### **Appendix: Inversion of the Ramberg-Osgood Constitutive Equation**

In this Appendix, a proof of the inversion formula (Prof. R. Haj-Ali, private communication) is presented.

With the stress and strain deviators, the equivalent stress and strain are defined as . Let

  (A.1)

Consequently, Eq. (32) can be written as

  (A.2)

where  are the elastic portions of ϵij. Obviously,

  (A.3)

and

  (A.4)

Hence

  (A.5)

This relation and the definition of *λ* results in the nonlinear equation

  (A.6)

which after rearrangement provides Eq. (34).

For a given strain, The root σeq of this nonlinear equation can be determined by assuming a trial value which is given by the linearly elastic relation, and subsequently employing the Newton- Raphson iteration procedure. Once σeq has been established, the value of *λ* can be determined and the stress deviators sij can be obtained from Eq. (A.4).

Finally, the inverse of Ramberg-Osgood constitutive relation, Eq. (33), can be established from

  (A.7)

which can be combined with the second relation of (A.3) and the definition of *λ* to yield

  (A.8)