacement Increments Only OK Cancel   |   |

 $Mode_X$  برای بار Results saved تنظیمات

الگوی بارگذاری جانبی متناسب با مود برای راستای Y دقیقا همانند راستای X تعریف می شود. نحوه تنظیمات برای راستای Y در اشکال زیر آورده شده است.

| 🔀 Load  | d Case Data - Nonlinear Static | ×                                      |
|---|--------------------------------|--|
| Load Case Name 1 Mode_Y Set Def Name                  | Notes<br>Modify/Show           | Load Case Type     Static   V   Design |
| Initial Conditions                                    |                                | Analysis Type                          |
| Zero Initial Conditions - Start from Unstressed State |                                | O Linear                               |
| Continue from State at End of Nonlinear Case          | $\vee$                         | Nonlinear 2                            |
| Important Note: Loads from this previous case are in  | cluded in the current case     | O Nonlinear Staged Construction        |
| Modal Load Case                                       |                                | Geometric Nonlinearity Parameters      |
| All Modal Loads Applied Use Modes from Case           | MODAL 🗸                        | None                                   |
| Loads Applied   |                                | O P-Delta                              |
| Load Type Load Name So                                | ale Factor                     | P-Delta plus Large Displacements       |
| 3 Mode v 2 1  |                                | Mass Source                            |
| Mode 2  | Add                            | Previous V                             |
| V coline to the last                                  | Modify                         |  |
| الولين مود عمان راستان ا                              | mouny                          |  |
|   | Delete                         |  |
|   |                                |  |
| Other Parameters                                      |                                |  |
| Load Application Full Load                            | Modify/Show 4                  | ОК                                     |
| Results Saved Final State Only                        | Modify/Show                    | Cancel                                 |
| Nonlinear Parameters Default                          | Modify/Show                    |  |
|   |                                |  |

تنظيمات بار Mode\_Y

| Load Application Control for Nonlinear Static Analysis  | × |
|---|---|
| Load Application Control         Full Load         Displacement Control         Control Displacement         Use Conjugate Displacement         Use Monitored Displacement              |   |
| Load to a Monitored Displacement Magnitude of 0.4406<br>Monitored Displacement      O DOF      U2      at Joint      132      Generalized Displacement      Y راستای Y      Modify/Show |   |
| OK Cancel   |   |

 $Mode_Y$  تنظیمات Load Application تنظیمات

| × | Results Saved for Nonlinear Static Load Cases  |  |
|---|--|--|
|   | C Final State Only   Multiple States   |  |
|   | For Each Stage       Minimum Number of Saved States       Maximum Number of Saved States       100 |  |
|   | Save positive Displacement Increments Only OK Cancel   |  |

 $Mode\_Y$  برای بار Results saved تنظیمات

✓ تنظيم مشخصات مربوط به FEMA356

| ×                         |               | 1              |                |              |            |       |      |          |           | SAP2       | 2000 1  | v20.0.0 | ) Ultim   | ate 32   | -bit -   | concret    | e-Push | nove |
|---------------------------|---------------|----------------|----------------|--------------|------------|-------|------|----------|-----------|------------|---------|---------|-----------|----------|----------|------------|--------|------|
| File                      | e Edit View   | Defi           | ne Draw        | Select Ass   | ign Ar     | alyze | Dis  | splay    | Desig     | n Optio    | ons     | Tools   | Help      |          |          |            |        |      |
|                           | 🔷   🔚 🖶   🗸   | K.             | Materials      |              |            | Ð,    | Q,   | <b>I</b> | ື ၈   3-d | xy xz      | yz n    | C VI    | 69   📲    | -        | NE 🔽     |            | П      | 71   |
|                           | 🔀 X-Z Plane ( | IJ             | Section Prope  | erties       | ×          |       |      |          |           |            |         |         |           | • ×      |          | ( 3-D Viev | /      |      |
| -2                        |               | •?             | Mass Source.   | ••           |            |       |      |          |           |            |         |         |           |          |          |            |        |      |
| •                         |               | (····)         | Coordinate S   | ystems/Grids |            |       |      |          |           |            |         |         |           |          |          |            |        |      |
| >                         | (6)           | ÷              | Joint Constra  | ints         |            | I     | ×    | D        | efine F   | ushove     | r Para  | meter   | rs for FE | EMA35    | 56 Co    | eff Meth   | nod    | ×    |
| $\sum_{n \in \mathbb{N}}$ | A             |                | Joint Patterns |              |            |       |      |          |           |            |         |         |           |          |          |            |        |      |
| $\times$                  |               | 7.             | Groups         |              |            | ⊢     |      | Pus      | hover Pa  | rameters   |         | C       | lick to:  |          |          |            |        |      |
|                           |               | 88             | Section Cuts.  |              |            | I     | 1    | 4 🖪      | 356PO1    |            |         |         | A         | dd New   | Parame   | eters      |        |      |
|                           |               | ~              | Generalized D  | )isplacement | s          |       |      |          |           |            |         |         | Ad        | d Copy o | of Parar | meters     |        |      |
|                           |               | *fx            | Functions      |              | ۲          |       |      |          |           |            |         | 5       | Moe       | dify/Sho | w Para   | meters     |        |      |
|                           |               | 2 E            | Load Patterns  | s            |            |       |      |          |           |            |         |         |           | Delete   | Parame   | ters       |        |      |
| ****                      |               | 1.0 D<br>1.5 E | Load Cases     |              |            | I     |      |          |           |            |         |         |           |          |          |            |        |      |
| _0<br>-0- <b>4</b>        |               | D+L<br>+E      | Load Combin    | nations      |            |       |      |          |           |            |         |         |           | ок       |          | Cancel     |        |      |
| ere a                     |               | <u>111</u>     | Moving Load    | ls           | •          |       |      |          |           |            | Λ       |         |           |          |          |            |        |      |
| ×                         |               |                | Named Prope    | erty Sets    | •          | 1     |      |          |           |            | 5       | 7       |           |          |          |            |        |      |
| -¢•                       | F             |                | Pushover Par   | ameter Sets  | <b>2</b> → |       | Forc | e vs D   | isplacen  | nent       |         |         |           |          |          |            |        |      |
| 24                        |               |                | Named Sets     |              | •          |       | ATC  | : 40 Ca  | pacity S  | pectrum    |         |         |           |          |          |            |        |      |
| ox                        | L             |                |                |              |            |       | FEM  | IA 356   | Coeffici  | ent Metho  | od      | 3       |           |          |          |            |        |      |
|                           |               |                | 山              | l.           |            |       | FEM  | IA 440   | Equivale  | ent Linear | ization |         |           |          |          |            |        |      |
| all                       |               |                |                |              |            |       | FEM  | IA 440   | Displace  | ement Mo   | dificat | ion     |           |          |          |            |        |      |

مسیر تنظیم پارامترهای Fema 356

| Parameters For FEMA 356 Coefficient Method                                      | × |
|---|---|
| Pushover Parameters Name     Units       Name     F356P01       Kgf, m, C     V |   |
| Demand Spectrum Definition  |   |
| Effective Viscous Damping (0 < Damp < 1) 0.05                                   |   |
| Defined Function     2800-III   |   |
| Scale Factor A × g = 3.4335   |   |
| Characteristic Period of Resp Spec, Ts 0.7                                      |   |
| O FEMA 356 General Response Spectrum  |   |
| Mapped Spectral Accel at Short Period, Ss                                       |   |
| Mapped Spectral Accel at 1 Sec Period, S1                                       |   |
| Site Class  |   |
| Selected Coefficients   |   |
| User Value for C2 1.  |   |
| User Value for C3   |   |
| User Value for Cm   |   |

تنظیم پارامترهای Fema 356

√ خروجی تحلیل پوش آور

| کان(نمودار پوش) | ر نيرو-تغييرما | : بررسی نمودار | گام اول |
|-----------------|----------------|----------------|---------|
|-----------------|----------------|----------------|---------|

| ×                 |                    |          |       |         | 1               |                | SAP2000       | v20.0. | 0 Ultin | nate 32    |
|-------------------|--------------------|----------|-------|---------|-----------------|----------------|---------------|--------|---------|------------|
| File Edit View    | Define Draw        | Select A | ssign | Analyze | Displ           | ay Design      | Options       | Tools  | Help    |            |
| 🛛 🗅 💊 I 🔚 🔒 и     | 2 🛯 🖉 🔒            | 🕨 🕑 🛛    | Q Q   | €, ⊕, ( | П               | Show Undefo    | rmed Shape    |        | F4      | - 🗣        |
| 📉 🥂 🔀 Shear Force | e 3-3 Diagram (SPY | )        |       |         | 2               | Show Misc Ob   | bject Assigns | s      | •       | <b>-</b> × |
|                   |                    |          |       |         | 2               | Show Misc Ele  | ement Assig   | ns     | •       |            |
|                   |                    |          |       |         | 2               | Show Object    | Load Assign   | s      | •       | I          |
|                   |                    |          |       |         | 2               | Show Element   | t Load Assig  | ns     | •       | I          |
|                   |                    |          |       |         | ll <sup>a</sup> | Show Paths     |               |        |         | 1          |
|                   |                    |          |       |         | 175-            | Show Load Ca   | ase Tree      |        |         | 1          |
|                   |                    |          |       |         | H               |                |               |        |         | - I        |
|                   |                    |          |       |         | Y Y             | Show Deform    | ed Shape      |        | FO      | 1          |
|                   |                    |          |       |         | TY I            | Show Forces/   | Stresses      |        | •       | I          |
|                   |                    |          |       |         | 2               | Show Virtual V | Work Diagra   | m      |         | I          |
|                   |                    |          |       |         | 1               | Show Influence | ce Lines      |        |         |            |
|                   |                    |          |       |         | Nº              | Show Respon    | se Spectrum   | Curves |         | I          |
|                   |                    |          |       |         | 1               | Show Plot Fur  | nctions       | F      | F12     | 1          |
|                   |                    |          |       | I       | (îi             | Show Static P  | ushover Cur   | ve     | 2       | 1          |
| - Ca              |                    |          | _     |         |                 |                |               |        |         |            |

مسیر نمایش نمودار پوش



نمودار پوش الگوی بار جانبی Uniform X-PG1



نمودار پوش الگوهای بار جانبی راستای X



نمودار پوش الگوهای بار جانبی راستای Y

## گام دوم: مفاصل پلاستیک المانها

| ×  | 1 SAP2000 v20.0.0 Ultim 🐹 Display Deformed Shape 🗴  |
|--|---|
| File       Edit       View       Define       Draw       Select       Assign       Analyze         Image: Select       Image: Select       Image: Select       Image: Select       Image: Select       Select       Assign       Analyze         Image: Select       I | Display Design Options Tools Help Case/Combo<br>Show Undeformed Shape F4 Case/Combo Name 3 UniformX-PG1   |
|  | Show Misc Element Assigns       Multivalued Options         Show Object Load Assigns       Envelope (Max or Min)         Show Paths       Stop         Show Case Tree       Scaling         Automatic       Automatic   |
|  | Image: Show Deformed Shape       2       F6         Image: Show Forces/Stresses       Image: Show Virtual Work Diagram       Image: Show Virtual Work Diagram         Image: Show Influence Lines       Image: Draw Contours on Objects         Image: Show Response Spectrum Curves       Image: Draw Continuous Contours         Image: Show Plot Functions       F12         Image: Show Plot Functions       F12                                |
| 中<br>、<br>、<br>、<br>、<br>、<br>、<br>、<br>、<br>、<br>、<br>、<br>、<br>、   | Image: Show Static Pushover Curve     Minimum Value for User Contour Range       Image: Show Hinge Results     Maximum Value for User Contour Range       Image: Show Tables     Ctrl+T       Save Named Display     Image: Options       Image: Show Named Display     Image: Option S       Image: Show Named Display     Image: Option S       Image: Show Named Display     Image: Option S       Image: Show Named Display     Image: Option S |

تنظیمات نمایش مفاصل پلاستیک برای الگوی بار Uniform X-PG1



تغییر شکل سازه در گام اول و آخر پوش سازه برای الگوی بار Uniform X-PG1

| ياىه  | برش        | سوم: | گام |
|-------|------------|------|-----|
| ** ** | <b>U J</b> |      | 1   |

| ×            |        |           |             |          |        |          |         | 1    |      |             | SAP2000       | v20.0. | 0 Ulti | mate 3 |
|--------------|--------|-----------|-------------|----------|--------|----------|---------|------|------|-------------|---------------|--------|--------|--------|
| Fil          | e Edit | View      | Define      | Draw     | Select | Assign   | Analyze | Disp | olay | Design      | Options       | Tools  | Help   | •      |
|              | 🦠   🔚  | - 🔒       | 90          |          | 🕨 🛞    |          | € €     |      | Sho  | w Undefo    | ormed Shape   |        | F4     | 1 🗸    |
|              | 🔀 Ai   | nalysis N | 1odel - X-Z | Plane @  | Y=25   |          |         | 20   | Sho  | w Misc O    | bject Assign  | s      | Þ      | - ×    |
| 7            |        |           |             |          |        |          |         | 2    | Sho  | w Misc El   | lement Assig  | ns     | •      |        |
| 16           |        |           |             |          |        |          |         | to a | Sho  | w Object    | Load Assign   | s      | •      |        |
|              |        |           |             |          |        |          |         | 20   | Sho  | w Elemer    | nt Load Assig | ns     | •      |        |
| 1            |        | _         |             | _        |        | _        | _       | 1112 | Sho  | w Paths     |               |        |        |        |
| $\mathbb{N}$ |        | ÷.        |             | *        |        | 옷        | 5       | 4    | ~    |             | -             |        |        | -      |
| 53           | (      | <u> </u>  | (           | Ŷ        | L L    | È l      |         | 1EE  | Sho  | w Load C    | ase Tree      |        |        |        |
|              |        | <u> </u>  |             | <u> </u> |        | <u> </u> |         |      | Sho  | w Deform    | ned Shape     |        | F6     |        |
|              |        |           |             |          |        |          |         | 17   | Sho  | w Forces/   | /Stresses     |        | Þ      |        |
|              |        |           |             |          |        |          |         | 1    | Sho  | w Virtual   | Work Diagra   | m      |        |        |
|              |        |           |             |          |        |          |         | Pp 0 | Sho  | w Influen   | ce Lines      |        |        |        |
| Ţ            |        |           |             |          |        |          |         | No   | Sho  | w Respon    | ise Spectrum  | Curves |        | 1      |
|              |        |           |             |          |        |          |         | 100  | She  | W Plot Fu   | nctions       |        | 12     |        |
| 10           |        |           |             |          |        |          |         |      | 5110 |             |               |        |        | -      |
| 2            |        |           |             |          |        |          |         |      | Sho  | ow Static F | Pushover Cur  | ve     |        |        |
| S.           |        |           |             |          |        |          |         | r.   | Sho  | w Hinge     | Results       |        |        |        |
| ~            |        |           |             |          |        |          |         |      | Sho  | w Tables.   | 2             | Ctrl   | + T    |        |
| -04          |        |           |             |          |        |          |         | a. P |      |             |               |        |        |        |

مسير نمايش خروجىها

| K Choose Tables for Display                                    | ×   |
|--|---|
| Edit   | Load Patterns (Model Def.)         Select Load Patterns         10 of 10 Selected         Load Cases (Results)         2       Select Load Cases         2 of 110 Selected         Modify/Show Options         Set Output Selections         Options         Selection Only         Show Unformatted         Named Sets         Save Named Set         Delete Named Set         Delete Named Set         Delete Named Set |
| Table Formats File Current Table Formats File: Program Default |   |

## انتخاب الگوی بار Uniform X-PG1 برای خروجی برش پایه

| OutputCase   | CaseType<br>Text | StepType<br>Text | GlobalFX<br>Kgf | GlobalFY<br>Kgf | GlobalFZ<br>Kgf | GlobalMX<br>Kgf-m | GlobalMY<br>Kgf-m | GlobalMZ<br>Kgf-m |
|--------------|------------------|------------------|-----------------|-----------------|-----------------|-------------------|-------------------|-------------------|
| UniformX-PG1 | NonStatic        | Max              | -4.15E-12       | 2.08            | 4374729.88      | 54532562.5        | -54805374         | 14218213.86       |
| UniformX-PG1 | NonStatic        | Min              | -1140441.46     | -0.7            | 4374729.88      | 54532556.52       | -65446322         | -2.346E-10        |

برش پایه برای الگوی بار Uniform X-PG1



برش پایه برای الگوهای بار جانبی راستای X و Y

**گام چهارم: تغییرمکان جانبی طبقات** برای بدست آوردن تغییرمکان جانبی طبقات، ابتدا تمامی گره های یک ستون را مطابق شکل زیر انتخاب میکنیم. سپس تغییرمکان جانبی گرهها را بدست می آوریم که همان تغییرمکان جانبی طبقات می باشد.



انتخاب تمامی گرههای یک ستون

| X  | Choose Tables for Display | ×   |
|--|---------------------------|---|
| Edit  Edit  MODEL DEFINITION (0 of 85 tables selected)  System Data  Property Definitions  Condetive Definitions  Connectivity Data Joint Assignments  Options/Preferences Data Joint Assignments Doptions/Preferences Data Joint Output Displacements Displacements Displacements Displacements Deliment Output Displacements Deliment Output Displacement Output Displacemen | Choose Tables for Display | X Load Patterns (Model Def.) Select Load Patterns 10 of 10 Selected Load Cases (Results) Select Load Cases fof 110 Selected V/Show Options uput Selections tion Only Unformatted S Ye Named Set te Named Set te Named Set |
| Table Formats File Current Table Formats File: Program   | m Default                 | OK Cancel   |

مسير خروجي تغييرمكان جانبي طبقات براي الكوى بار جانبي Uniform X-PG1

| Joint<br>Text | OutputCase   | CaseType<br>Text | StepType<br>Text | U1<br>m    | U2<br>m   | U3<br>m   | R1<br>Radians | R2<br>Radians | R3<br>Radians |
|---------------|--------------|------------------|------------------|------------|-----------|-----------|---------------|---------------|---------------|
| 32            | UniformX-PG1 | NonStatic        | Max              | 0.047324   | 0.000189  | -0.000255 | -9.7E-05      | 0.019161      | 1.2E-05       |
| 32            | UniformX-PG1 | NonStatic        | Min              | -3.49E-06  | -0.000109 | -0.000443 | -0.000259     | -0.000166     | -8.084E-06    |
| 33            | UniformX-PG1 | NonStatic        | Max              | 0.117473   | 0.000269  | -0.000467 | -0.000101     | 0.022176      | 1.7E-05       |
| 33            | UniformX-PG1 | NonStatic        | Min              | -6.489E-06 | -0.000155 | -0.000826 | -0.00016      | 8.719E-06     | -1.2E-05      |
| 34            | UniformX-PG1 | NonStatic        | Max              | 0.188044   | 0.000299  | -0.000654 | -0.000257     | 0.019703      | 1.9E-05       |
| 34            | UniformX-PG1 | NonStatic        | Min              | -6.413E-06 | -0.00017  | -0.001144 | -0.000271     | -7.7E-05      | -1.3E-05      |
| 35            | UniformX-PG1 | NonStatic        | Max              | 0.246379   | 0.000306  | -0.000801 | -0.000177     | 0.014393      | 2E-05         |
| 35            | UniformX-PG1 | NonStatic        | Min              | -6.59E-06  | -0.000177 | -0.001369 | -0.000182     | -3.3E-05      | -1.3E-05      |
| 36            | UniformX-PG1 | NonStatic        | Max              | 0.286101   | 0.000308  | -0.00087  | -0.000683     | 0.009897      | 2E-05         |
| 36            | UniformX-PG1 | NonStatic        | Min              | -6.475E-06 | -0.00018  | -0.001467 | -0.000685     | -0.000138     | -1.3E-05      |

تغییرمکان جانبی طبقات برای الگوی بار جانبی Uniform X-PG1

مقدار جابجایی نسبی طبقات(دریفت) مطابق جدول زیر میباشد. مقدار دریفت از تقسیم اختلاف تغییرمکان جانبی طبقه نسبت به طبقه پایین خود، به ارتفاع طبقه بدست می آید.

| SPQX      | -PG1     | Uniforn   | nX-PG1  | EC        | QX       | Mode-X    |          |      |  |  |  |
|-----------|----------|-----------|---------|-----------|----------|-----------|----------|------|--|--|--|
| تغييرمكان |          | تغييرمكان |         | تغييرمكان |          | تغييرمكان |          | طبقه |  |  |  |
| جانبی(m)  | دريفت    | جانبی(m)  | دريفت   | جانبی(m)  | دريفت    | جانبی(m)  | دريفت    |      |  |  |  |
| 0.046694  | 0.014592 | 0.047324  | 0.01479 | 0.042066  | 0.013146 | 0.06357   | 0.019866 | 1    |  |  |  |
| 0.131739  | 0.026577 | 0.117473  | 0.02192 | 0.1327    | 0.028323 | 0.171971  | 0.033875 | 2    |  |  |  |
| 0.229132  | 0.030435 | 0.188044  | 0.02205 | 0.237129  | 0.032634 | 0.28933   | 0.036675 | 3    |  |  |  |
| 0.32768   | 0.030796 | 0.246379  | 0.01823 | 0.343863  | 0.033354 | 0.402575  | 0.035389 | 4    |  |  |  |
| 0.408168  | 0.025153 | 0.286101  | 0.01241 | 0.440547  | 0.030214 | 0.443097  | 0.012663 | 5    |  |  |  |

دریفت و تغییرمکان جانبی طبقات برای الگوهای بار جانبی راستای X



دریفت طبقات برای الگوهای بار جانبی راستای X



X تغییرمکان جانبی طبقات برای الگوهای بار جانبی راستای

گام پنجم: نیروی داخلی المانها







مسير نمايش نيروهاي داخلي المانها براي الگوي بار جانبي Uniform X-PG1

| ×       |               |              |               |                  | Element          | Forces - Fi | ames             |           |            |             |             | × |
|---------|---------------|--------------|---------------|------------------|------------------|-------------|------------------|-----------|------------|-------------|-------------|---|
| File    | View Edit     | Format-Filte | r-Sort Select | Options          |                  |             |                  |           |            |             |             |   |
| Units:  | As Noted      |              |               |                  |                  |             | Element Forces - | Frames    |            |             |             | ~ |
| Filter: |               |              |               |                  |                  |             |                  |           |            |             |             |   |
|         | Frame<br>Text | Station<br>m | OutputCase    | CaseType<br>Text | StepType<br>Text | P<br>Kgf    | V2<br>Kgf        | V3<br>Kgf | T<br>Kgf-m | M2<br>Kgf-m | M3<br>Kgf-m | ^ |
| ►       | 26            | 0            | UniformX-PG1  | NonStatic        | Max              | -63347.65   | 30417.24         | 1774.01   | 63.48      | 6790.91     | 107446.08   |   |
|         | 26            | 1.475        | UniformX-PG1  | NonStatic        | Max              | -61818.37   | 30417.24         | 1774.01   | 63.48      | 4174.24     | 62580.66    |   |
|         | 26            | 2.95         | UniformX-PG1  | NonStatic        | Max              | -60289.09   | 30417.24         | 1774.01   | 63.48      | 3138.55     | 17898.11    |   |
|         | 26            | 0            | UniformX-PG1  | NonStatic        | Min              | -109037.33  | 1705.69          | -2395     | -43.18     | -4222.53    | 1743.48     |   |
|         | 26            | 1.475        | UniformX-PG1  | NonStatic        | Min              | -107508.05  | 1705.69          | -2395     | -43.18     | -689.91     | -772.42     |   |
|         | 26            | 2.95         | UniformX-PG1  | NonStatic        | Min              | -105978.77  | 1705.69          | -2395     | -43.18     | 1557.58     | -3288.32    |   |
|         | 27            | 0.25         | UniformX-PG1  | NonStatic        | Max              | -44507.55   | 20194.11         | -2028.28  | 20.43      | -2666.5     | 39011.52    |   |
|         | 27            | 1.6          | UniformX-PG1  | NonStatic        | Max              | -43331.43   | 20194.11         | -2028.28  | 20.43      | 155.36      | 12220.77    | Γ |
|         | 27            | 2.95         | UniformX-PG1  | NonStatic        | Max              | -42155.31   | 20194.11         | -2028.28  | 20.43      | 3274.88     | -1009.49    |   |
|         | 27            | 0.25         | UniformX-PG1  | NonStatic        | Min              | -79168.56   | 1252.16          | -2882.71  | -13.03     | -4508.44    | 2371.34     |   |
|         | 27            | 1.6          | UniformX-PG1  | NonStatic        | Min              | -77992.44   | 1252.16          | -2882.71  | -13.03     | -616.78     | 680.93      |   |
|         | 27            | 2.95         | UniformX-PG1  | NonStatic        | Min              | -76816.32   | 1252.16          | -2882.71  | -13.03     | 2809.87     | -17960.72   | T |
|         | 28            | 0.25         | UniformX-PG1  | NonStatic        | Max              | -32392.02   | 12397.69         | -2069.76  | 5.6        | -2341.35    | 10818.36    |   |
|         | 28            | 1.6          | UniformX-PG1  | NonStatic        | Max              | -31420.02   | 12397.69         | -2069.76  | 5.6        | 452.82      | -228.46     |   |
|         | 28            | 2.95         | UniformX-PG1  | NonStatic        | Max              | -30448.02   | 12397.69         | -2069.76  | 5.6        | 3333.54     | -742.51     | ~ |
| <       |               |              |               |                  |                  |             |                  |           |            |             |             | > |
| Record  | d: << <       | 1            | > >> of 30    | 1                |                  |             |                  |           | Add Tables | S           | Done        | ] |

نیروهای داخلی المانها برای الگوی بار جانبی Uniform X-PG1

لنگر داخلی ستون F-1 تحت الگوهای بار جانبی راستای X

| SPQX-PG1 | UniformX-PG1 | EQX      | Mode-X   | طبقه |
|----------|--------------|----------|----------|------|
| 88805.61 | 107446.1     | 98781.31 | 72829.28 | 1    |
| 49401.95 | 39011.52     | 54905.47 | 43446.59 | 2    |
| 24937.27 | 10818.36     | 21110.33 | 16251.18 | 3    |
| 15751.49 | 6776.14      | 13100.31 | 13222.52 | 4    |
| 2436.6   | 669.44       | 1128.47  | 1050.79  | 5    |



لنگر داخلی ستون F-1 تحت الگوهای بار جانبی راستای X