

## The Effect of Liquefied Stabilized Soil with Geosynthetics against Thrust Force of Buried Bend

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### ABSTRACT

Thrust force is generated at a bend of pipeline due to internal water pressure. Commonly, the thrust force is resisted by the passive resistance acting on the bend. In Japanese current design (M.A.F.F. 1998), the passive resistance is calculated based on Rankine's earth pressure theory.

In this paper, new backfill methods using geogrid, gravel and liquefied stabilized soil were proposed. In the new backfill methods, geogrids are employed at the passive area in front of the bend in order to increase the passive resistance against thrust force. In addition, gravel or liquefied stabilized soil are used for the reinforcement of the passive area. In order to clarify the effect of these proposed methods, lateral loading experiments were carried out using a model pipe having a diameter of 114 mm. The model pipe was backfilled in dry sand at the depth of 114 mm. After backfilling, the model pipe was laterally loaded at a speed of 0.5 mm/min. using a jack.

From the experimental results, it was proved that the passive resistance in case of reinforcement was larger than that in case of non-reinforcement. In addition, it was found that the passive resistance was influenced by the arrangement of geogrid. Furthermore, it was confirmed that the passive resistance was considerably increased in case of using liquefied stabilized soil with geogrid.

**KEY WORDS:** Buried pipelines; thrust force; model test, lateral resistance; geogrid

### INTRODUCTION

Generally pipelines for irrigation are subjected to internal water pressure. At bends in such pressure pipelines, thrust force is generated depending on the pressure level and bending angle. This thrust force tends to move the bend of underground pipeline outward. Commonly, the thrust force is resisted by the passive resistance acting on the pipe bend. A concrete block is installed at the pipe bend when the thrust force is larger than the passive resistance. However, it is expected that such heavy concrete block become a weak point during earthquakes because the concrete block moves largely due to inertia.

For these problems, Kawabata *et al.* (2005) proposed a light weight thrust restraint using geosynthetics and an anchor plate as shown in Fig.

1. In this method, three components of resistances, (1) Passive resistance acting on the anchor plate, (2) Pull-out resistance of the geogrid, (3) Passive resistance acting on the bend can be expected. In addition, Kawabata *et al.* (2007) conducted large scale tests using a pipeline ( $\phi 300$ ) to investigate the effect of the proposed method in actual size. As the result, the resistance in case of using the proposed method increased 60 % compared to the case of the non reinforced pipe. Furthermore, Sawada *et al.* (2007) estimated the lateral resistance of the bend in order to establish the detail design for proposed method.

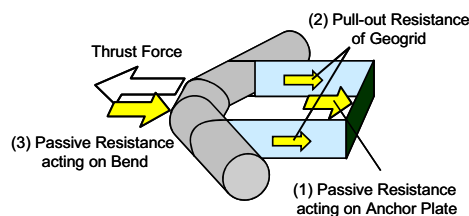


Fig. 1 Lightweight thrust restraint

Meanwhile, the methods of shallowly buried pipeline have been widely used in Japan. However, it is difficult to provide the passive resistance of the bend in the case using these methods. Therefore, it is expected that the proposed thrust restraint is imperfect without the reinforcement of the passive area of the bend.

In this paper, new backfill methods for thrust restraint using geogrids were proposed as shown in Fig. 2. In the new methods, geogrids are employed at the passive area to increase the resistance against thrust force. In addition, gravel and liquefied stabilized soil are used for the reinforcement of the passive area. In order to verify the effect of these proposed methods, lateral loading experiments were conducted.

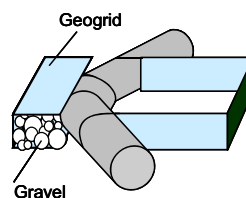


Fig. 2 New backfill method