





Attuazione dell'articolo 11 della legge 24 giugno 2009, n.77

# MICROZONAZIONE SISMICA Livello 3

## Regione Emilia-Romagna

Comune di Mirandola



## Relazione Illustrativa - Allegato 3

Verifica Potenziale di Liquefazione CPTU MS

Regione	Soggetto realizzatore	Data
Emilia–Romagna	Geotema S.r.l.	02/05/2018

## Liquefaction analysis overall plot CRR plot FS Plot LРI Vertical settlements Lateral displacements 0.5-0.5-0.5-0.5-0.5-During earthq 1.5-1.5 1.5-1.5= 1.5 2-2-2-2-2-2.5-2.5-2.5-2.5-2.5-3-3. 3-3.5 3.5-3.5 3.5 3.5-4.5-4.5-4.5-4.5-4.5-5-5. 5.5-5.5-5.5-5.5-5.5-6-6.5-6.5-6.5-6.5-6.5-7.5-7.5-7.5-7.5-7.5-8-8-8-8.5-8.5-8.5-8.5-8.5-9-9-9-Depth (m) Depth (m) Depth (m) Depth (m) Depth (m) 9.5-9.5-9.5-9.5-9.5-10 -10 -10 -10 -10 -10.5-10.5 10.5-10.5 10.5 11 11 -11 11 -11 11.5 11.5 11.5 11.5-11.5-12-12-12. 12-12-12.5-12.5-12.5-12.5 12.5-13-13-13 13-13-13.5 13.5 13.5 13.5-13.5-14-14-14 14 -14-14.5 14.5 14.5 14.5-14.5 15 15 15 15 15-15.5 15.5 15.5 15.5-15.5-16 16 -16 16 -16 -16.5-16.5 16.5 16.5 16.5-17 -17 -17 17 17 -17.5-17.5-17.5 17.5-17.5-18 -18-18 18-18-18.5 18.5-18.5 18.5 18.5 19-19-19 19-19-19.5-19.5-19.5-19.5 19.5-20-20 -20 20 20 -0 0.2 0.4 10 10 0 Factor of safety ШI CRR & CSR Liquefaction potential Settlement (cm) F.S. color scheme LPI color scheme Input parameters and analysis data Almost certain it will liquefy Very high risk Analysis method: B&I (2014) Depth to GWT (erthq.): 1.00 m N/A Fill weight: Fines correction method: B&I (2014) Average results interval: Transition detect, applied: No Very likely to liquefy High risk Based on Ic value Ic cut-off value: 2.60 Yes Points to test: $K_{\sigma}$ applied: Liquefaction and no liq. are equally likely Low risk Unit weight calculation: Based on SBT Clay like behavior applied: Earthquake magnitude M<sub>w</sub>: 6.14 Sands only Unlike to liquefy Use fill: No Limit depth applied: Peak ground acceleration: No Depth to water table (insitu): 1.00 m Fill height: N/A Limit depth: N/A Almost certain it will not liquefy

CLiq v.2.1.6.7 - CPT Liquefaction Assessment Software

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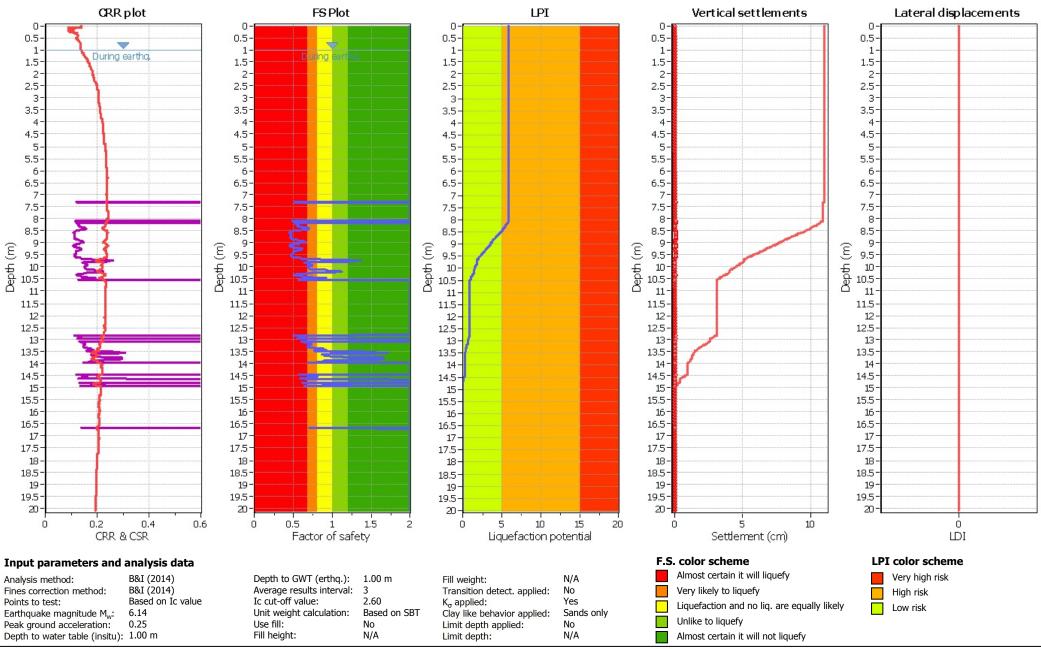
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## Liquefaction analysis overall plot



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## Liquefaction analysis overall plot CRR plot FS Plot ĽП Vertical settlements Lateral displacements 0.5-0.5-0.5-0.5-0.5- $\nabla$ During earthq 1.5-1.5-1.5-1.5-1.5-2-2-2-2.5 2.5 2.5-2.5-2.5-3-3-3-3.5-3.5 3.5-3.5-3.5-4.5-4.5-4.5-4.5-4.5-5-5. 5.5-5.5-5.5-5.5-5.5-6-6-6. 6.5-6.5-6.5-6.5-6.5-7.5-7.5-7.5-7.5= 7.5-8-8-8. 8-8.5-8.5-8.5-9.5. 9.5. 10.5. 10.5. 9.5 -0.1 -0.5 -0.5 -0.5 (E) 9-9.5-10-10-5-Depth (m) Depth (m) 9.5-10 -10.5-11 11-11 11-11 -11.5 11.5 11.5 11.5-11.5 12-12-12 12-12-12.5 12.5 12.5 12.5= 12.5-13-13-13 -13 -13-13.5-13.5-13.5 13.5 13.5-14 14-14 14 14-14.5-14.5-14.5-14.5 14.5 15 -15-15 15-15-15.5 15.5-15.5 15.5-15.5-16-16-16 16-16-16.5 16.5-16.5 16.5-16.5 17 17 17 17 17 17.5-17.5-17.5 17.5-17.5-18-18-18 18-18-18.5-18.5-18.5 18.5-18.5-19-19-19-19 -19-19.5-19.5-19.5 19.5 19.5 0 0.2 0.4 10 0 CRR & CSR Factor of safety ШI Liquefaction potential Settlement (cm) F.S. color scheme LPI color scheme Input parameters and analysis data Almost certain it will liquefy Very high risk Analysis method: B&I (2014) Depth to GWT (erthq.): 1.00 m N/A Fill weight: Fines correction method: B&I (2014) Average results interval: Transition detect, applied: No Very likely to liquefy High risk Based on Ic value Ic cut-off value: 2.60 Yes Points to test: $K_{\sigma}$ applied: Liquefaction and no liq. are equally likely Low risk Unit weight calculation: Based on SBT Clay like behavior applied: Sands only Earthquake magnitude M<sub>w</sub>: 6.14 Unlike to liquefy Use fill: No Limit depth applied: Peak ground acceleration: No Depth to water table (insitu): 1.00 m Fill height: N/A Limit depth: N/A Almost certain it will not liquefy

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## Liquefaction analysis overall plot CRR plot FS Plot LРI Vertical settlements Lateral displacements 0.5-0.5-0.5-0.5-0.5-During earthq 1.5 1.5 1.5-1.5= 1.5 2-2-2-2-2-2.5-2.5-2.5-2.5-2.5-3-3. 3-3-3.5 3.5-3.5-3.5 3.5-4.5-4.5-4.5-4.5-4.5-5 5. 5.5-5.5-5.5-5.5-5.5-6. 6.5-6.5-6.5-6.5-6.5-7.5-7.5-7.5-7.5-7.5-8-8 8.5-8.5-8.5-8.5-8.5-9-Depth (m) Depth (m) Depth (m) Depth (m) Depth (m) 9.5-9.5-9.5-9.5-9.5-10 -10 -10 -10 -10 -10.5 10.5 10.5 10.5 10.5-11-11-11 11-11-11.5-11.5-11.5-11.5-11.5-12 12-12. 12-12-12.5-12.5-12.5-12.5-12.5-13-13-13-13 -13-13.5-13.5-13.5-13.5-13.5-14-14-14 -14 -14 -14.5-14.5-14.5-14.5 14.5-15-15-15 -15-15-15.5-15.5-15.5-15.5-15.5-16-16-16 -16 -16 -16.5-16.5-16.5-16.5-16.5 17 17 -17 17 -17 -17.5 17.5 17.5 17.5-17.5 18-18-18 18 -18-18.5 18.5-18.5-18.5-18.5 19-19-19 19-19-19.5-19.5-19.5 19.5-19.5-20-20 -20 -20 -0 0.2 0.4 10 0 CRR & CSR Factor of safety ШI Liquefaction potential Settlement (cm) F.S. color scheme LPI color scheme Input parameters and analysis data Almost certain it will liquefy Very high risk Analysis method: B&I (2014) Depth to GWT (erthq.): 1.00 m N/A Fill weight: Fines correction method: B&I (2014) Average results interval: Transition detect, applied: No Very likely to liquefy High risk Based on Ic value Ic cut-off value: 2.60 Yes Points to test: $K_{\sigma}$ applied: Liquefaction and no liq. are equally likely Low risk Unit weight calculation: Based on SBT Clay like behavior applied: Sands only Earthquake magnitude M<sub>w</sub>: 6.14 Unlike to liquefy Use fill: No Limit depth applied: Peak ground acceleration: No Depth to water table (insitu): 1.00 m Fill height: N/A Limit depth: N/A Almost certain it will not liquefy

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## Liquefaction analysis overall plot Lateral displacements CRR plot FS Plot ĽП Vertical settlements 0.5 0.5-0.5 0.5-0.5-1-1-During earthq 1.5 1.5-1.5 1.5 1.5 2-2-2-2.5 2.5 2.5-2.5-2.5 3-3-3-3-3-3.5 3.5 3.5-3.5-3.5-4-4.5 4.5 4.5 4.5 4.5-5-5-5.5 5.5-5.5 5.5 5.5-6-6-6. 6-6. 6.5-6.5-6.5 6.5-6.5-Depth (m) Depth (m) Depth (m) Depth (m) 7.5-Depth (m) 7.5-7.5-7.5-7.5-8-8-8. 8.5 8.5 9. 9.5-9.5 9.5-9.5-9.5-10 -10 -10 10 10 -10.5 10.5-10.5-10.5-10.5 11-11 -11-11 11 -11.5 11.5-11.5 11.5 11.5 12 12 12 12 12 12.5 12.5 12.5 12.5 12.5 13-13-13 13 -13-13.5-13.5 13.5 13.5 13.5 14 14 14 14 -14 14.5 14.5 14.5 14.5 14.5 15 15 15 15 15 15.5 15.5 15.5 15.5-15.5 16-16-16 16-16-0 0.2 0.4 10 20 40 CRR & CSR Factor of safety ШI Liquefaction potential Settlement (cm) F.S. color scheme LPI color scheme Input parameters and analysis data Almost certain it will liquefy Very high risk Analysis method: B&I (2014) Depth to GWT (erthq.): 1.00 m Fill weight: N/A B&I (2014) Fines correction method: Average results interval: Transition detect, applied: No Very likely to liquefy High risk Based on Ic value Ic cut-off value: 2.60 Yes Points to test: $K_{\sigma}$ applied: Liquefaction and no liq. are equally likely Low risk Unit weight calculation: Based on SBT Clay like behavior applied: Sands only Earthquake magnitude Mw: 6.14 Unlike to liquefy Peak ground acceleration: Use fill: No Limit depth applied: No Depth to water table (insitu): 1.00 m Fill height: N/A Limit depth: N/A Almost certain it will not liquefy

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