Appendix A:

Results for 8-story and 20-story databases.

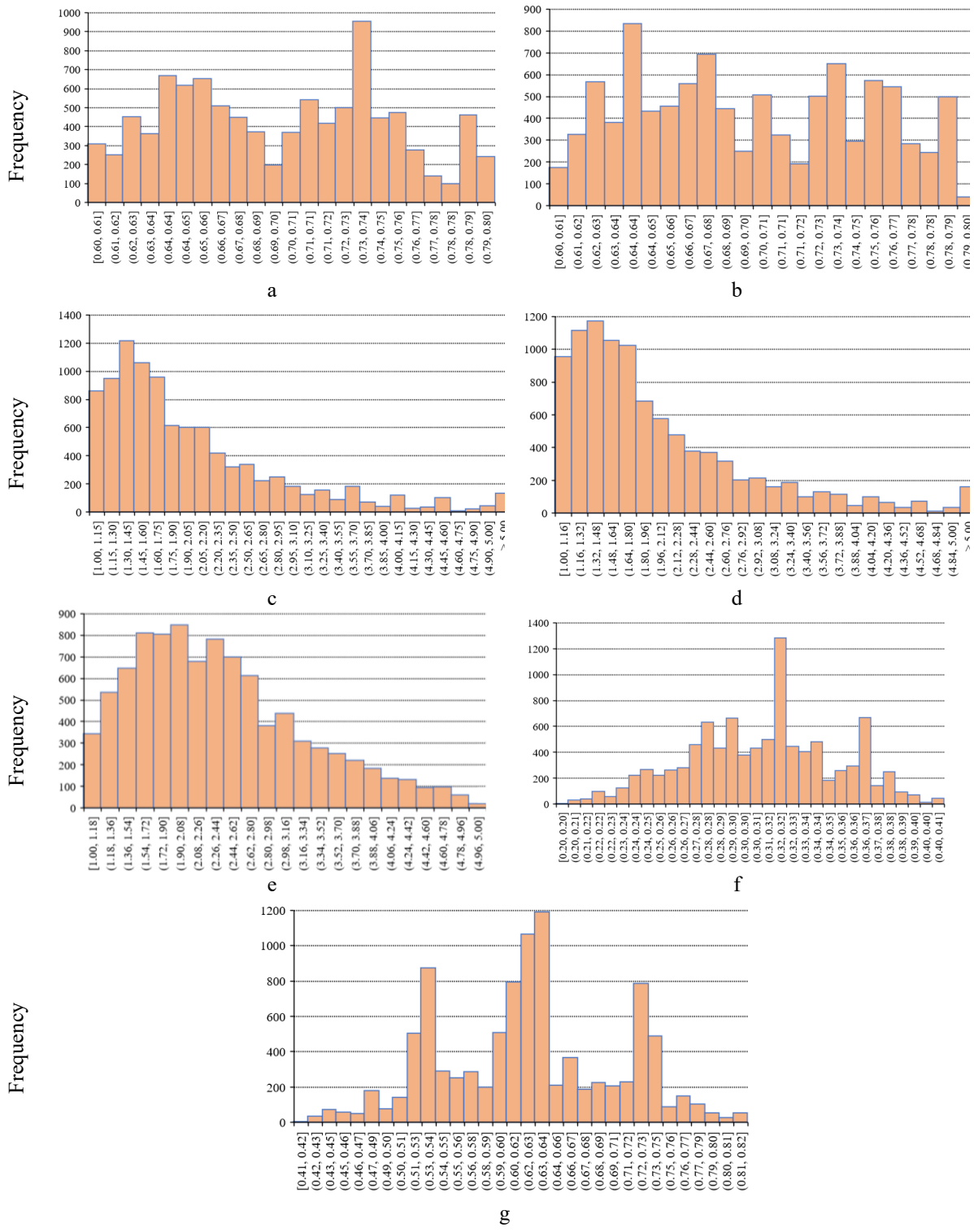


Fig. 1. The histogram of I33 for 8-story building for ratio of: a) EC1_1/ IC1_1; b) EC1_3/ IC1_3; c) IC1_1/ IC1_3; d) EC1_1/ EC1_3; e) EB1_1/EB1_3; f) EB1_3/(EC1_3+ EC1_4); g) EB1_8/ EC1_8

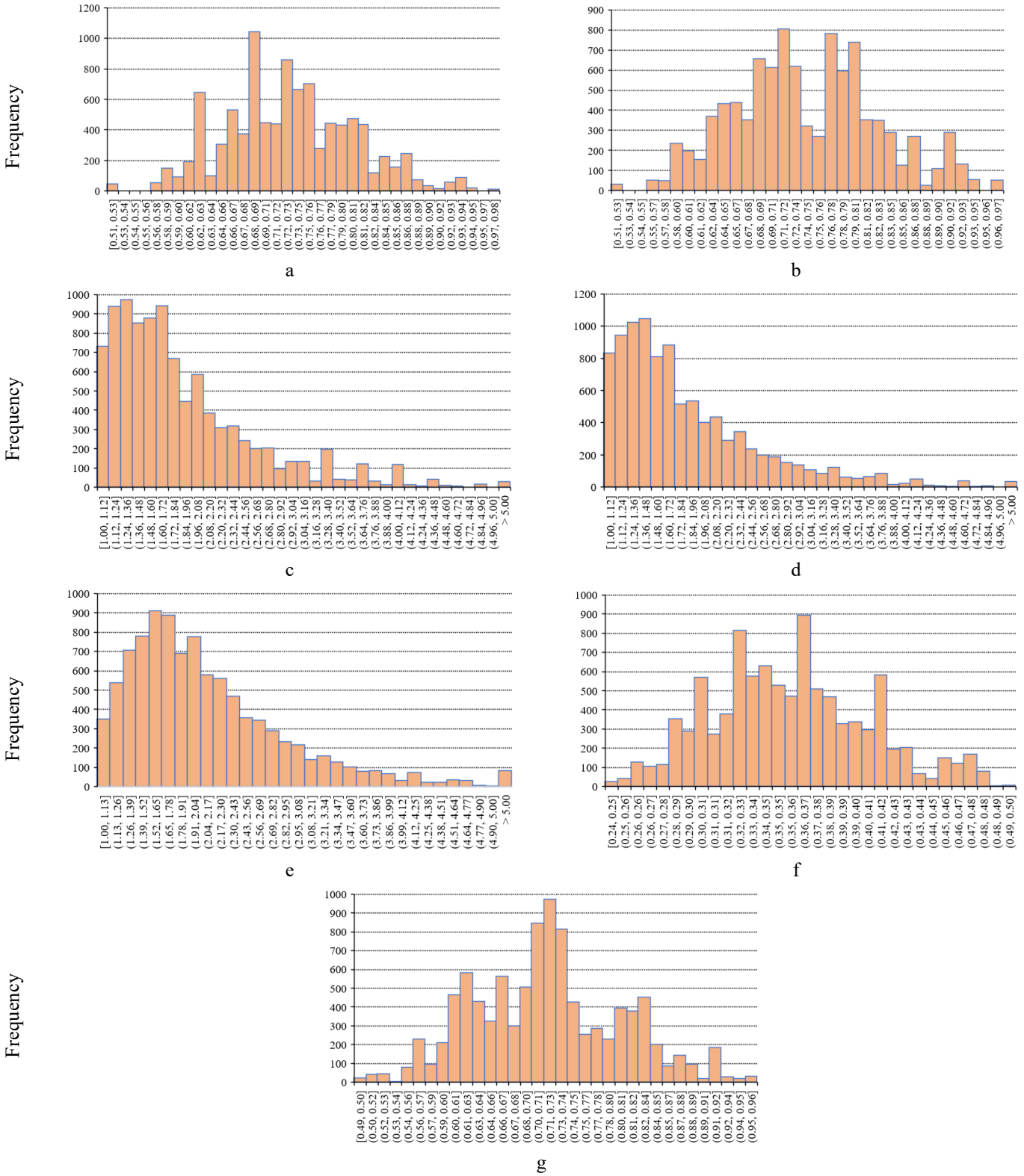


Fig. 2. The histogram of Z33 for 8-story building for ratio of: a) EC1_1/ IC1_1; b) EC1_3/ IC1_3; c) IC1_1/ IC1_3; d) EC1_1/ EC1_3; e) EB1_1/EB1_3; f) EB1_3/(EC1_3+ EC1_4); g) EB1_8/ EC1_8

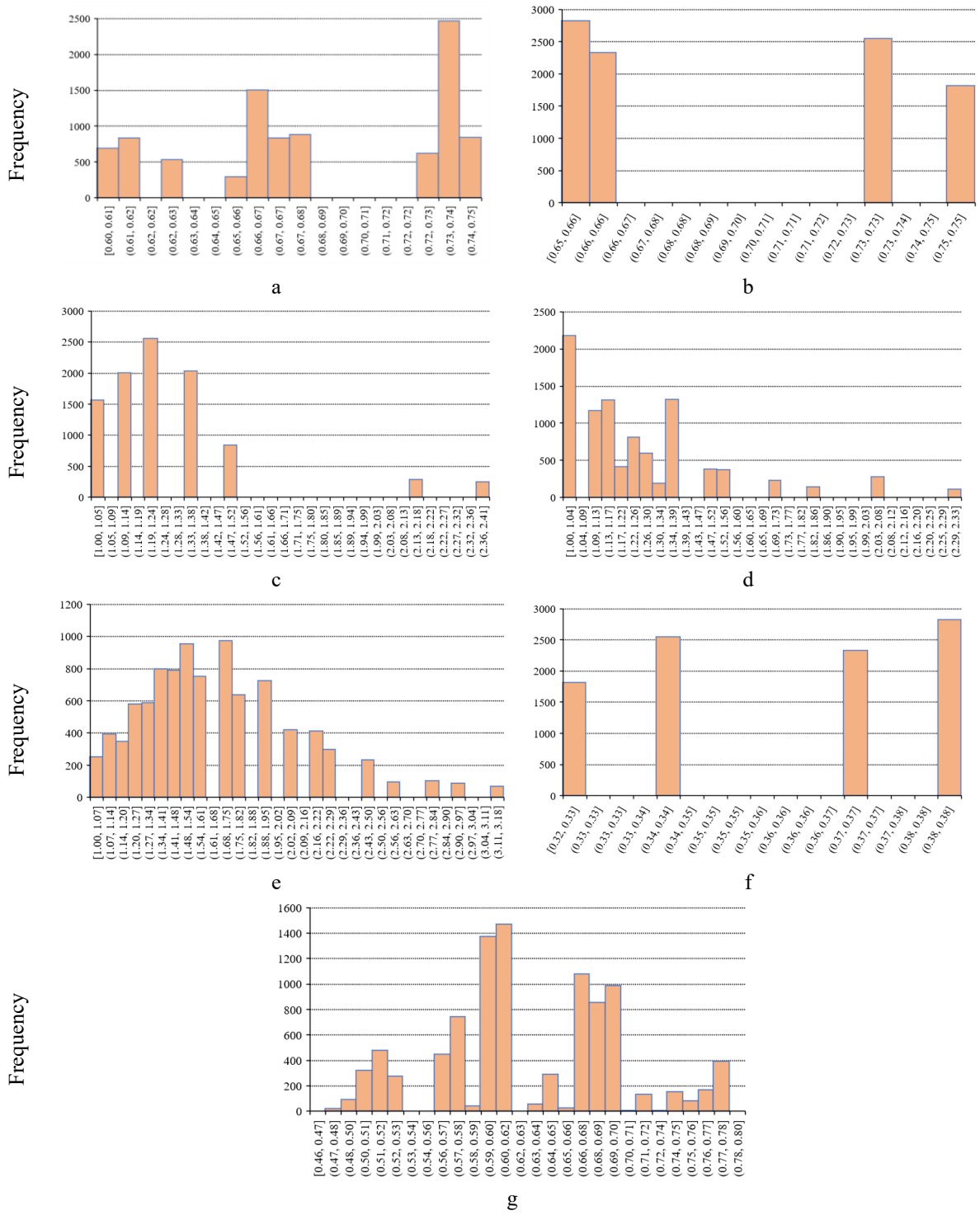


Fig. 3. The histogram of I33 for 20-story building for ratio of: a) EC1_1/ IC1_1; b) EC1_3/ IC1_3; c) IC1_1/ IC1_3; d) EC1_1/ EC1_3; e) EB1_1/EB1_3; f) EB1_3/(EC1_3+ EC1_4); g) EB1_20/ EC1_20

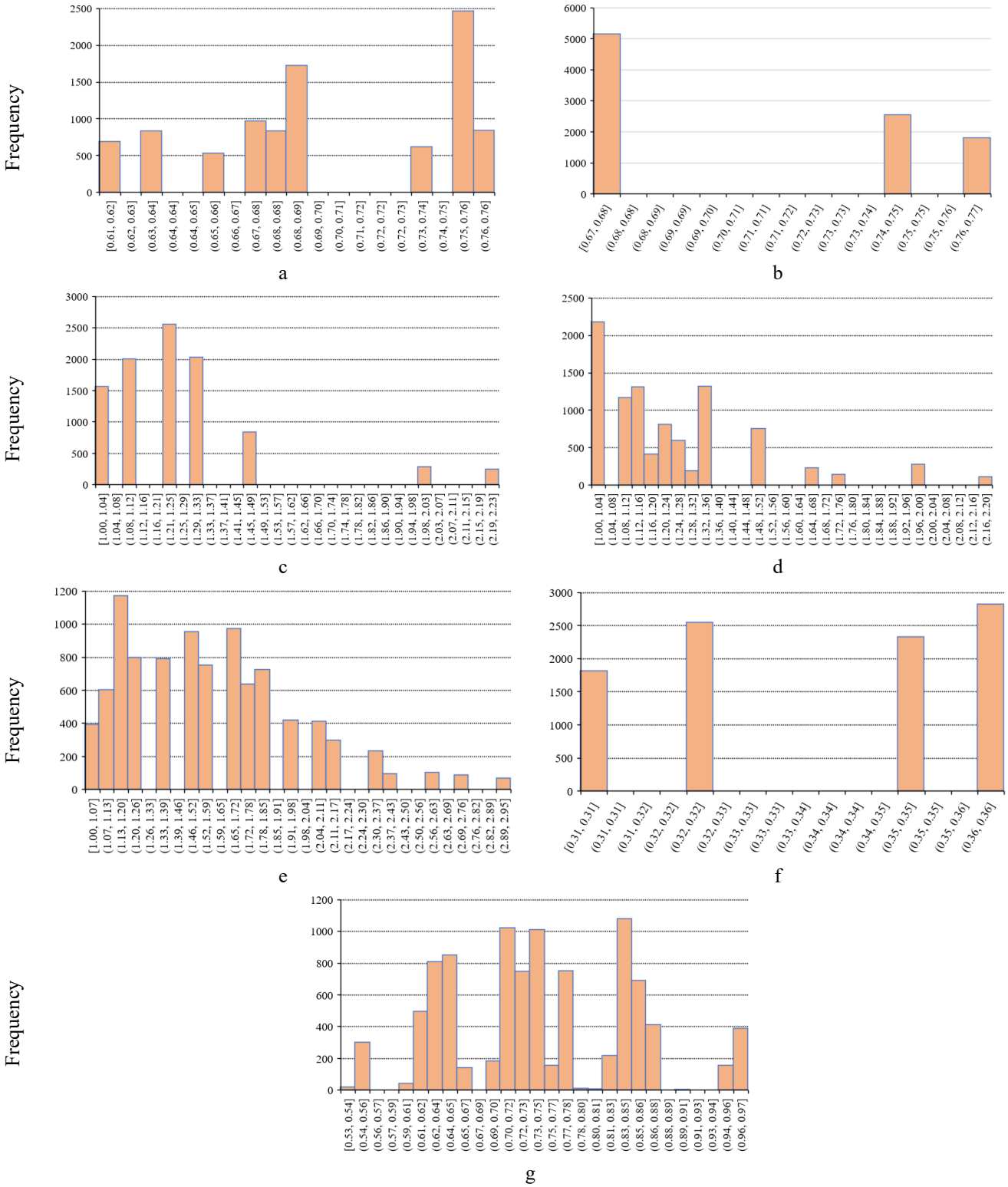


Fig. 4. The histogram of Z33 for 20-story building for ratio of: a) EC1_1/ IC1_1; b) EC1_3/ IC1_3; c) IC1_1/ IC1_3; d) EC1_1/ EC1_3; e) EB1_1/EB1_3; f) EB1_3/(EC1_3+ EC1_4); g) EB1_20/ EC1_20

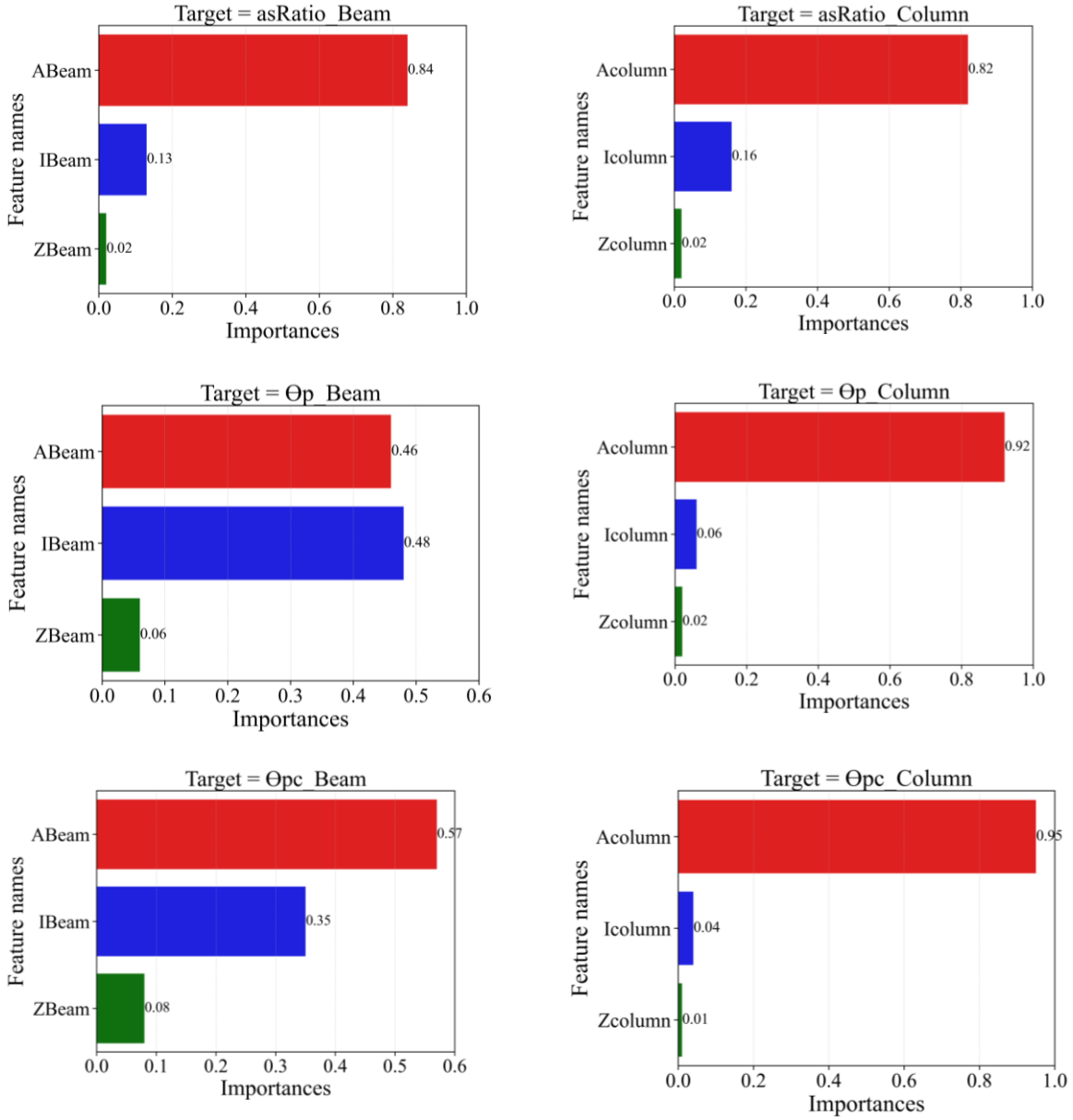
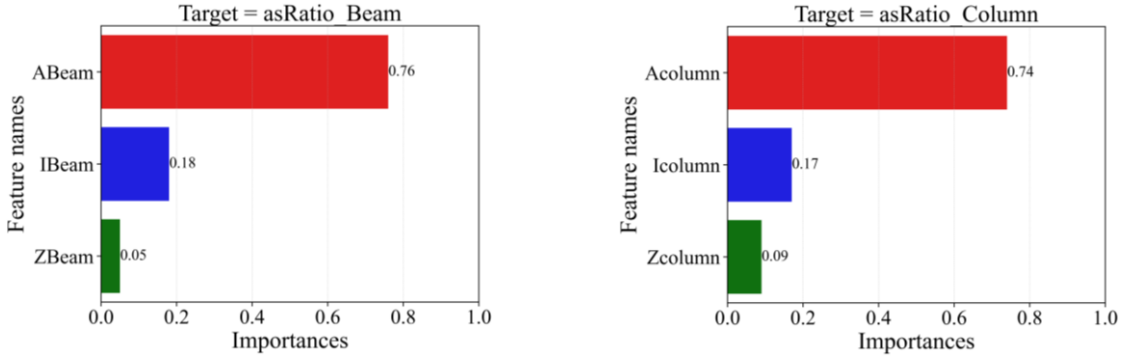


Fig.5. Random Forest feature importance for spring parameters of 8-story buildings



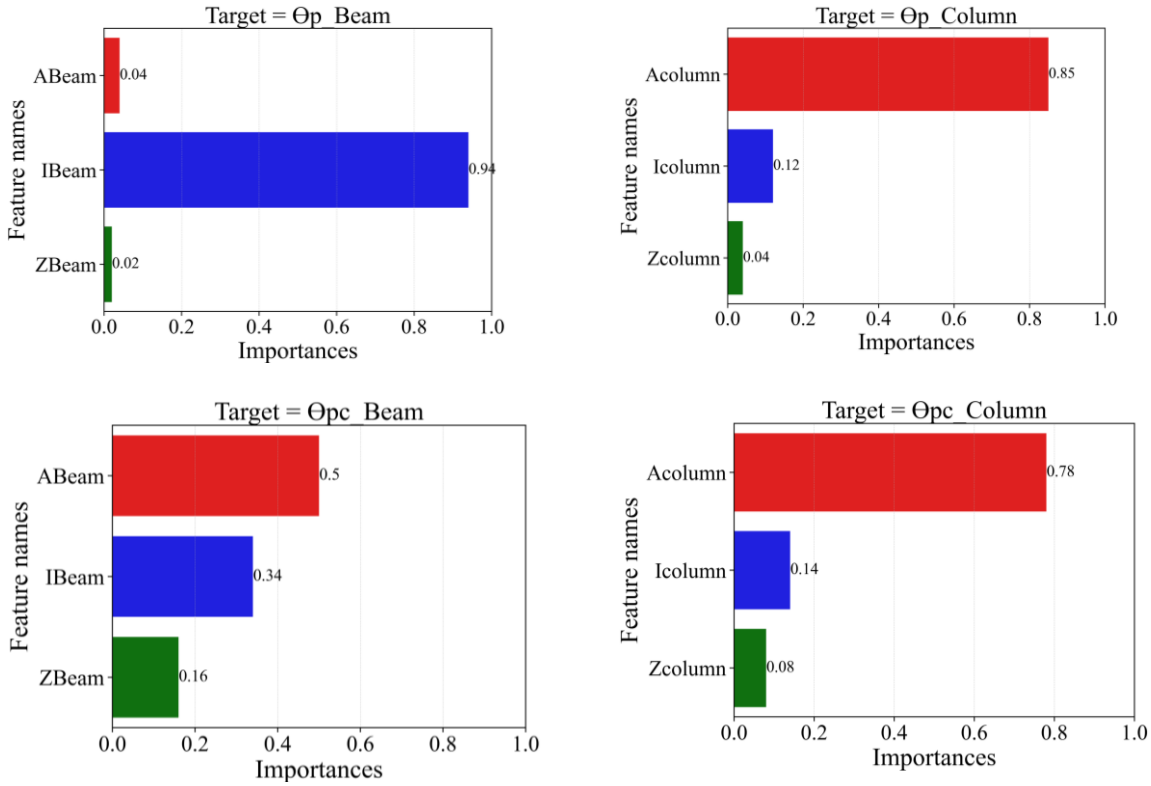
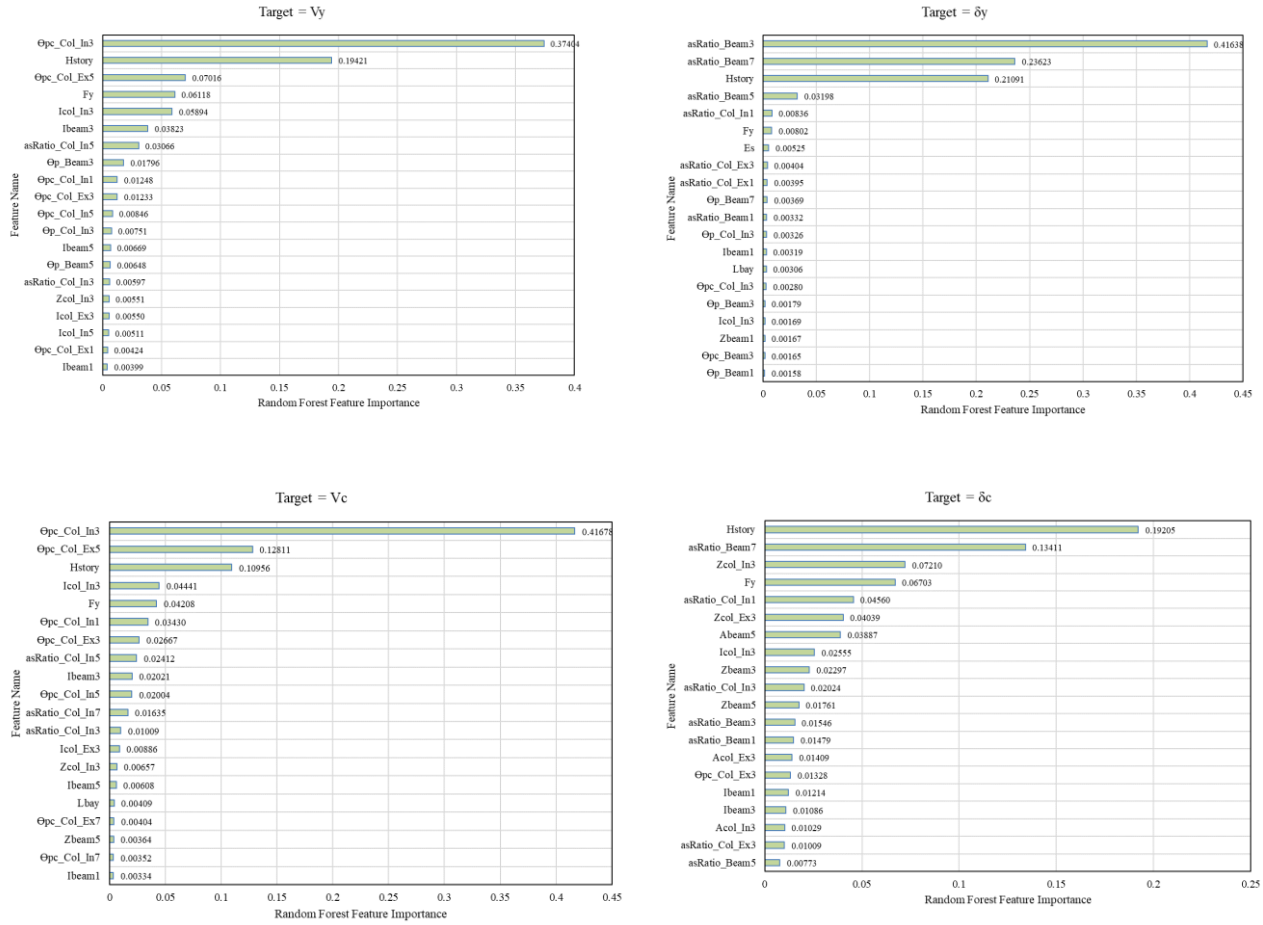


Fig.6. Random Forest feature importance for spring parameters of 20-story buildings



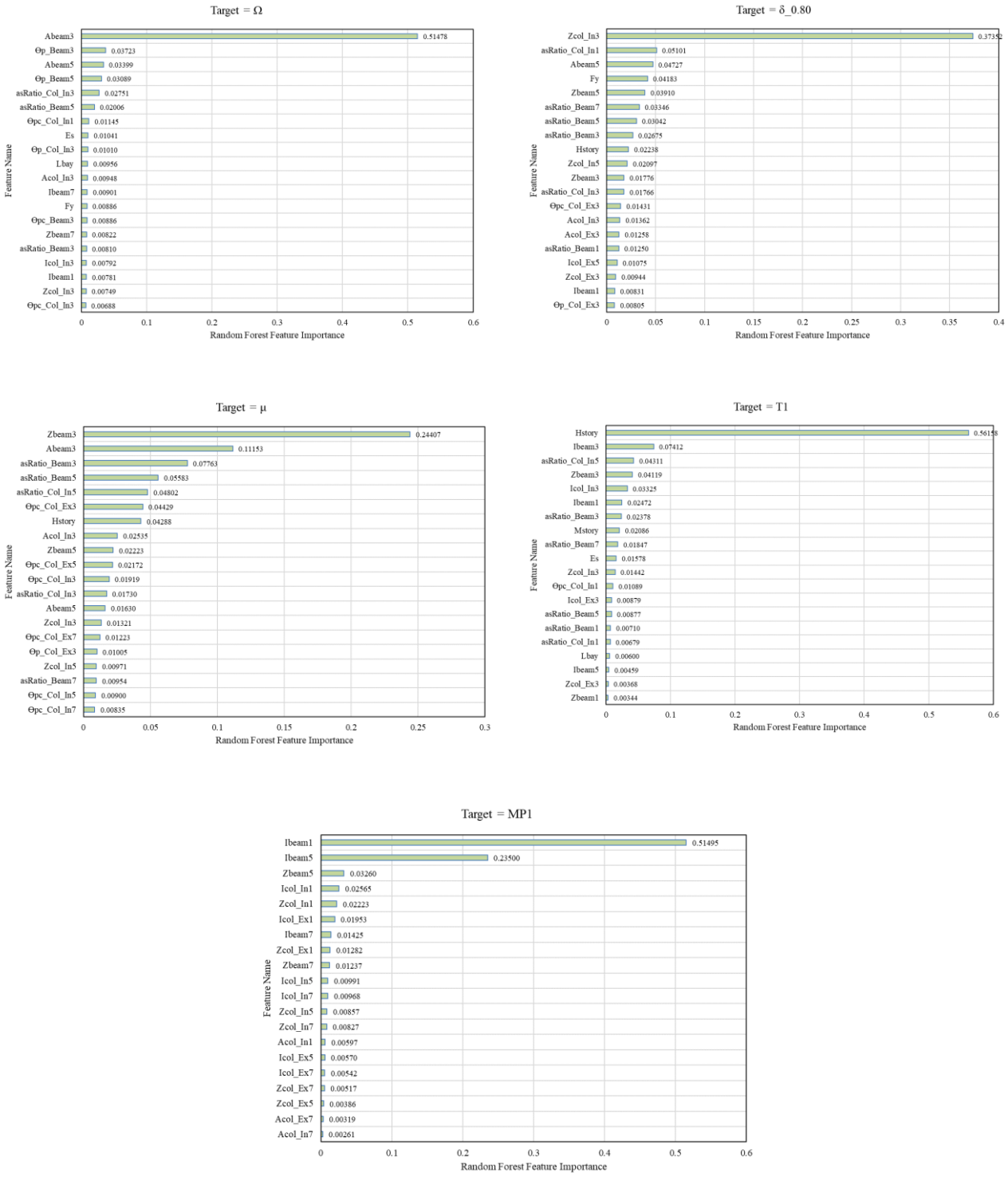
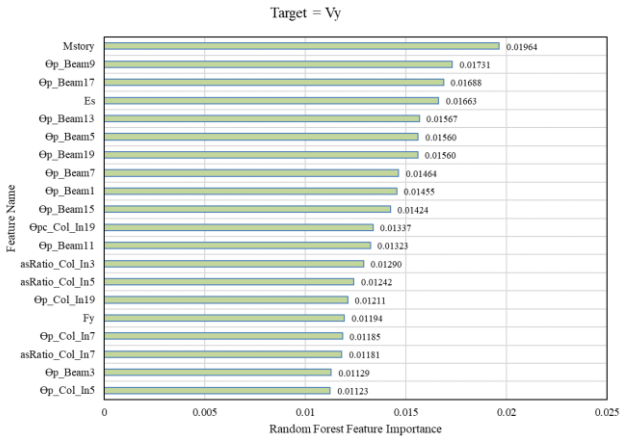
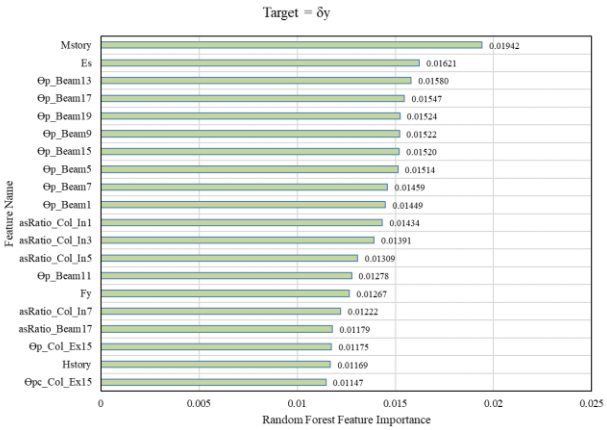
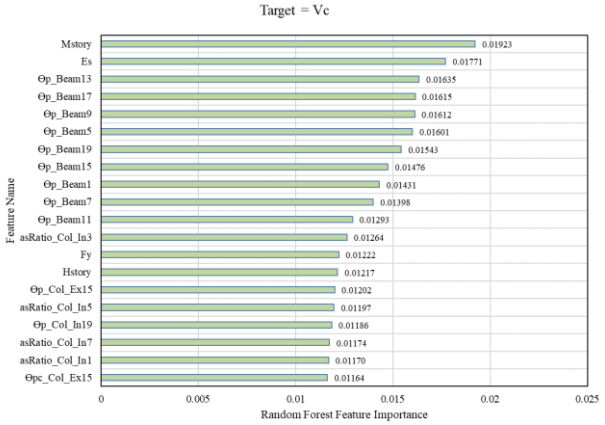
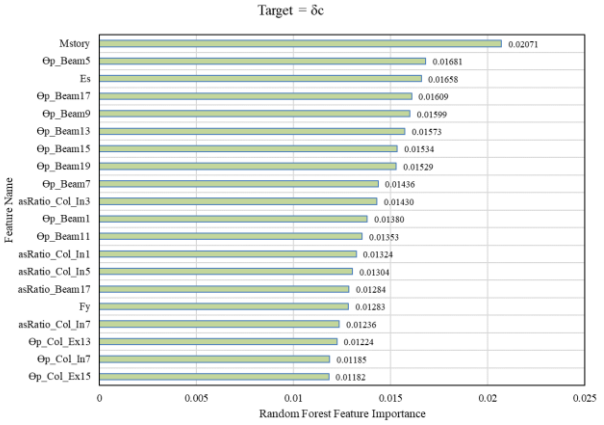


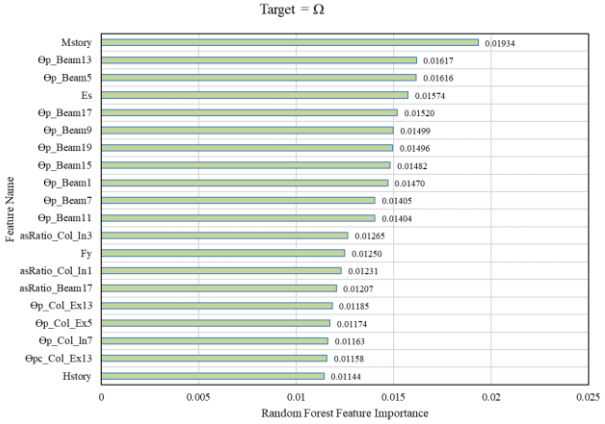
Fig.7. Random Forest feature importance considering all random and casual random parameters of 8-story buildings

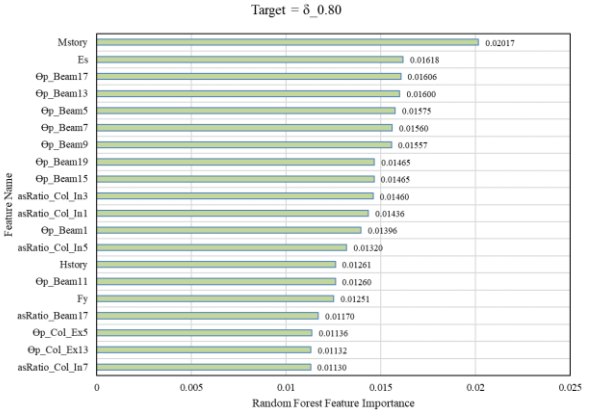

Target = Vy
Mstory 0.01964
θp_Beam9 0.01731
θp_Beam17 0.01688
Es 0.01663
θp_Beam13 0.01567
θp_Beam5 0.01560
θp_Beam19 0.01560
θp_Beam7 0.01464
θp_Beam1 0.01455
θp_Beam15 0.01424
θpc_Col_In19 0.01337
θp_Beam11 0.01323
asRatio_Col_In3 0.01290
asRatio_Col_In5 0.01242
θp_Col_In19 0.01211
Fy 0.01194
θp_Col_In7 0.01185
asRatio_Col_In7 0.01181
θp_Beam3 0.01129
θp_Col_In5 0.01123
Feature Name
0 0.005 0.01 0.015 0.02 0.025
Random Forest Feature Importance


Target = δy
Mstory 0.01942
Es 0.01621
θp_Beam13 0.01580
θp_Beam17 0.01547
θp_Beam19 0.01524
θp_Beam9 0.01522
θp_Beam15 0.01520
θp_Beam5 0.01514
θp_Beam7 0.01459
θp_Beam1 0.01449
asRatio_Col_In1 0.01434
asRatio_Col_In3 0.01391
asRatio_Col_In5 0.01309
θp_Beam11 0.01278
Fy 0.01267
asRatio_Col_In7 0.01222
asRatio_Beam17 0.01179
θp_Col_Ex15 0.01175
Hstory 0.01169
θpc_Col_Ex15 0.01147
Feature Name
0 0.005 0.01 0.015 0.02 0.025
Random Forest Feature Importance


Target = Vc
Mstory 0.01923
Es 0.01771
θp_Beam13 0.01635
θp_Beam17 0.01615
θp_Beam9 0.01612
θp_Beam5 0.01601
θp_Beam19 0.01543
θp_Beam15 0.01476
θp_Beam1 0.01431
θp_Beam7 0.01398
θp_Beam11 0.01293
asRatio_Col_In3 0.01264
Fy 0.01222
Hstory 0.01217
θp_Col_Ex15 0.01202
asRatio_Col_In5 0.01197
θp_Col_In19 0.01186
asRatio_Col_In7 0.01174
asRatio_Col_In1 0.01170
θpc_Col_Ex15 0.01164
Feature Name
0 0.005 0.01 0.015 0.02 0.025
Random Forest Feature Importance


Target = δc
Mstory 0.02071
θp_Beam5 0.01681
Es 0.01658
θp_Beam17 0.01609
θp_Beam9 0.01599
θp_Beam13 0.01573
θp_Beam15 0.01534
θp_Beam19 0.01529
θp_Beam7 0.01436
asRatio_Col_In3 0.01430
θp_Beam1 0.01380
θp_Beam11 0.01353
asRatio_Col_In1 0.01324
asRatio_Col_In5 0.01304
asRatio_Beam17 0.01284
Fy 0.01283
asRatio_Col_In7 0.01236
θp_Col_Ex13 0.01224
θp_Col_In7 0.01185
θp_Col_Ex15 0.01182
Feature Name
0 0.005 0.01 0.015 0.02 0.025
Random Forest Feature Importance


Target = Ω
Mstory 0.01934
θp_Beam13 0.01617
θp_Beam5 0.01616
Es 0.01574
θp_Beam17 0.01520
θp_Beam9 0.01499
θp_Beam19 0.01496
θp_Beam15 0.01482
θp_Beam1 0.01470
θp_Beam7 0.01405
θp_Beam11 0.01404
asRatio_Col_In3 0.01265
Fy 0.01250
asRatio_Col_In1 0.01231
asRatio_Beam17 0.01207
θp_Col_Ex13 0.01185
θp_Col_Ex5 0.01174
θp_Col_In7 0.01163
θpc_Col_Ex13 0.01158
Hstory 0.01144
Feature Name
0 0.005 0.01 0.015 0.02 0.025
Random Forest Feature Importance


Target = δ_0.80
Mstory 0.02017
Es 0.01618
θp_Beam17 0.01606
θp_Beam13 0.01600
θp_Beam5 0.01575
θp_Beam7 0.01560
θp_Beam9 0.01557
θp_Beam19 0.01465
θp_Beam15 0.01465
asRatio_Col_In3 0.01460
asRatio_Col_In1 0.01436
θp_Beam1 0.01396
asRatio_Col_In5 0.01320
Hstory 0.01261
θp_Beam11 0.01260
Fy 0.01251
asRatio_Beam17 0.01170
θp_Col_Ex5 0.01136
θp_Col_Ex13 0.01132
asRatio_Col_In7 0.01130
Feature Name
0 0.005 0.01 0.015 0.02 0.025
Random Forest Feature Importance

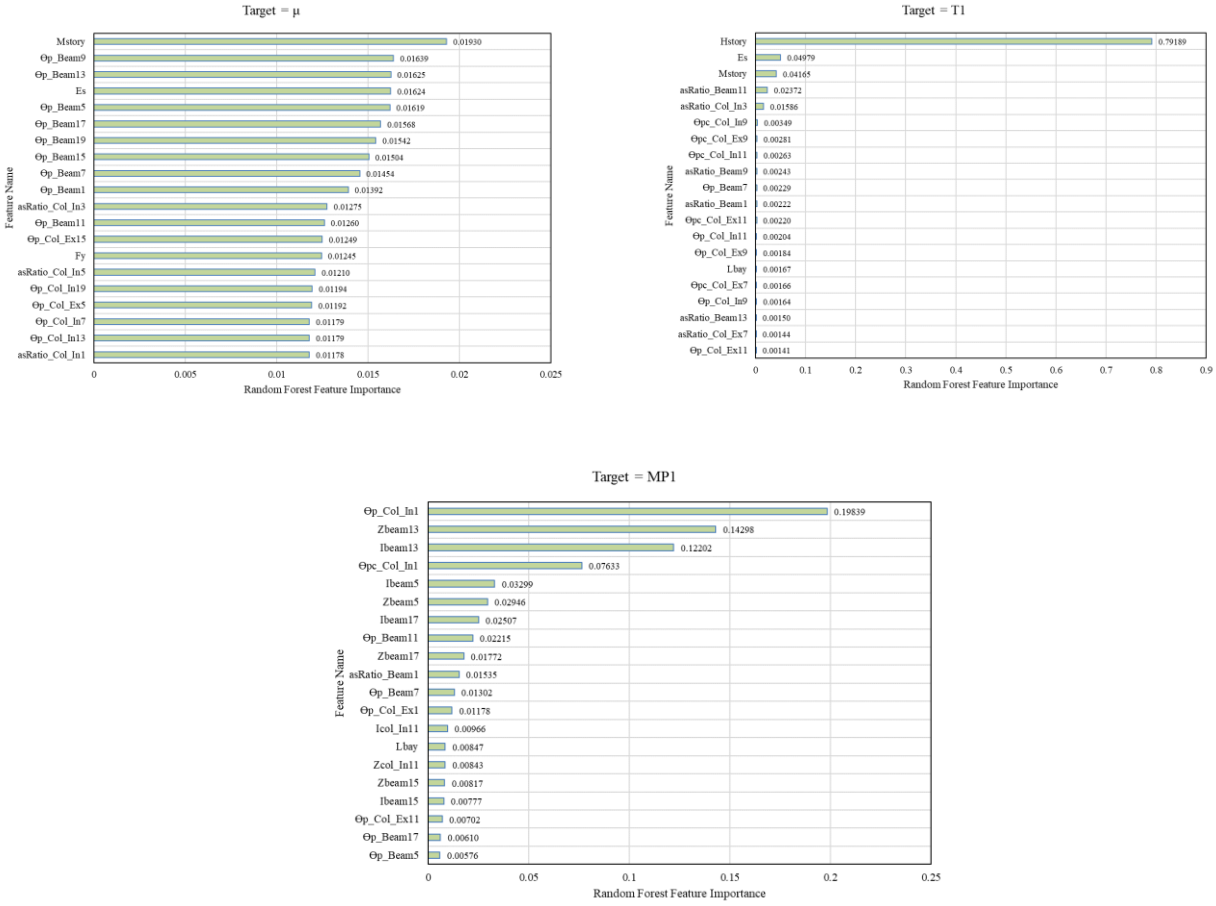
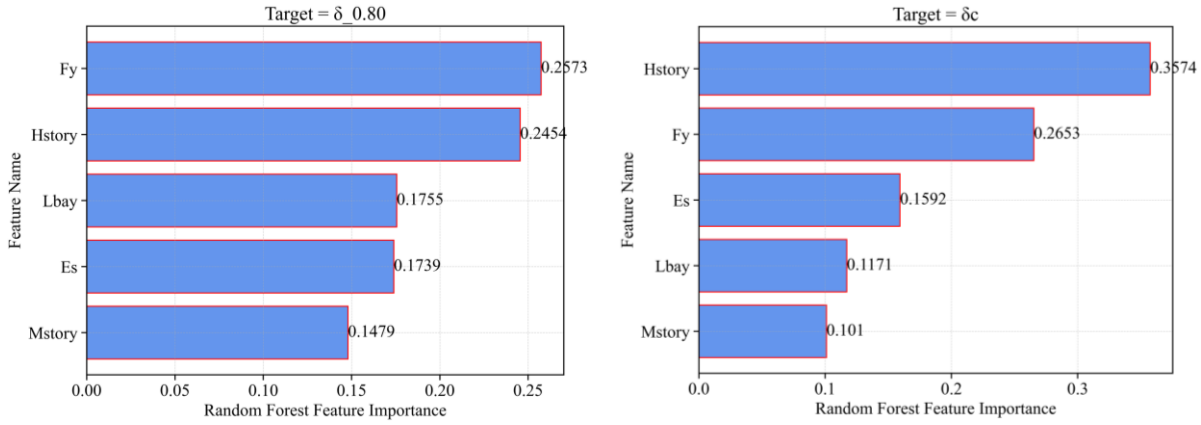


Fig.8. Random Forest feature importance considering all random and casual random parameters of 8-story buildings



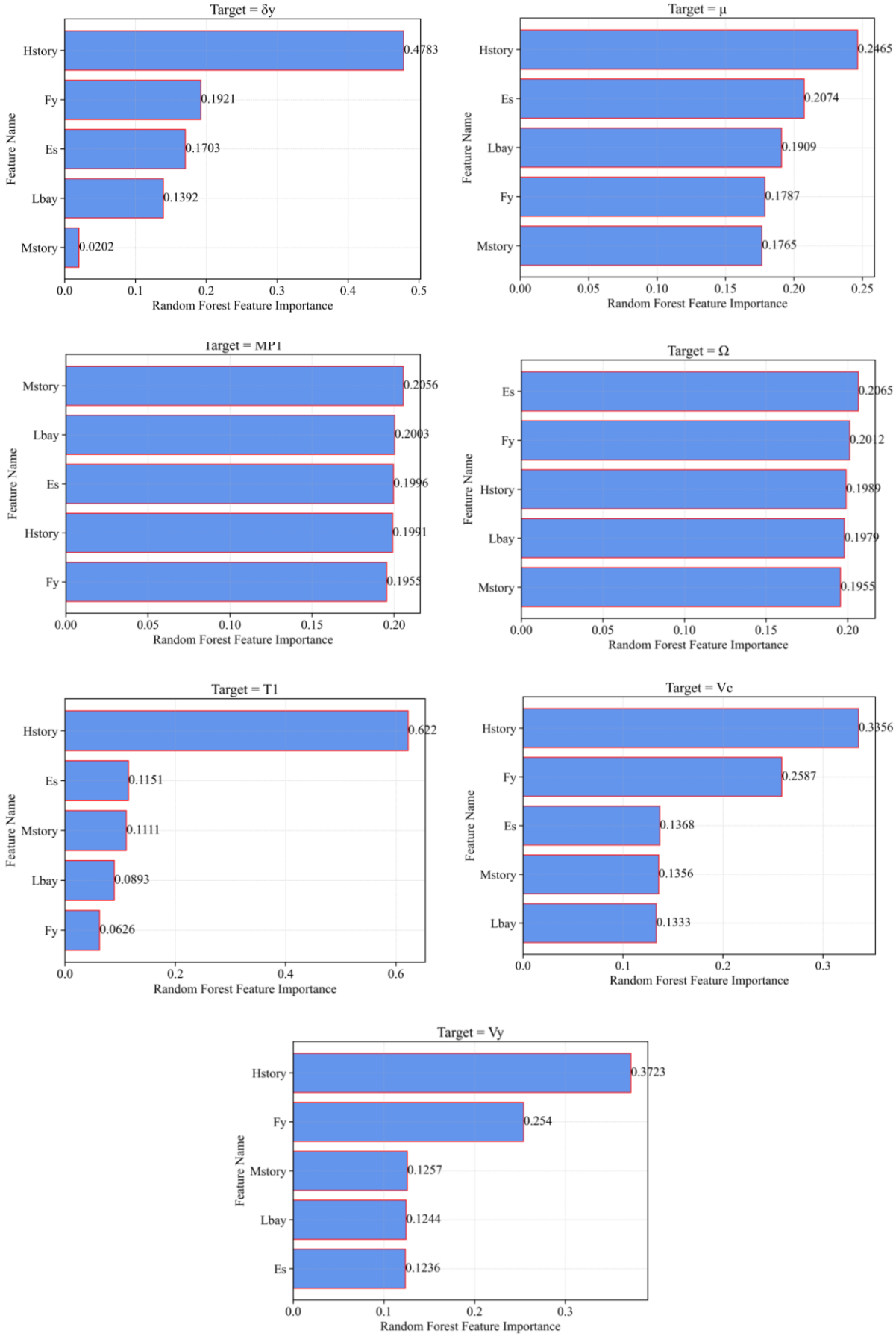
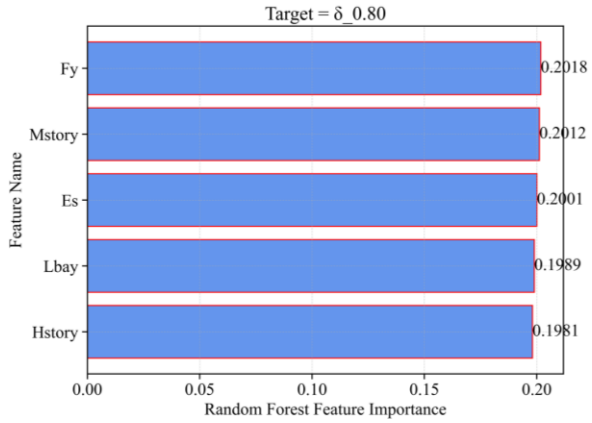
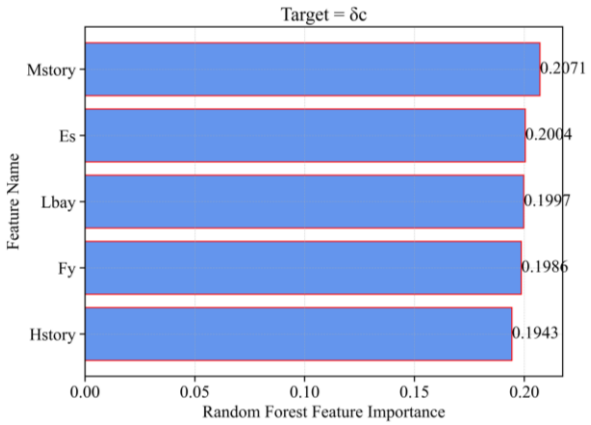
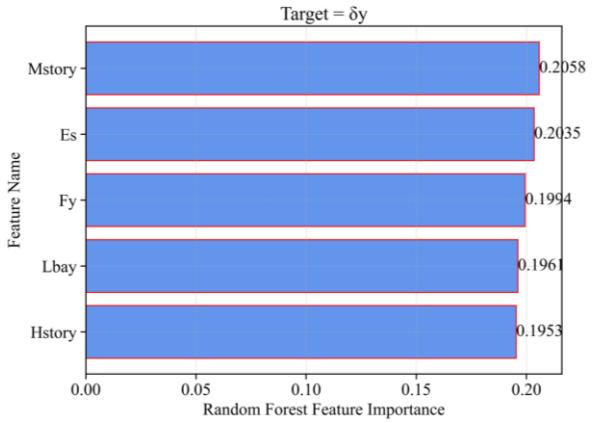
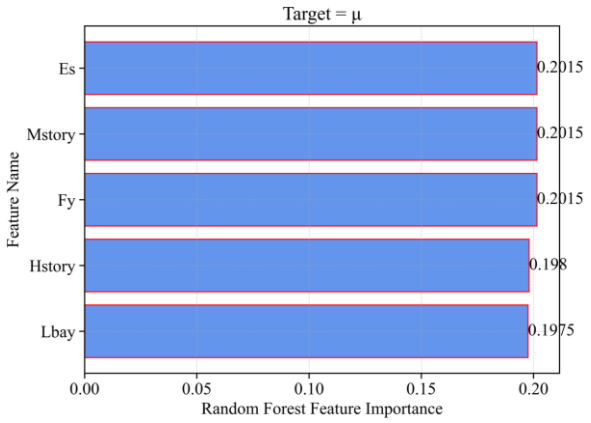


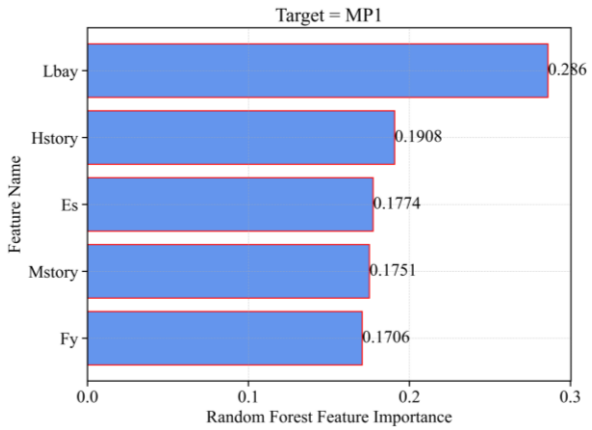
Fig. 9. Random Forest feature importance considering only random parameters of 8-story buildings


Target = δ_0.80
Feature Name
Fy
Mstory
Es
Lbay
Hstory
0.2018
0.2012
0.2001
0.1989
0.1981
0.00
0.05
0.10
0.15
0.20
Random Forest Feature Importance

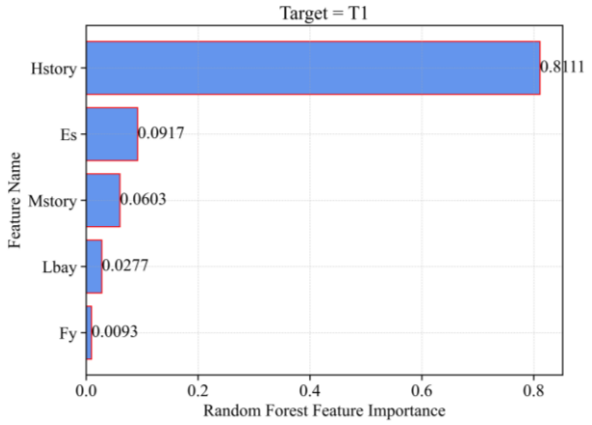

Target = δc
Feature Name
Mstory
Es
Lbay
Fy
Hstory
0.2071
0.2004
0.1997
0.1986
0.1943
0.00
0.05
0.10
0.15
0.20
Random Forest Feature Importance

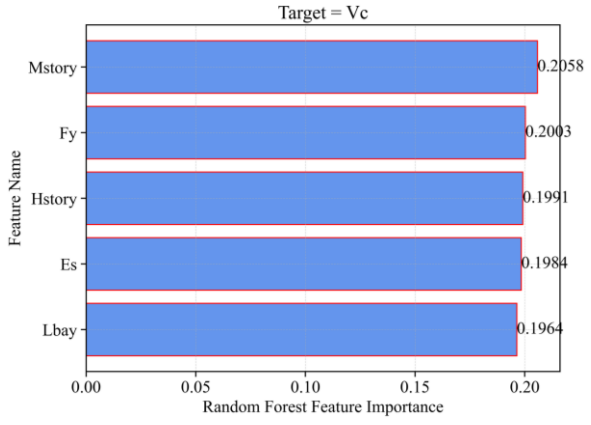

Target = δy
Feature Name
Mstory
Es
Fy
Lbay
Hstory
0.2058
0.2035
0.1994
0.1961
0.1953
0.00
0.05
0.10
0.15
0.20
Random Forest Feature Importance


Target = μ
Feature Name
Es
Mstory
Fy
Hstory
Lbay
0.2015
0.2015
0.2015
0.198
0.1975
0.00
0.05
0.10
0.15
0.20
Random Forest Feature Importance


Target = MP1
Feature Name
Lbay
Hstory
Es
Mstory
Fy
0.286
0.1908
0.1774
0.1751
0.1706
0.0
0.1
0.2
0.3
Random Forest Feature Importance

Target = Ω
Feature Name
Hstory
Es
Mstory
Lbay
Fy
0.3013
0.2135
0.1798
0.1543
0.1511
0.0
0.1
0.2
0.3
Random Forest Feature Importance


Target = T1
Feature Name
Hstory
Es
Mstory
Lbay
Fy
0.8111
0.0917
0.0603
0.0277
0.0093
0.0
0.2
0.4
0.6
0.8
Random Forest Feature Importance


Target = Vc
Feature Name
Mstory
Fy
Hstory
Es
Lbay
0.2058
0.2003
0.1991
0.1984
0.1964
0.00
0.05
0.10
0.15
0.20
Random Forest Feature Importance

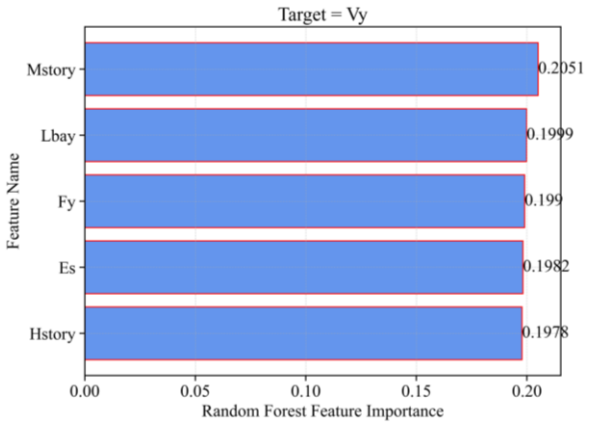


Fig. 10. Random Forest feature importance considering only random parameters of 20-story buildings

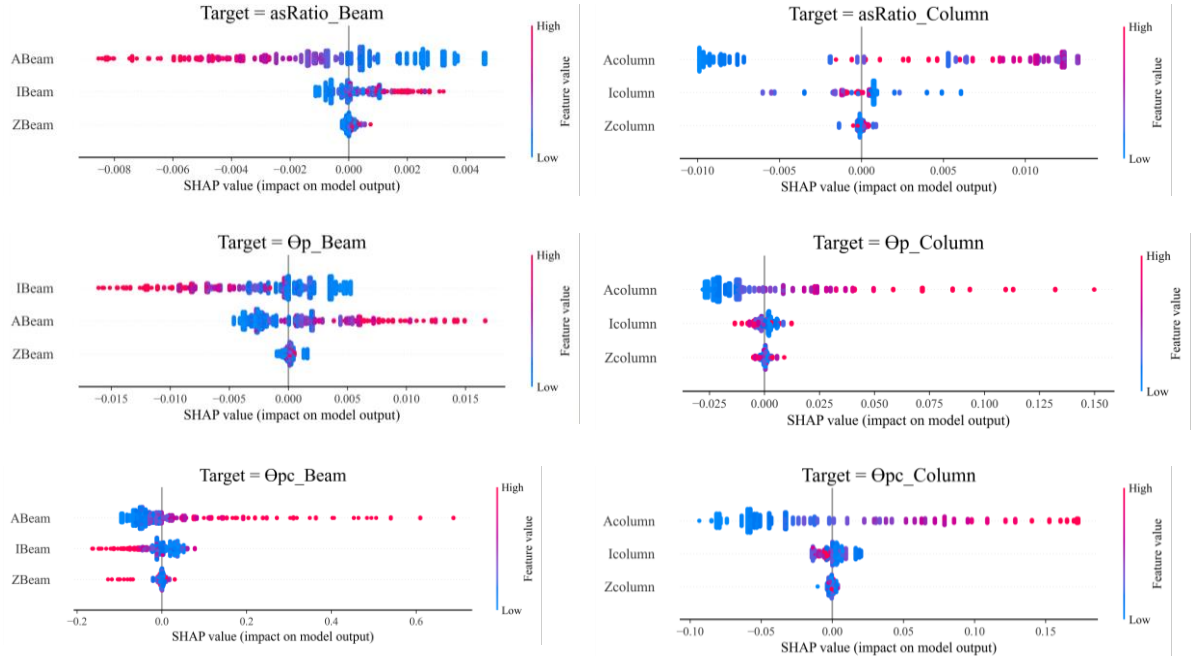
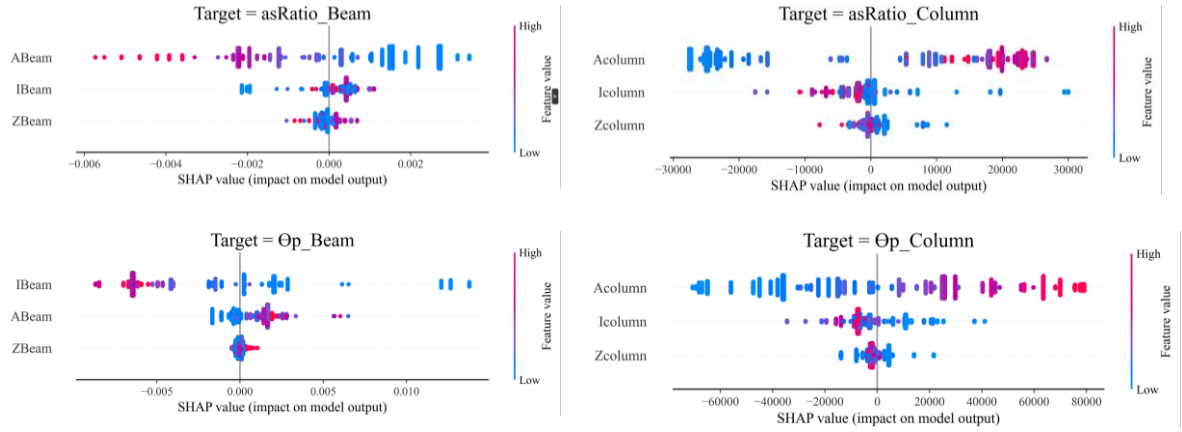


Fig. 11. SHAP values in predicting the plastic hinges parameters for 8-story buildings



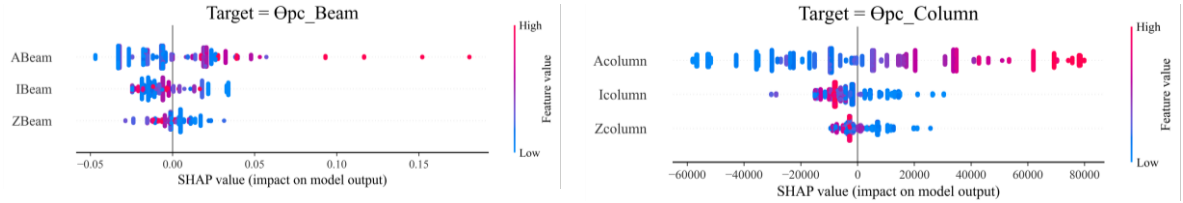


Fig. 12. SHAP values in predicting the plastic hinges parameters for 20-story buildings

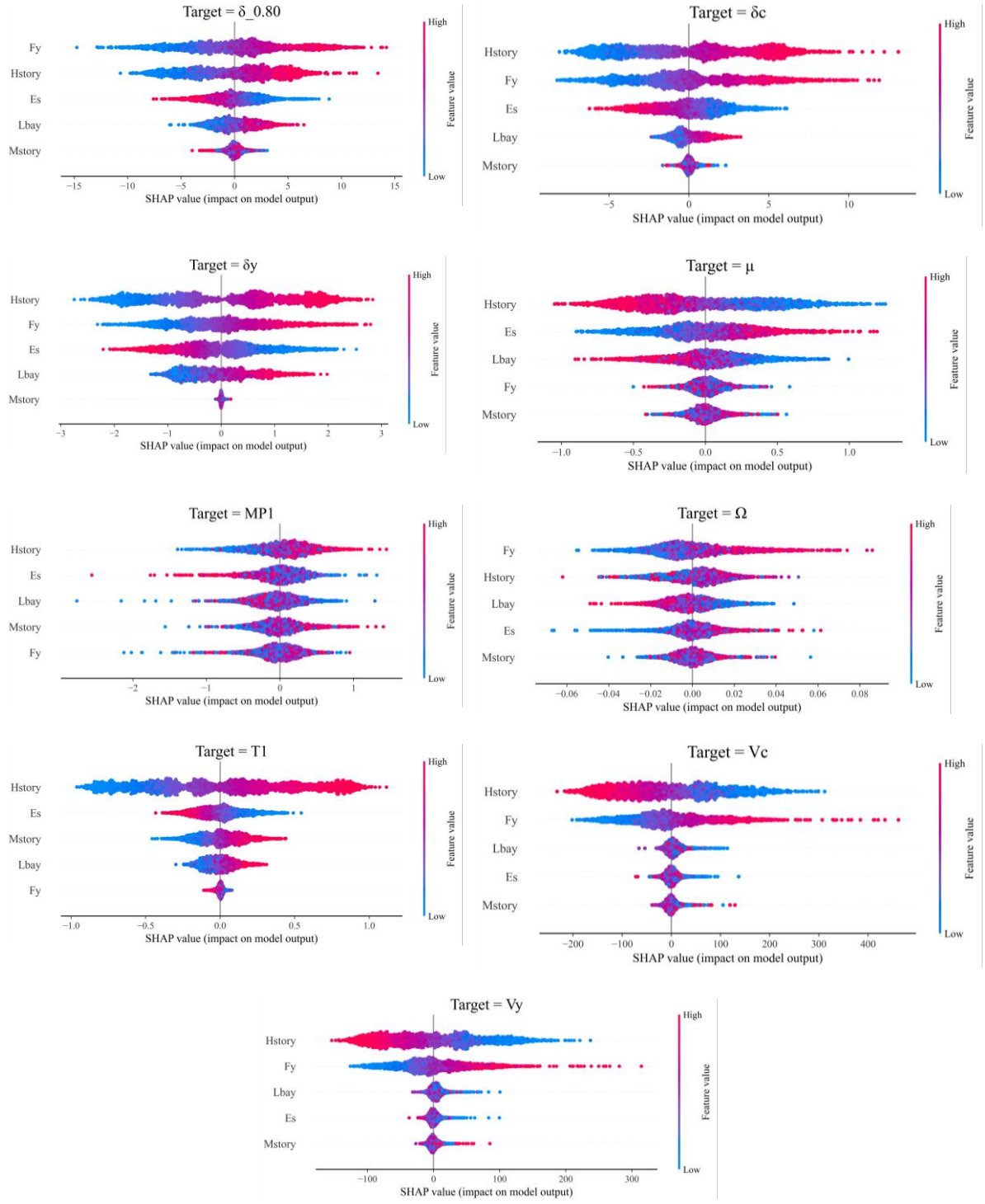


Fig. 13. SHAP values in predicting only random parameters for 8-story buildings

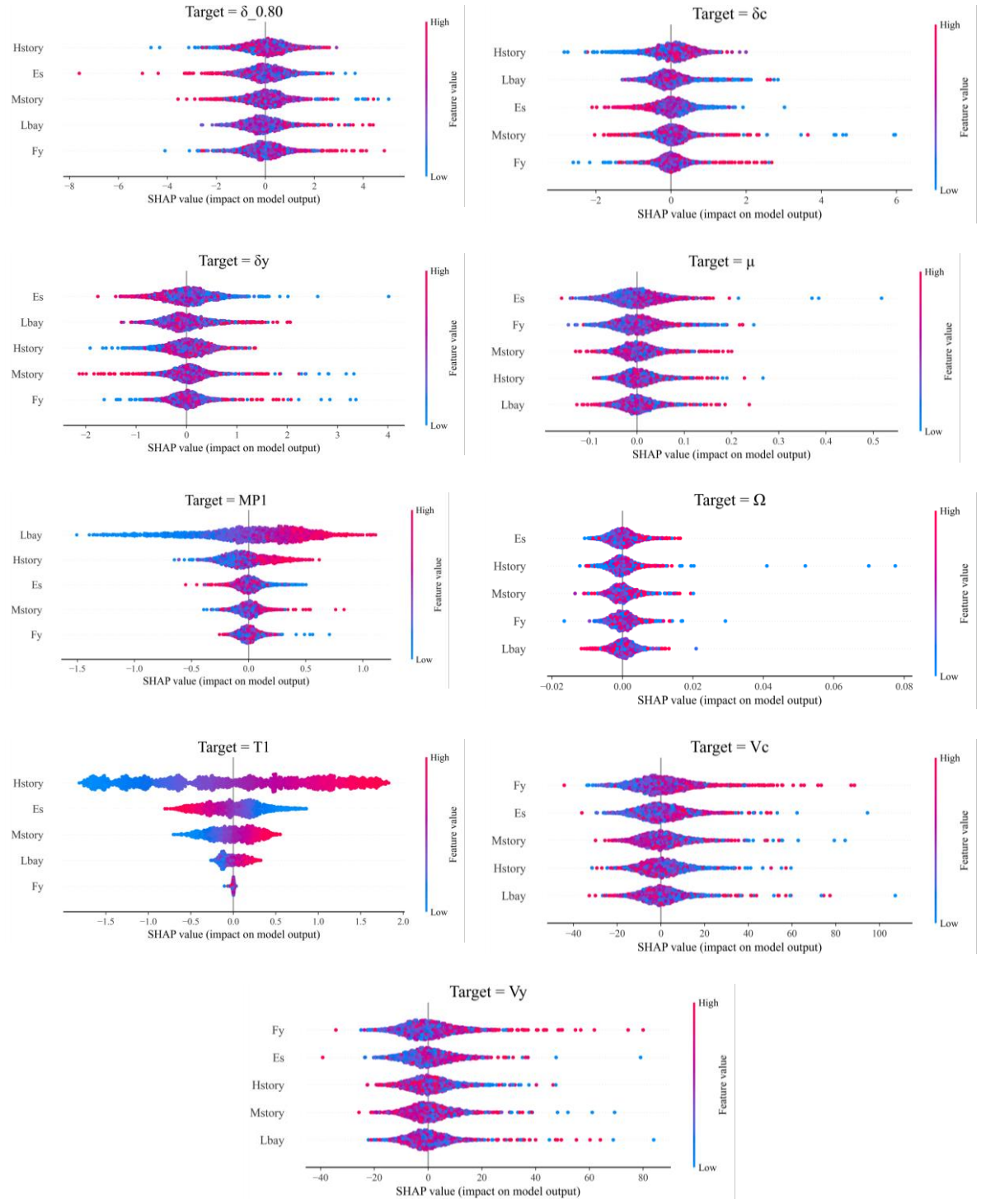
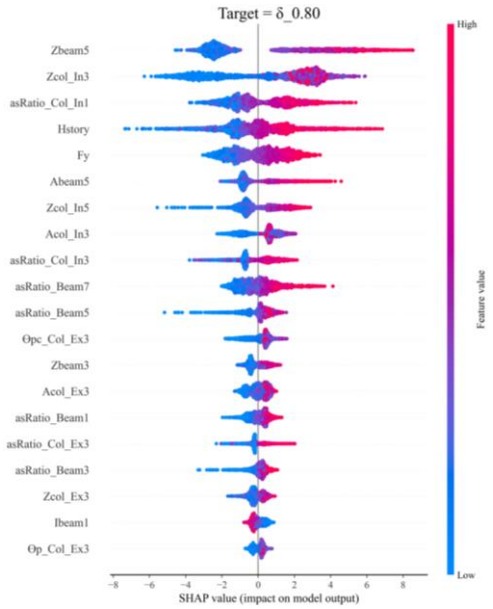
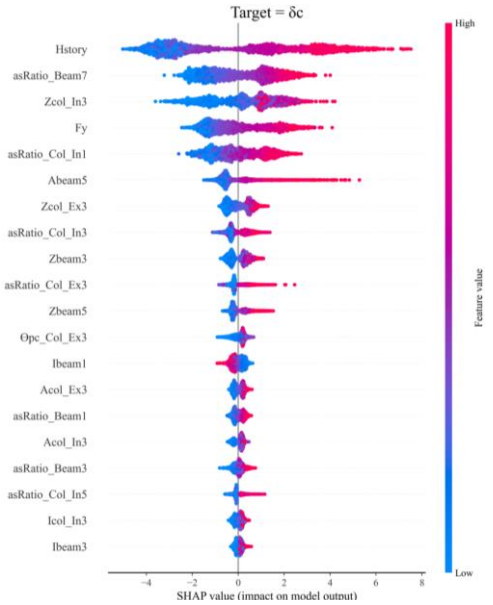
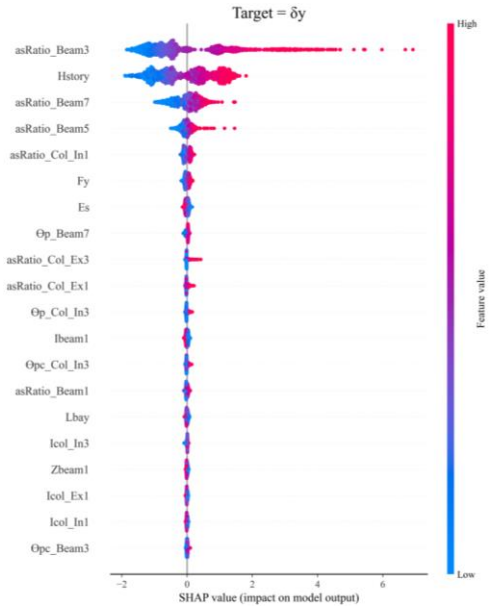
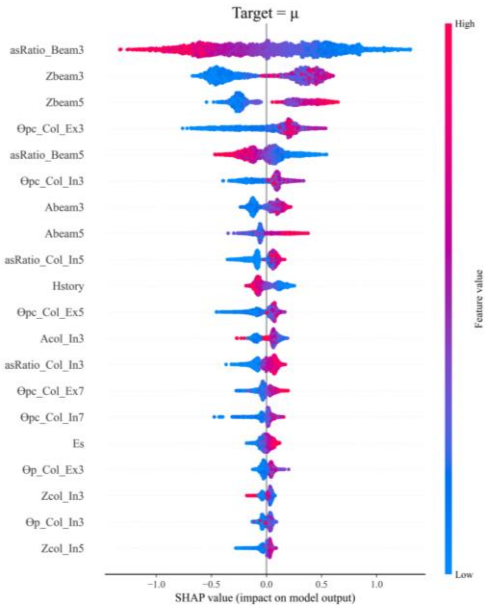


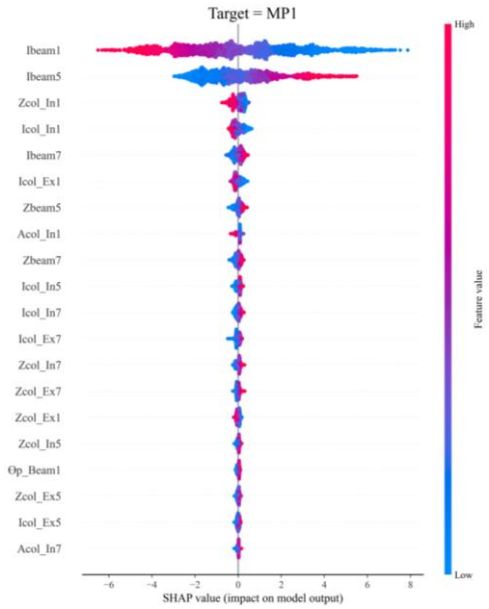
Fig. 14. SHAP values in predicting only random parameters for 20-story buildings

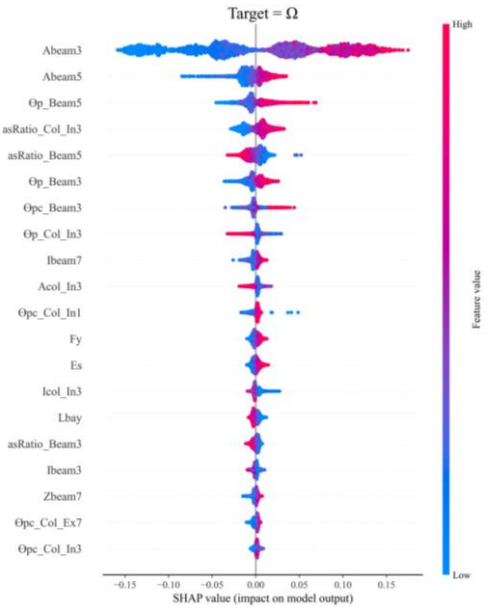

Target = δ_0.80
Zbeam5
Zcol_In3
asRatio_Col_In1
Hstory
Fy
Abeam5
Zcol_In5
Acol_In3
asRatio_Col_In3
asRatio_Beam7
asRatio_Beam5
θpc_Col_Ex3
Zbeam3
Acol_Ex3
asRatio_Beam1
asRatio_Col_Ex3
asRatio_Beam3
Zcol_Ex3
Ibeam1
θp_Col_Ex3
−8 −6 −4 −2 0 2 4 6 8
SHAP value (impact on model output)
High
Feature value
Low

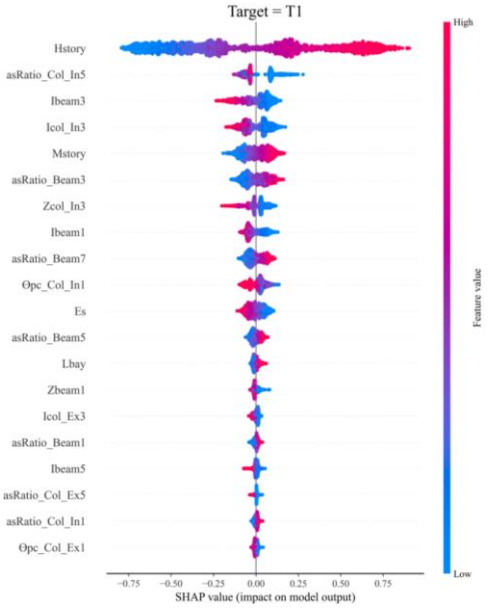

Target = δc
Hstory
asRatio_Beam7
Zcol_In3
Fy
asRatio_Col_In1
Abeam5
Zcol_Ex3
asRatio_Col_In3
Zbeam3
asRatio_Col_Ex3
Zbeam5
θpc_Col_Ex3
Ibeam1
Acol_Ex3
asRatio_Beam1
Acol_In3
asRatio_Beam3
asRatio_Col_In5
Icol_In3
Ibeam3
−4 −2 0 2 4 6 8
SHAP value (impact on model output)
High
Feature value
Low

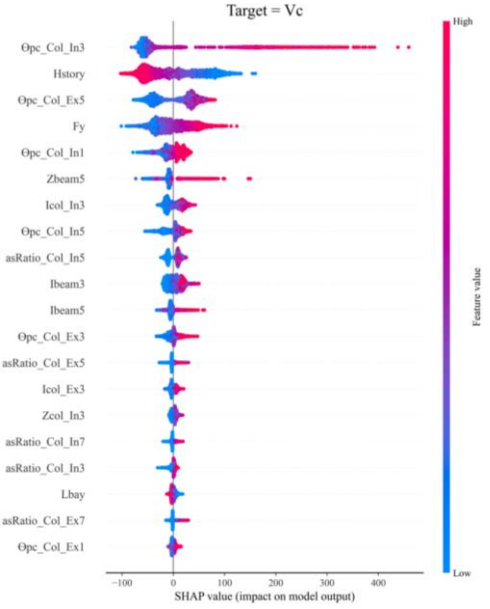

Target = δy
asRatio_Beam3
Hstory
asRatio_Beam7
asRatio_Beam5
asRatio_Col_In1
Fy
Es
θp_Beam7
asRatio_Col_Ex3
asRatio_Col_Ex1
θp_Col_In3
Ibeam1
θpc_Col_In3
asRatio_Beam1
Lbay
Icol_In3
Zbeam1
Icol_Ex1
Icol_In1
θpc_Beam3
−2 0 2 4 6
SHAP value (impact on model output)
High
Feature value
Low


Target = μ
asRatio_Beam3
Zbeam3
Zbeam5
θpc_Col_Ex3
asRatio_Beam5
θpc_Col_In3
Abeam3
Abeam5
asRatio_Col_In5
Hstory
θpc_Col_Ex5
Acol_In3
asRatio_Col_In3
θpc_Col_Ex7
θpc_Col_In7
Es
θp_Col_Ex3
Zcol_In3
θp_Col_In3
Zcol_In5
−1.0 −0.5 0.0 0.5 1.0
SHAP value (impact on model output)
High
Feature value
Low


Target = MP1
Ibeam1
Ibeam5
Zcol_In1
Icol_In1
Ibeam7
Icol_Ex1
Zbeam5
Acol_In1
Zbeam7
Icol_In5
Icol_In7
Icol_Ex7
Zcol_In7
Zcol_Ex7
Zcol_Ex1
Zcol_In5
Θp_Beam1
Zcol_Ex5
Icol_Ex5
Acol_In7
−6 −4 −2 0 2 4 6 8
SHAP value (impact on model output)
High
Feature value
Low


Target = Ω
Abeam3
Abeam5
Θp_Beam5
asRatio_Col_In3
asRatio_Beam5
Θp_Beam3
Θpc_Beam3
Θp_Col_In3
Ibeam7
Acol_In3
Θpc_Col_In1
Fy
Es
Icol_In3
Lbay
asRatio_Beam3
Ibeam3
Zbeam7
Θpc_Col_Ex7
Θpc_Col_In3
−0.15 −0.10 −0.05 0.00 0.05 0.10 0.15
SHAP value (impact on model output)
High
Feature value
Low


Target = T1
Hstory
asRatio_Col_In5
Ibeam3
Icol_In3
Mstory
asRatio_Beam3
Zcol_In3
Ibeam1
asRatio_Beam7
Θpc_Col_In1
Es
asRatio_Beam5
Lbay
Zbeam1
Icol_Ex3
asRatio_Beam1
Ibeam5
asRatio_Col_Ex5
asRatio_Col_In1
Θpc_Col_Ex1
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
SHAP value (impact on model output)
High
Feature value
Low


Target = Vc
Θpc_Col_In3
Hstory
Θpc_Col_Ex5
Fy
Θpc_Col_In1
Zbeam5
Icol_In3
Θpc_Col_In5
asRatio_Col_In5
Ibeam3
Ibeam5
Θpc_Col_Ex3
asRatio_Col_Ex5
Icol_Ex3
Zcol_In3
asRatio_Col_In7
asRatio_Col_In3
Lbay
asRatio_Col_Ex7
Θpc_Col_Ex1
−100 0 100 200 300 400
SHAP value (impact on model output)
High
Feature value
Low

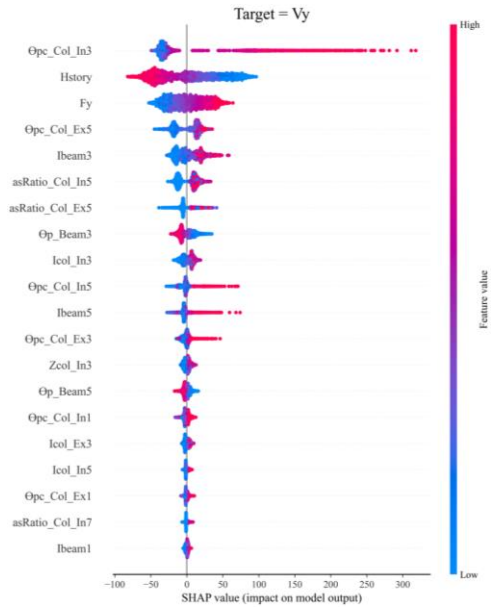
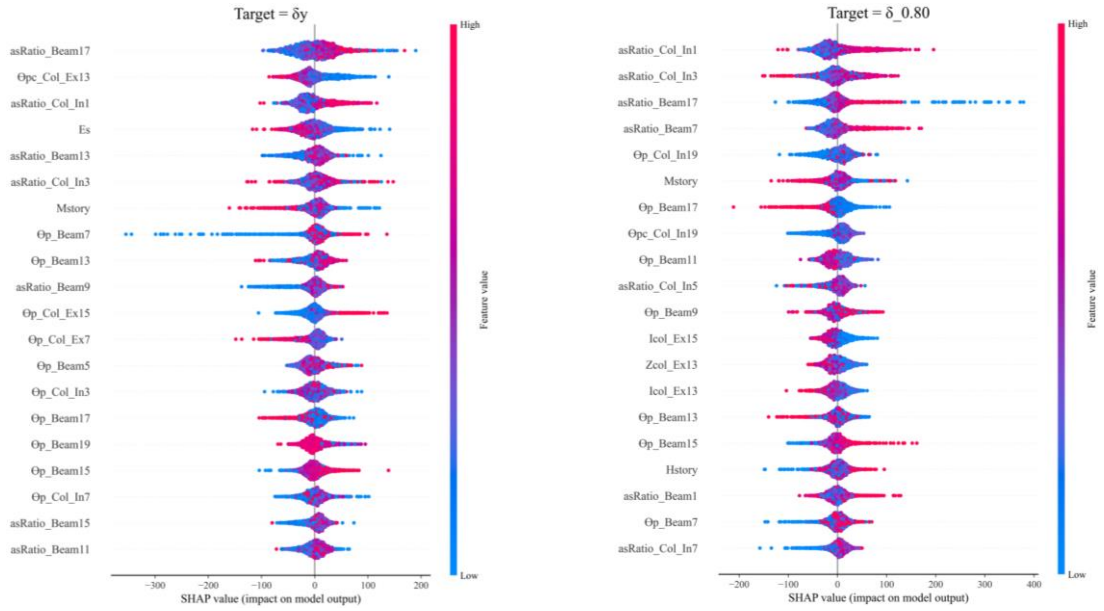
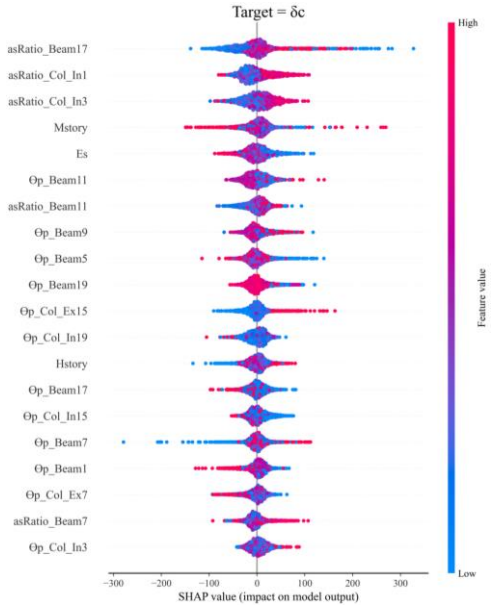
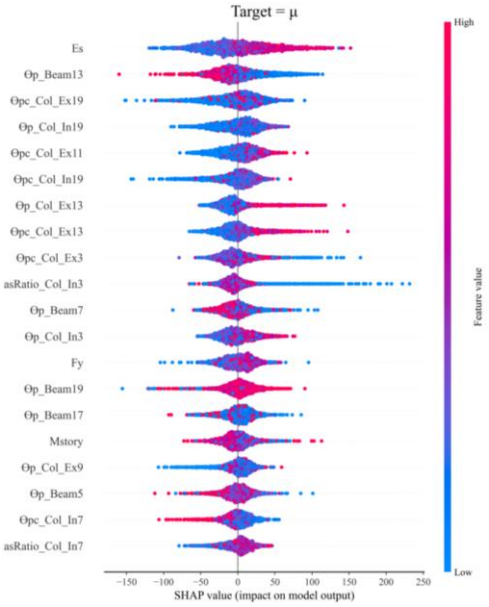
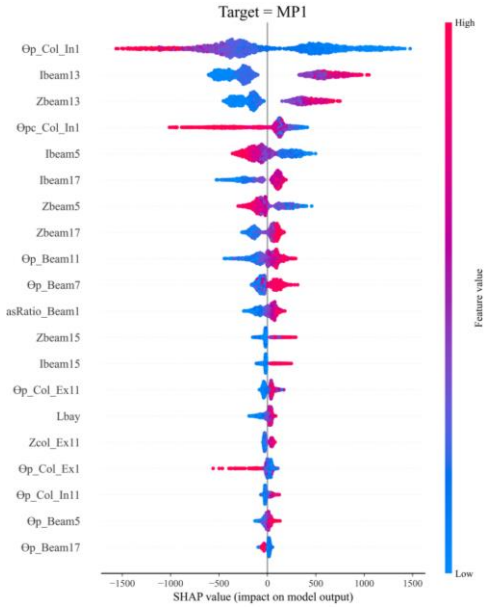


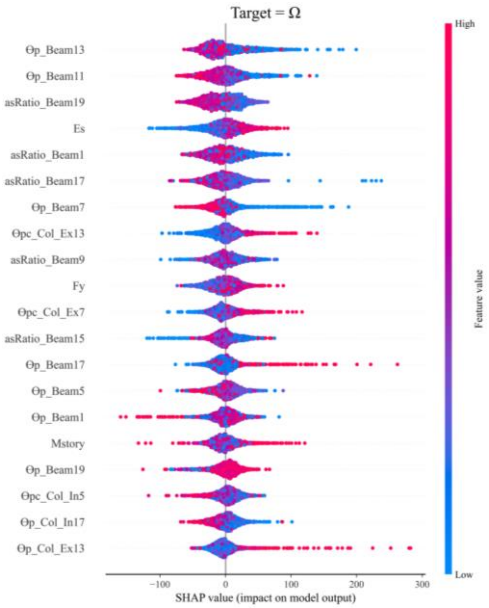
Fig. 15. SHAP values in predicting all random parameters for 8-story buildings




Target = δc
asRatio_Beam17
asRatio_Col_In1
asRatio_Col_In3
Mstory
Es
θp_Beam11
asRatio_Beam11
θp_Beam9
θp_Beam5
θp_Beam19
θp_Col_Ex15
θp_Col_In19
Hstory
θp_Beam17
θp_Col_In15
θp_Beam7
θp_Beam1
θp_Col_Ex7
asRatio_Beam7
θp_Col_In3
−300 −200 −100 0 100 200 300
SHAP value (impact on model output)
High
Feature value
Low


Target = μ
Es
θp_Beam13
θpc_Col_Ex19
θp_Col_In19
θpc_Col_Ex11
θpc_Col_In19
θp_Col_Ex13
θpc_Col_Ex13
θpc_Col_Ex3
asRatio_Col_In3
θp_Beam7
θp_Col_In3
Fy
θp_Beam19
θp_Beam17
Mstory
θp_Col_Ex9
θp_Beam5
θpc_Col_In7
asRatio_Col_In7
−150 −100 −50 0 50 100 150 200 250
SHAP value (impact on model output)
High
Feature value
Low


Target = MP1
θp_Col_In1
Ibeam13
Zbeam13
θpc_Col_In1
Ibeam5
Ibeam17
Zbeam5
Zbeam17
θp_Beam11
θp_Beam7
asRatio_Beam1
Zbeam15
Ibeam15
θp_Col_Ex11
Lbay
Zcol_Ex11
θp_Col_Ex1
θp_Col_In11
θp_Beam5
θp_Beam17
−1500 −1000 −500 0 500 1000 1500
SHAP value (impact on model output)
High
Feature value
Low


Target = Ω
θp_Beam13
θp_Beam11
asRatio_Beam19
Es
asRatio_Beam1
asRatio_Beam17
θp_Beam7
θpc_Col_Ex13
asRatio_Beam9
Fy
θpc_Col_Ex7
asRatio_Beam15
θp_Beam17
θp_Beam5
θp_Beam1
Mstory
θp_Beam19
θpc_Col_In5
θp_Col_In17
θp_Col_Ex13
−100 0 100 200 300
SHAP value (impact on model output)
High
Feature value
Low

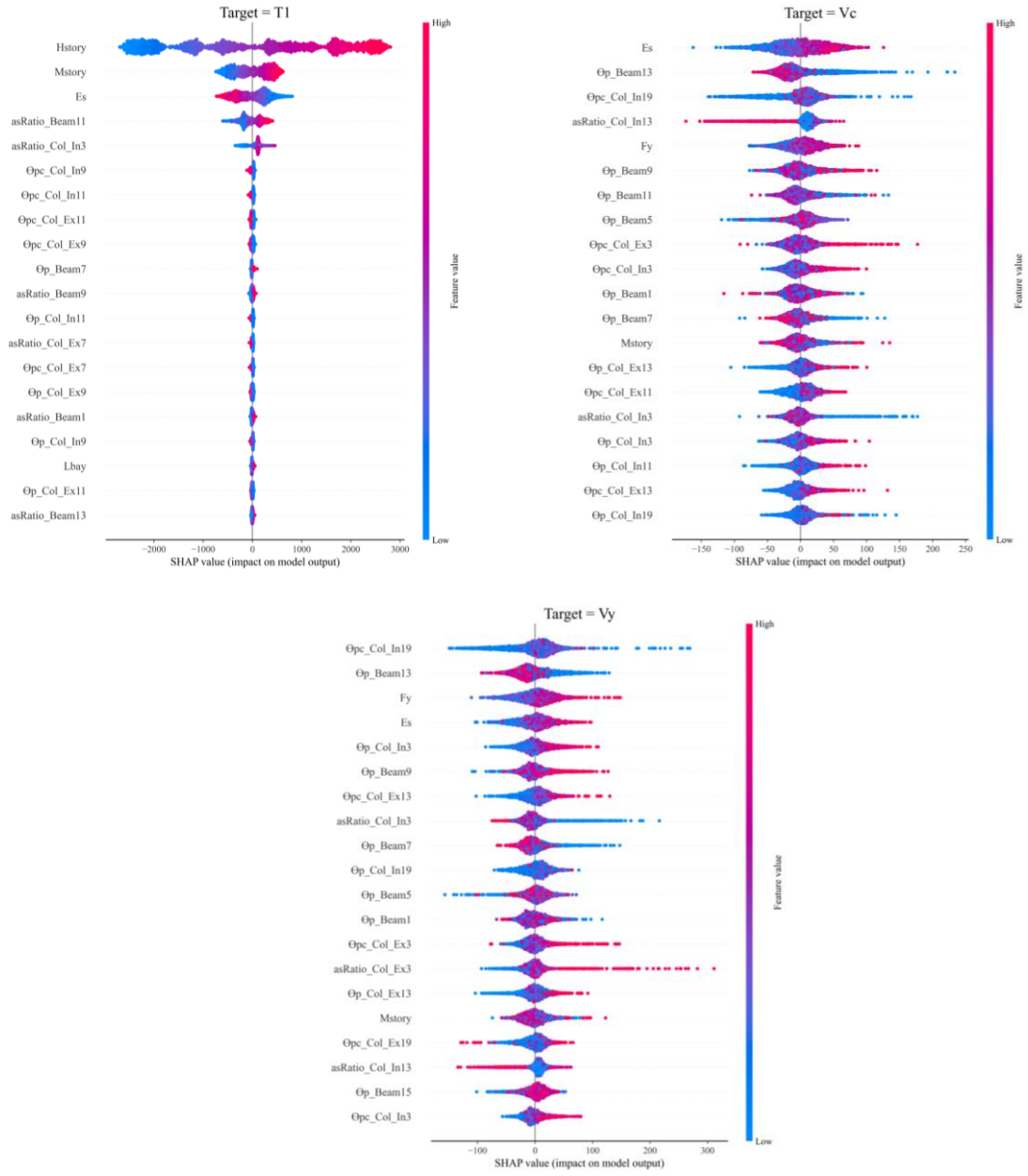


Fig. 16. SHAP values in predicting all random parameters for 20-story buildings