A culvert is to be built to pass 25 m^3/s under a road embankment crossing a flood plain. The ground level is R.L. 12.000 m and the water level corresponding to this flow is expected to be R.L. 13.100 m. Both levels are at the centreline of the embankment which is 25-m wide at its base. The flood gradient is 0.003 and the upstream flood plain is 12 m wide.
(A) Design a minimum energy loss culvert with a maximum throat width of 4.2 m. (*Use "simple" method for design. "NO AFFLUX" design.*)
(B) Design the culvert inlet.

(A) B_{min} = **4.2** m $\Rightarrow \Delta z_o$ = 1.02 m, B_{max} = 10.10 m **(for zero afflux)**
Barrel: S_c = 0.0032 (f=0.0147 concrete)
ΔH available= 0.15 m, ΔH_{exit} = 0.25 (ideal), 0.08 m (real) $\Rightarrow$ Physical model

(B) L_{min}(inlet) = 5.05 m - Inlet shape : straight wingwalls

Distance C.L. embankment	Excav. depth (m)	Natural Ground level (m R.L.)	Invert level (m R.L.)	Width (m)	d_c (m)	q (m^2/s)
-17.55	**0.000**	12.053	12.053	10.10	0.86	2.48
-15.49	**0.255**	12.046	11.792	7.69	1.03	3.25
-14.14	**0.510**	12.042	11.533	6.11	1.20	4.09
-13.19	**0.764**	12.040	11.275	5.01	1.36	4.99
-12.50	**1.019**	12.038	11.018	4.20	1.53	5.95
0.00	**1.019**	12.000	10.981	4.20	1.53	5.95
12.50	**1.019**	11.963	10.943	4.20	1.53	5.95
15.24	**0.764**	11.954	11.190	5.01	1.36	4.99
18.99	**0.510**	11.943	11.433	6.11	1.20	4.09
24.35	**0.255**	11.927	11.672	7.69	1.03	3.25
32.50	**0.000**	11.903	11.903	10.10	0.86	2.48

Design : straight conical shape (7-degree)

Notes:
(1) Fixed wingwall shape $\Rightarrow$ calculated invert excavation
(2) Barrel length ~ embankment base length
(3) Outlet length : selected on the basis of a straight conical shape (7°)