EFFECT OF JOINT PARTS ON ASEISMIC STRENGTH OF BURIED PIPELINE[I]

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The aseismic strength for underground pipelines with small diameter transporting gas and water is studied. Statical model experiments are performed to obtain the simulation parameters. In order to take the phase difference of ground motion into consideration, seismic wave which propagates in the surface layer to the pipe axis direction is assumed similar to the sine wave. Analytical models for both weld-jointed steel pipelines and castiron pipelines provided with a lot of mechanical joints positioned in distance about 6 m which have sliding latitude and slip inhibiting function are also set and the numerical response analysis is practiced using the Displacement method aiming at the strain of ground.

Table 1 and 2 show the dimensions of the straight pipe and earthquake input. The perfect elasto-plastic relationships between the dislocation of the pipe to ground and the frictional force acting on the pipe are adopted. The joint properties in the direction of pipe axis are shown in Fig.1.

Fig.2. shows displacement response at the middle point of a steel pipeline, while that of a cast iron pipeline is shown in Fig.3. IF the relation between pipe and ground is assumed as linear (caseVI) the steel pipeline follows ground dislocation well and calculation results show large stress which is twice larger than that in the case of ship effect expected is produced, while in the case that slips are taken place pipeline movement is independent to the ground dislocation because the stiffness of pipe is much larger than the maximum frictional force. The behavior of the joint parts change remarkably on the condition that the frictional effect of ground is linear or non-linear. In the case that the frictional force is linear, the joint under tensile load are pulled out frequently, because their movement follows the ground displacement, furthermore, the axial force tends to increase too. Therefore the tensile force of the neighboring pipe is balanced with a compression force produced, which serves to absorb and support the earthquake force effect. This is a remarkable feature not found in the case that slip occur. When the slip effect is expected, the joint parts absorb the ground dislocation efficiently within the sliding latitude.

Table. 1 Dimensions of pipes

	Steel	Cast iron
Nominal size(mm)	300	300
Outer diameter(")	318.5	322.8
Wall thickness(")	6.9	8.5
Young's modulus(kg/cm²)	2.1×10^6	1.6×10^6
Moment of inertia(cm⁴)	1.31×10^5	1.66×10^5
Area of cross section(cm²)	67.55	83.93
Length(m)	120	120

Table 2 Earthquakes for aseismic design

Earthquake	(A)	(B)	(C)
Amplitude (cm)	5.5	8.4	2.2
Period (sec)	2.3	3.5	0.9
Wave velocity (m/sec)	77.8	62.1	137.8
Wave length (m)	174.1	214.9	123.2

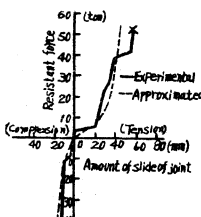

Fig. 1 Properties of joint for Pipe axis direction

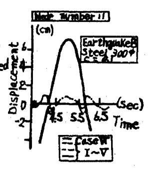

Fig 2 Response curve of displacement

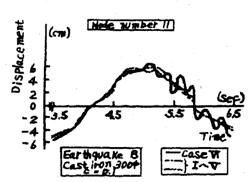

Fig 3 Response curve of displacement

I Detailed procedures and results are explained in Proceedings of the Fourth Japan Earthquake Engineering Symposium - 1975.

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