Effect of Soil Properties and Post Embedment Depth on Impact Performance of Steel Guardrail Posts

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EN1317 and Soil Issue

- EN 1317 defines performance classes, impact test acceptance criteria and test methods for vehicle restraint systems.

- Ground characteristics is still under evaluation and will be covered in EN 1317–5: “testing of ground”.

- It is a well known fact that soil conditions influence the outcome of crash tests and the soil classification is necessary.

- Therefore a detailed research attempt was undertaken to evaluate effect of soil characteristics, post embedement depth and post type on dynamic performance of posts.

- The aim is to determine optimum embedment depths based on post type and soil characteristics.
Posts Used

- In Turkey steel guardrail systems utilizes basically two post types:
  
  **Sigma Section (S100)**  
  **C section (C120 or C150)**
Phase 1 – Soil Preparations

- In research program three different soil conditions prepared:
  - Weak soil
  - Medium strong soil and
  - Strong soil
Soil Conditions

- Soil properties monitored and verified
Driving Posts

- Sigma and C posts utilized
- Post Embedment Depths varied
  - For sigma posts between 600 mm to 1300 mm
  - For C posts between 650 mm to 900 mm
Test Area
Phase 2 – Pendulum Testing

- 1 ton pendulum was used to impact posts
- Acceleration data measured and recorded
Phase 3 – Finite Element Simulations
Comparison

Dense Soil, C-Post, 650 mm Embedment Depth
Dense Soil – C-post – 650 mm Embedment Comparison

![Graph showing acceleration vs. time after impact for LS-DYNA and Pendulum models with an 180 Hz filter applied.](image-url)
Comparison

Dense Soil, C-Post, 900 mm Embedment Depth
Dense Soil, C-Post, 900 mm Embedment Comparison

![Graph showing acceleration versus time after impact for LS-DYNA and Pendulum. The graph is labeled with '180 Hz Filter' and includes two lines representing 'LS-DYNA' and 'Pendulum'.]
Full Scale Crash Testing Details

Dense Soil, C–Post, 750 mm Embedment Depth
Full Scale Crash Testing Details

Dense Soil, C-Post, 750 mm Embedment Depth
(Post yielding was observed)
Full Scale Test Simulations – D–C750
Full Scale Test Simulations – D–C750
Full Scale Test Simulations – D–C750

TUBİTAK 213M516 PROJECT - D-C750 CASE - TB42 TEST
Time = 0.696
Results and Conclusions

● A total of 63 pendulum tests and accompanying LS-DYNA simulations were performed.
● It was once again determined that soil characteristics has a significant effect on posts under dynamic forces
● For sigma posts the optimum post embedment depths for weak, medium strong and strong soils were found to be 1200, 1100 and 1000 mm, respectively.
● For the C posts the optimum post embedment depths for weak, medium strong and strong soils were found to be 850, 800 and 750 mm, respectively.
● Full scale crash test simulations also performed to support field test results and develop models for further investigations.
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THANK YOU FOR YOUR ATTENTION

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