



**Anlage B**  
**Annexe B**  
**Appendix B**

Diagrammsammlung zur Beurteilung der Fahrsicherheit  
 von Güterwagen mit zwei Radsätzen mit Blatttragfedern  
 mit progressiver Kennlinie

Recueil de diagrammes permettant d'apprécier  
 la sécurité de circulation des wagons à 2 essieux  
 équipés de ressorts à lames à raideur progressive

Set of diagrams enabling the running safety of 2-axle wagons fitted  
 with leaf springs of progressive stiffness

Tragfederbauarten

Types de ressorts de suspension

Types of suspension springs

Teil 1: Trapezfeder für 20 t / Radsatz  
 Partie 1: Trapézoidal apte à 20 t / essieu  
 Part 1: Trapezoidal spring suitable for 20 t / axle

$$c_{z1} = 1,14 \text{ kN/mm}; \quad c_{z2} = 2,08 \text{ kN/mm}$$

Teil 2: Parabelfeder für 20 t / Radsatz  
 Partie 2: Parabolique apte à 20 t / essieu  
 Part 2: Parabolic spring suitable for 20 t / axle

$$c_{z1} = 0,55 \text{ kN/mm}; \quad c_{z2} = 1,69 \text{ kN/mm}$$

Teil 3: Parabelfeder für 22,5 t / Radsatz  
 Partie 3: Parabolique apte à 22,5 t / essieu  
 Part 3: Parabolic spring suitable for 22,5 t / axle

$$c_{z1} = 0,65 \text{ kN/mm}; \quad c_{z2} = 1,82 \text{ kN/mm}$$

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Änderungen - Mises a jour - Revisions

Änderungsanzeige - Modificatif - Amendment

Nr. – N° No.	vom - du date	Nr. – N° No.	vom - du date



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Teil 1

Partie 1

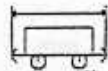
Part 1

Trapezfeder für 20 t/Radsatz

Resort de suspension trapézoidal apte à 20 t / essieu

Trapezoidal spring suitable for 20 t / axle

$c_{z1} = 1,14 \text{ kN/mm}; \quad c_{z2} = 2,08 \text{ kN/mm}$



$$2a^* = 9500 \text{ mm}$$

$$2a^* = 5500 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

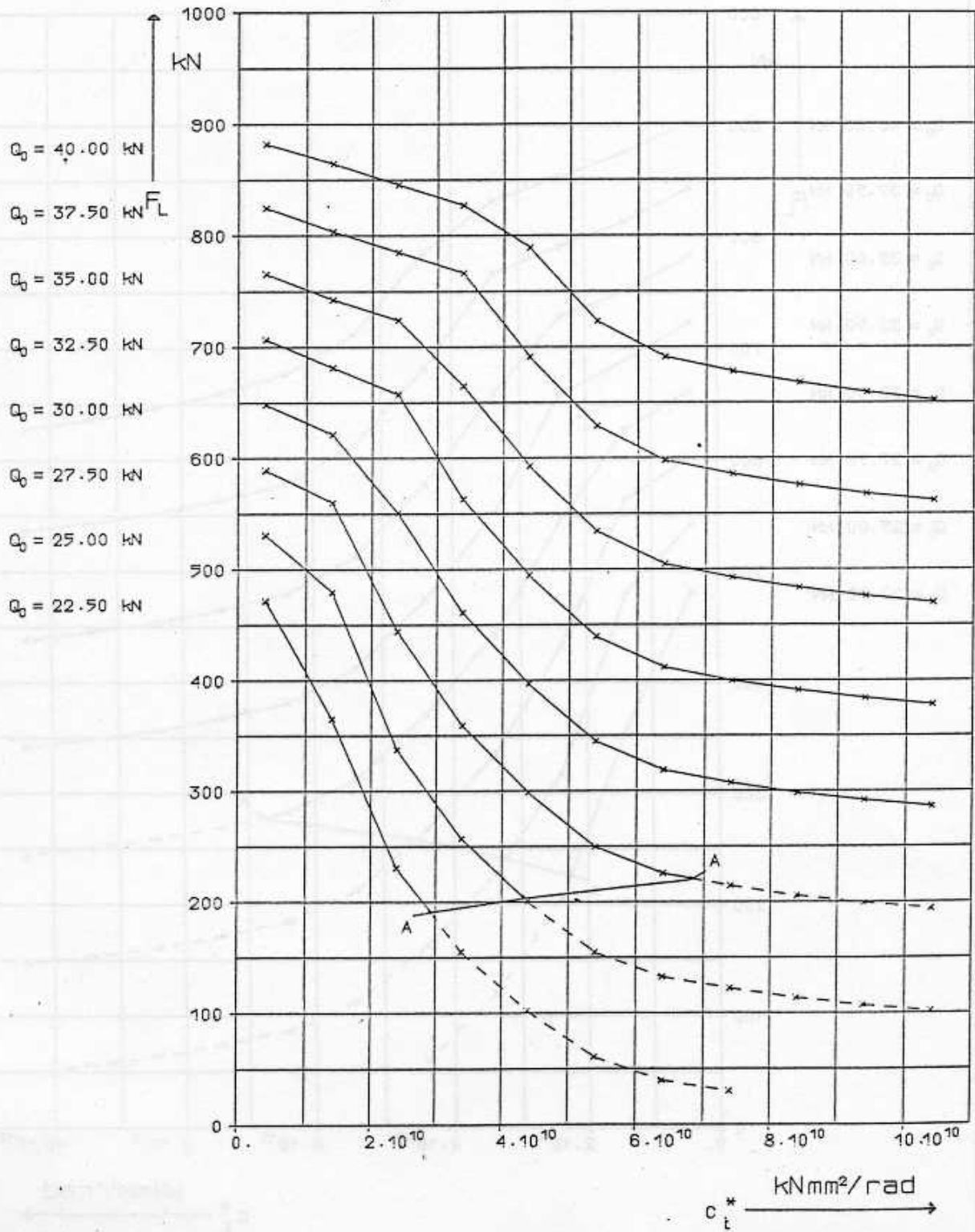
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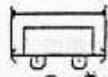
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cZ} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 9500 \text{ mm}$$

$$2a^* = 6000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

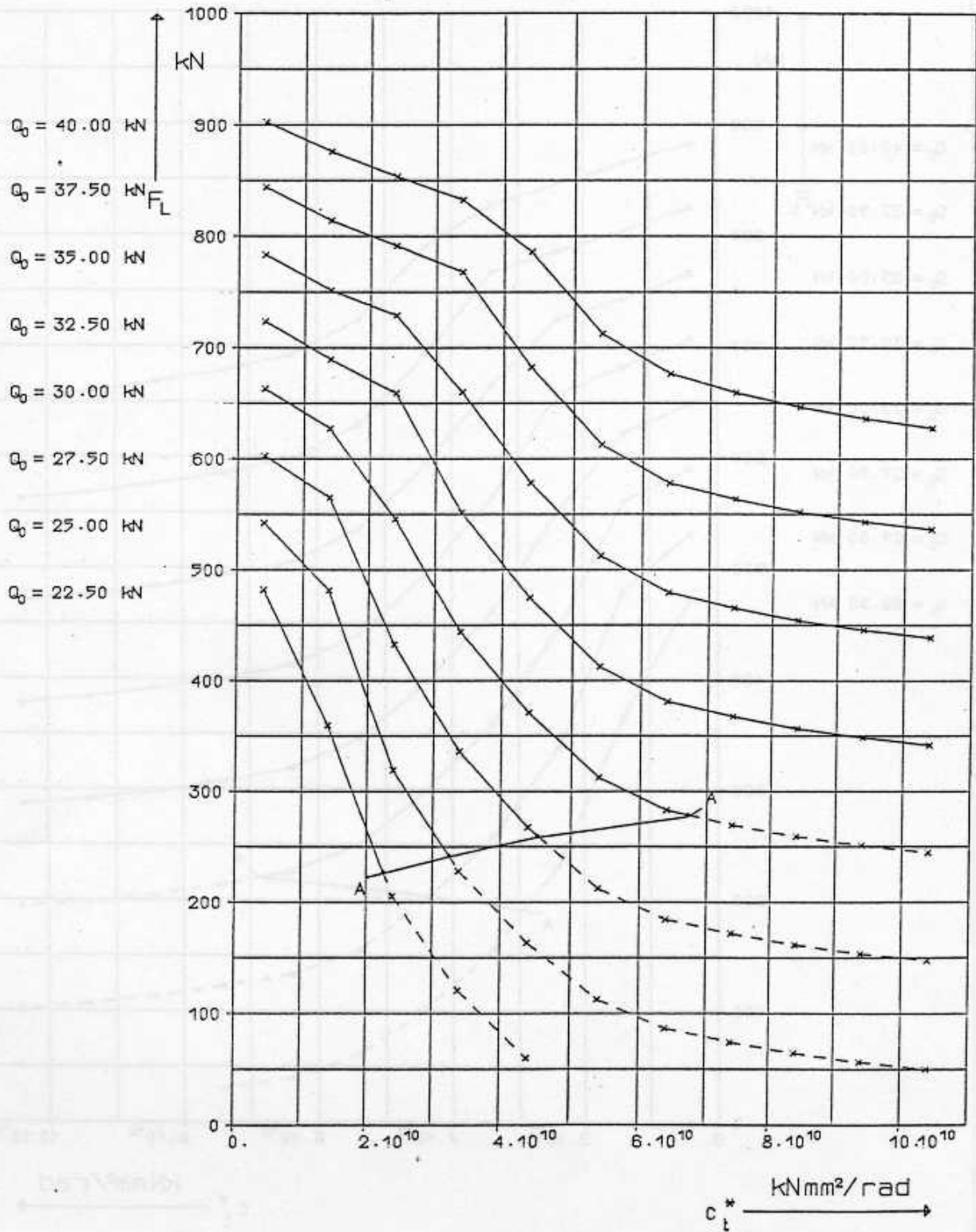
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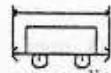
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 10000 \text{ mm}$$

$$2a^* = 5500 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

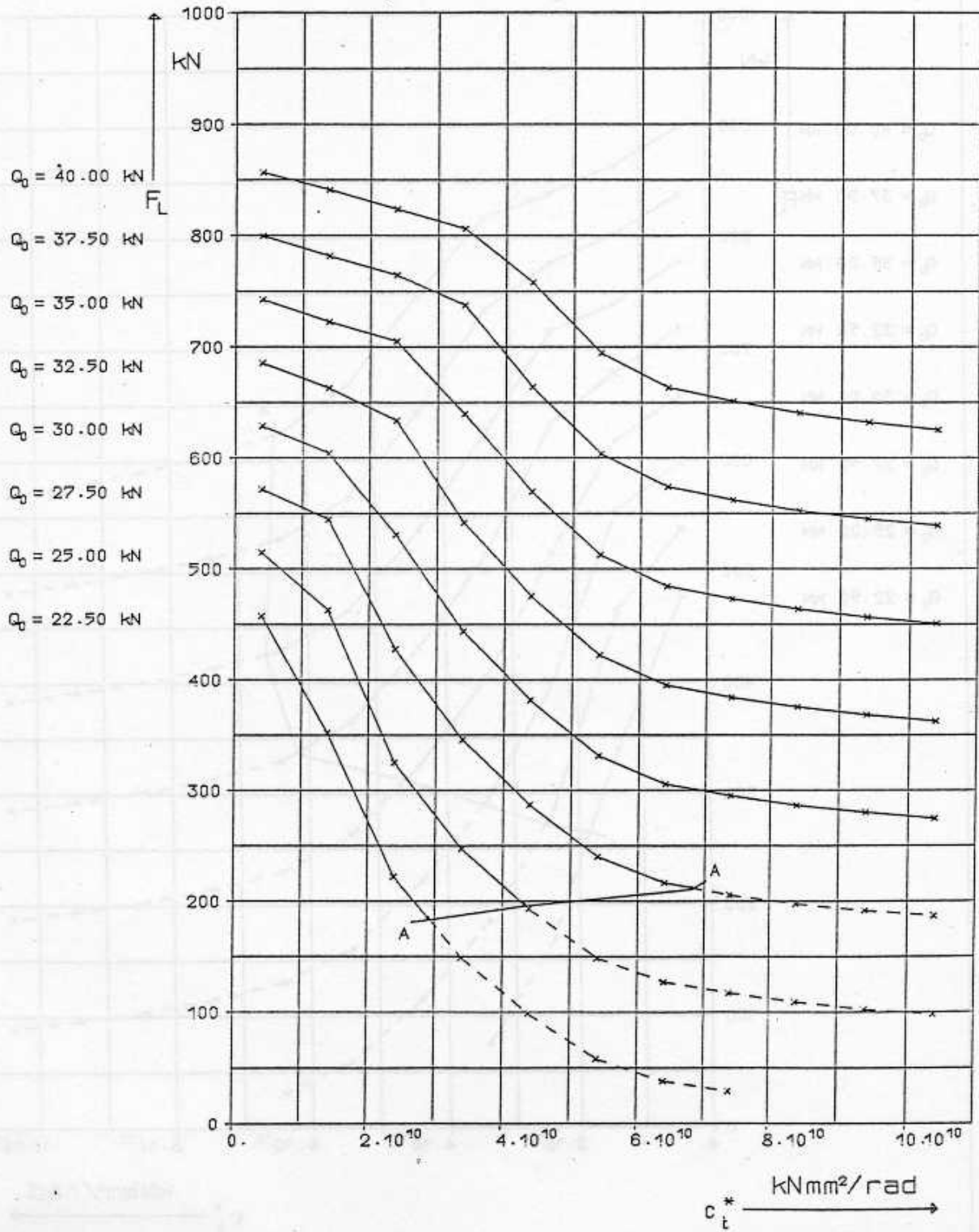
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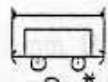
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$2a^* = 10000 \text{ mm}$$

$$2a^* = 6500 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

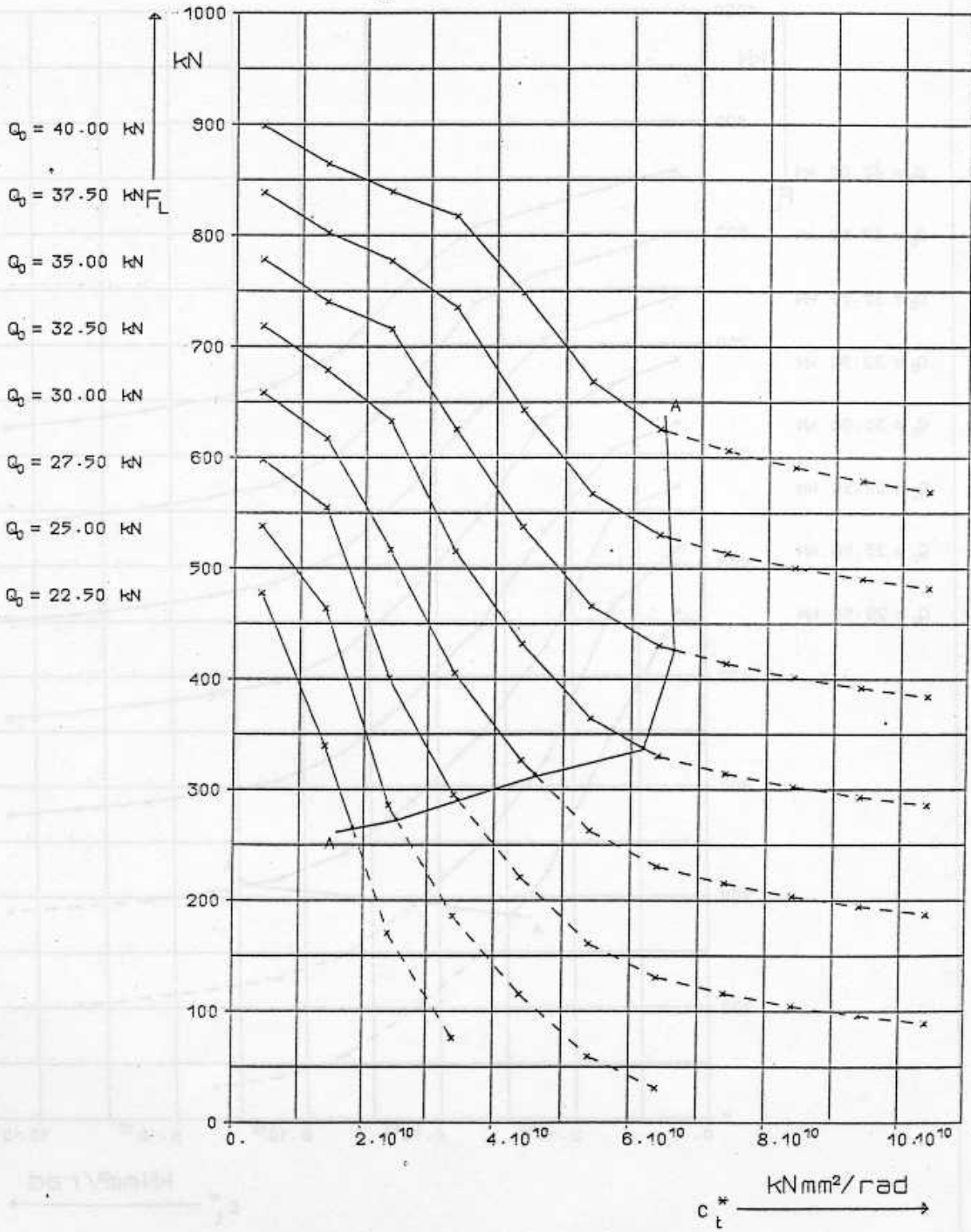
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$$c_{z1} = 1.14 \text{ N/mm}$$

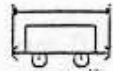
$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$







$$2a^* = 10500 \text{ mm}$$

$$2a^* = 5500 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

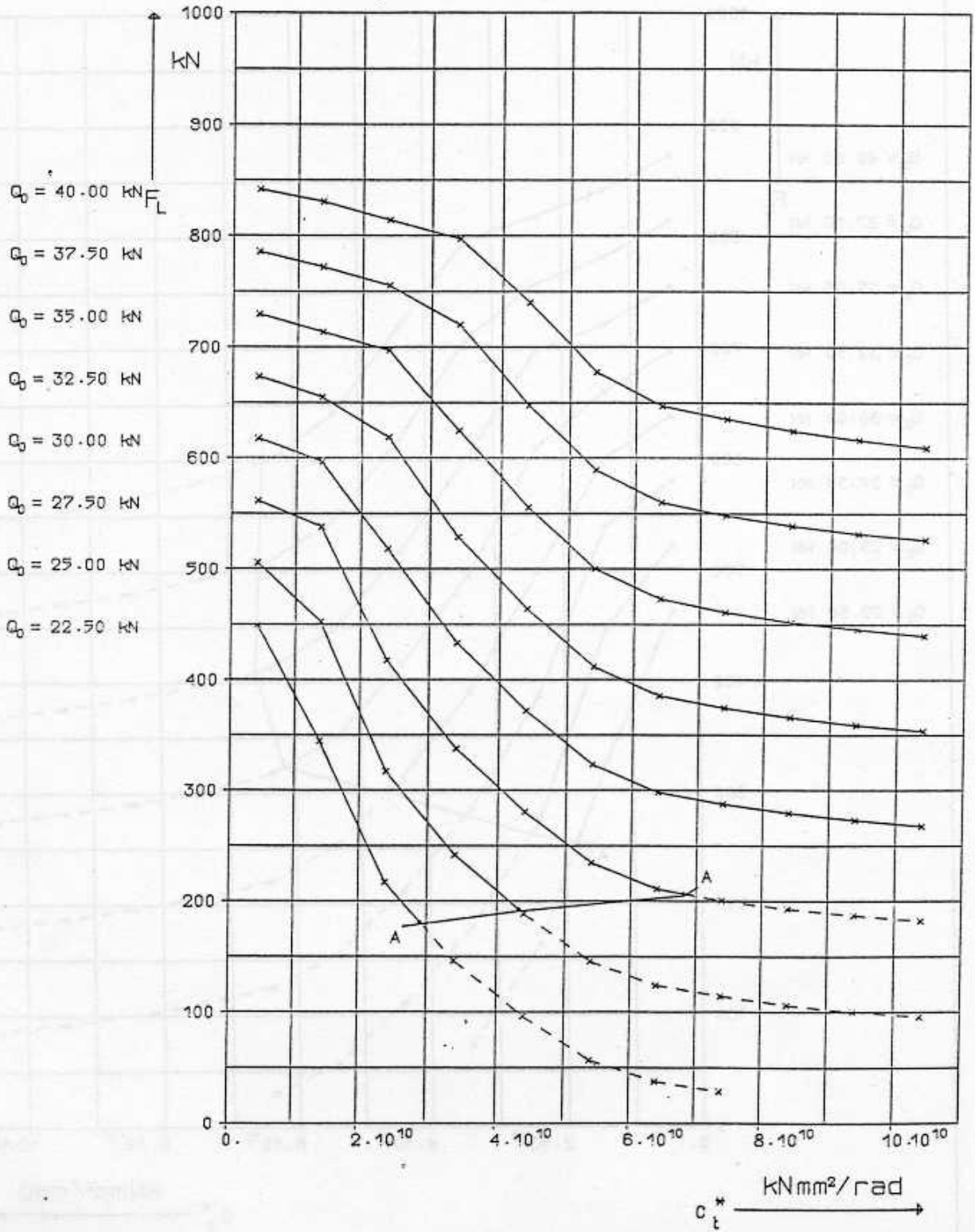
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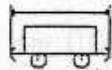
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$2a^* = 10500 \text{ mm}$$

$$2a^* = 6500 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

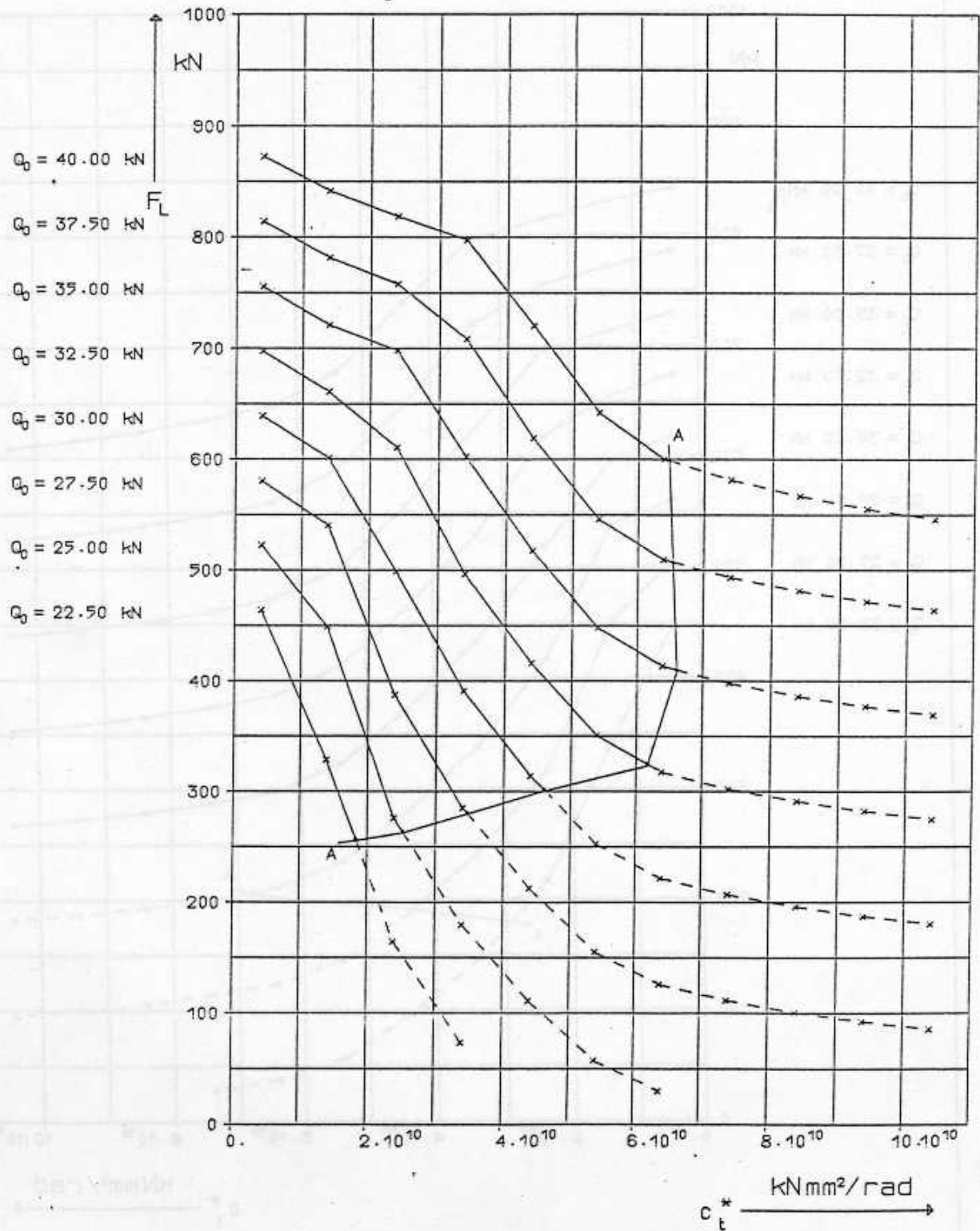
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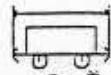
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 11000 \text{ mm}$$

$$2a^* = 6000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

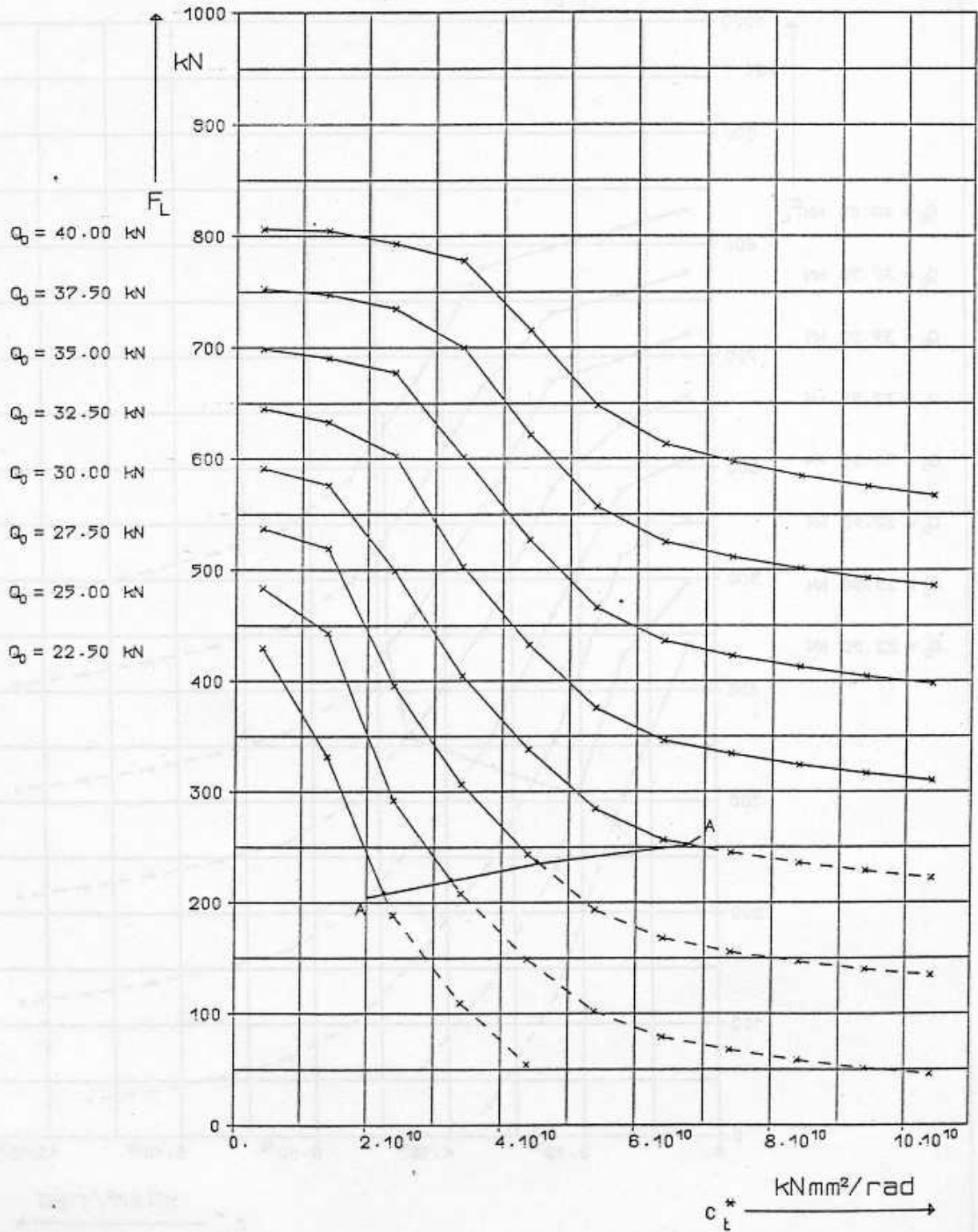
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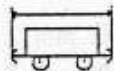
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 11000 \text{ mm}$$

$$2a^* = 7000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

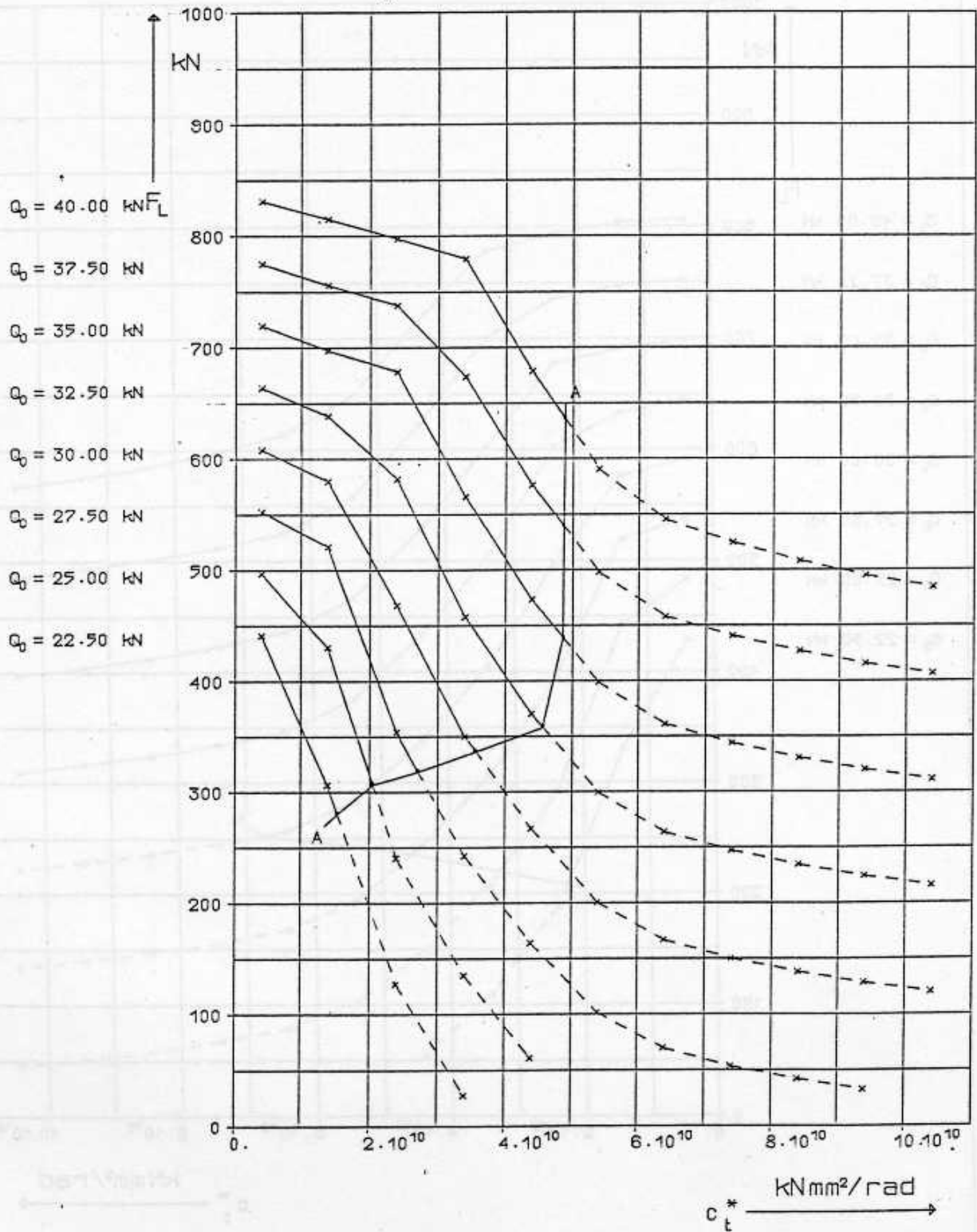
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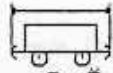
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$2a^* = 12000 \text{ mm}$$

$$2a^* = 7000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

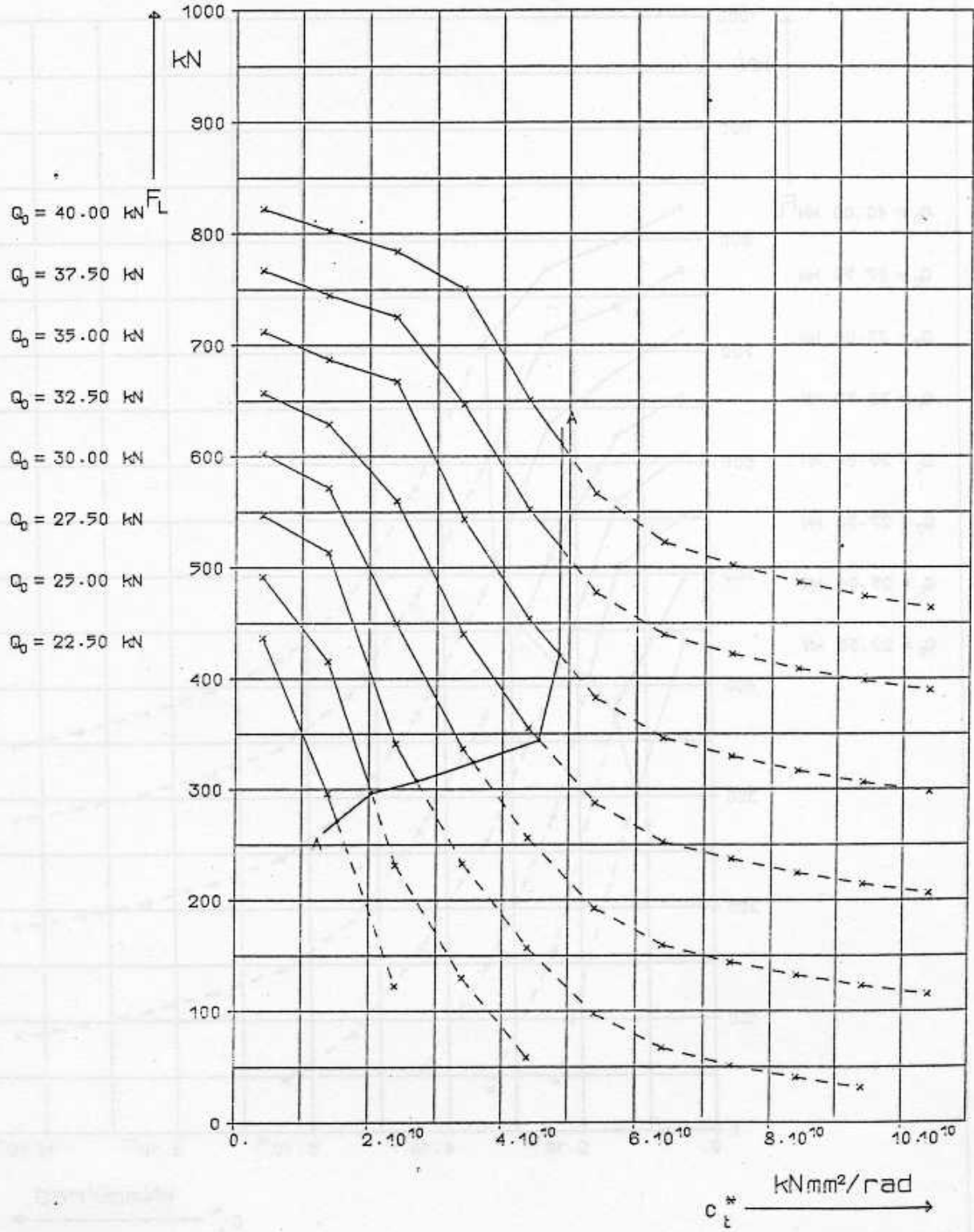
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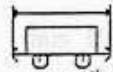
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 12000 \text{ mm}$$

$$2a^* = 8000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

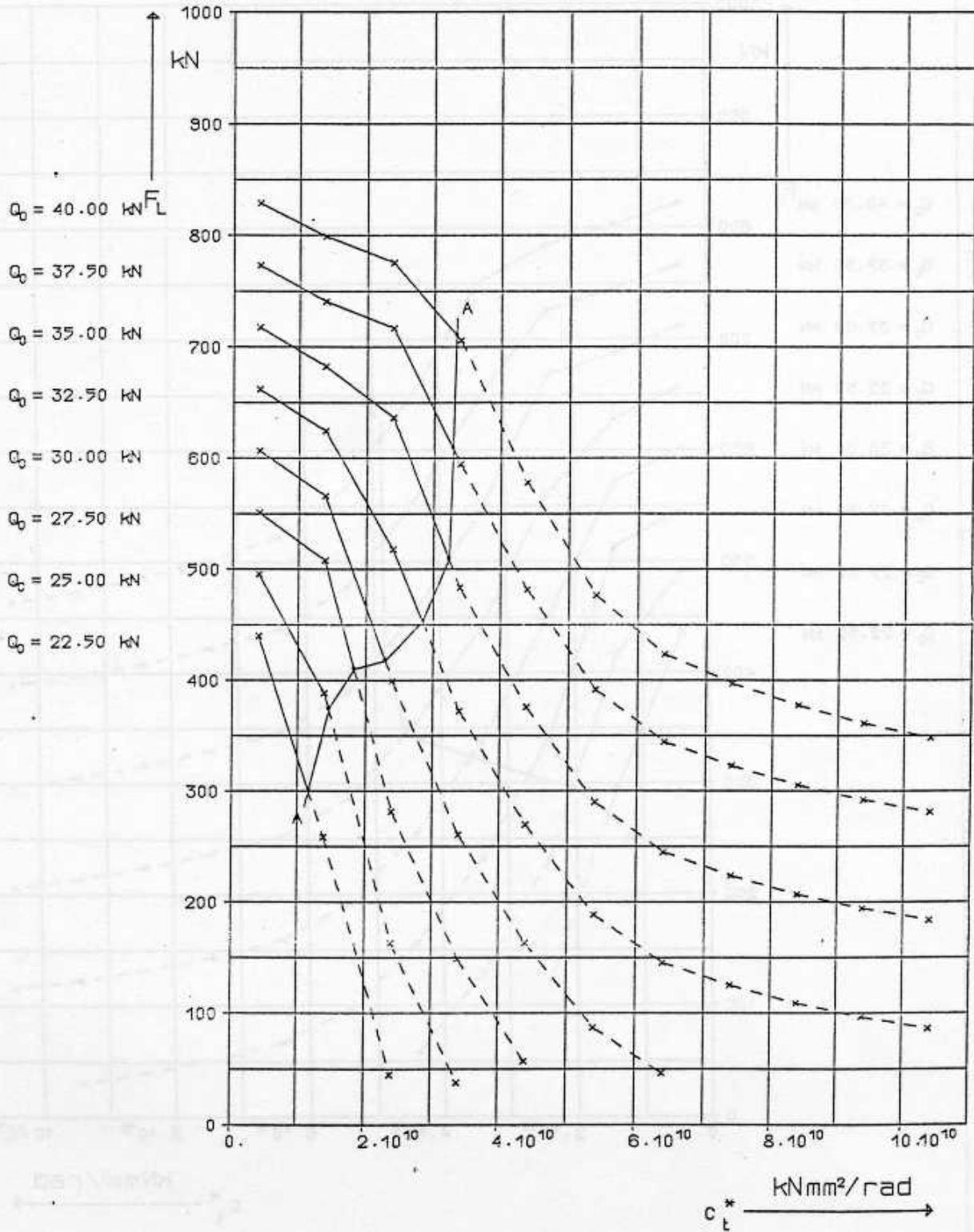
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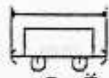
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 13000 \text{ mm}$$

$$2a^* = 7000 \text{ mm}$$

$$\Delta q_0 = F(c_t^*)$$

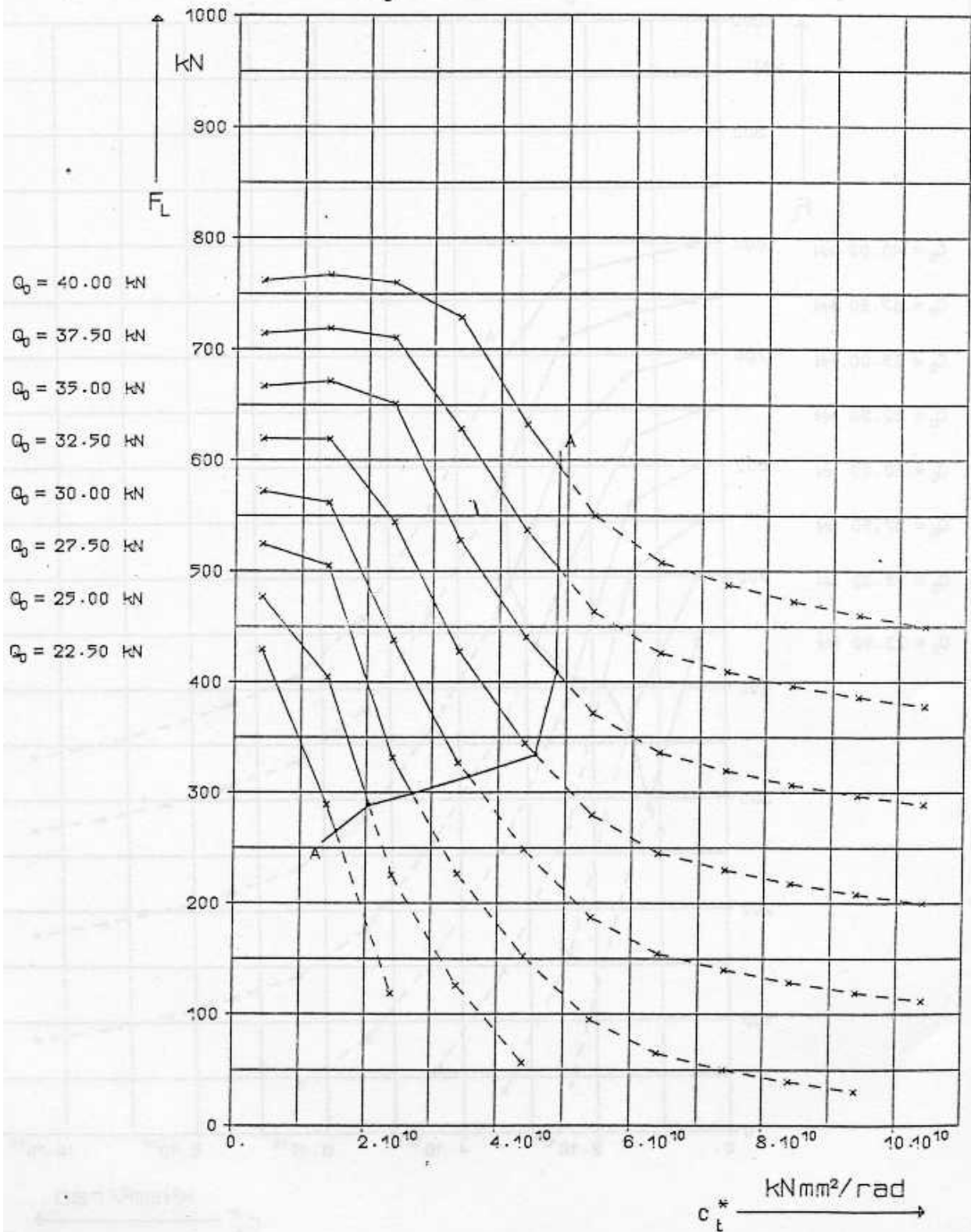
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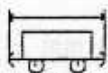
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 13000 \text{ mm}$$

$$2a^* = 8000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

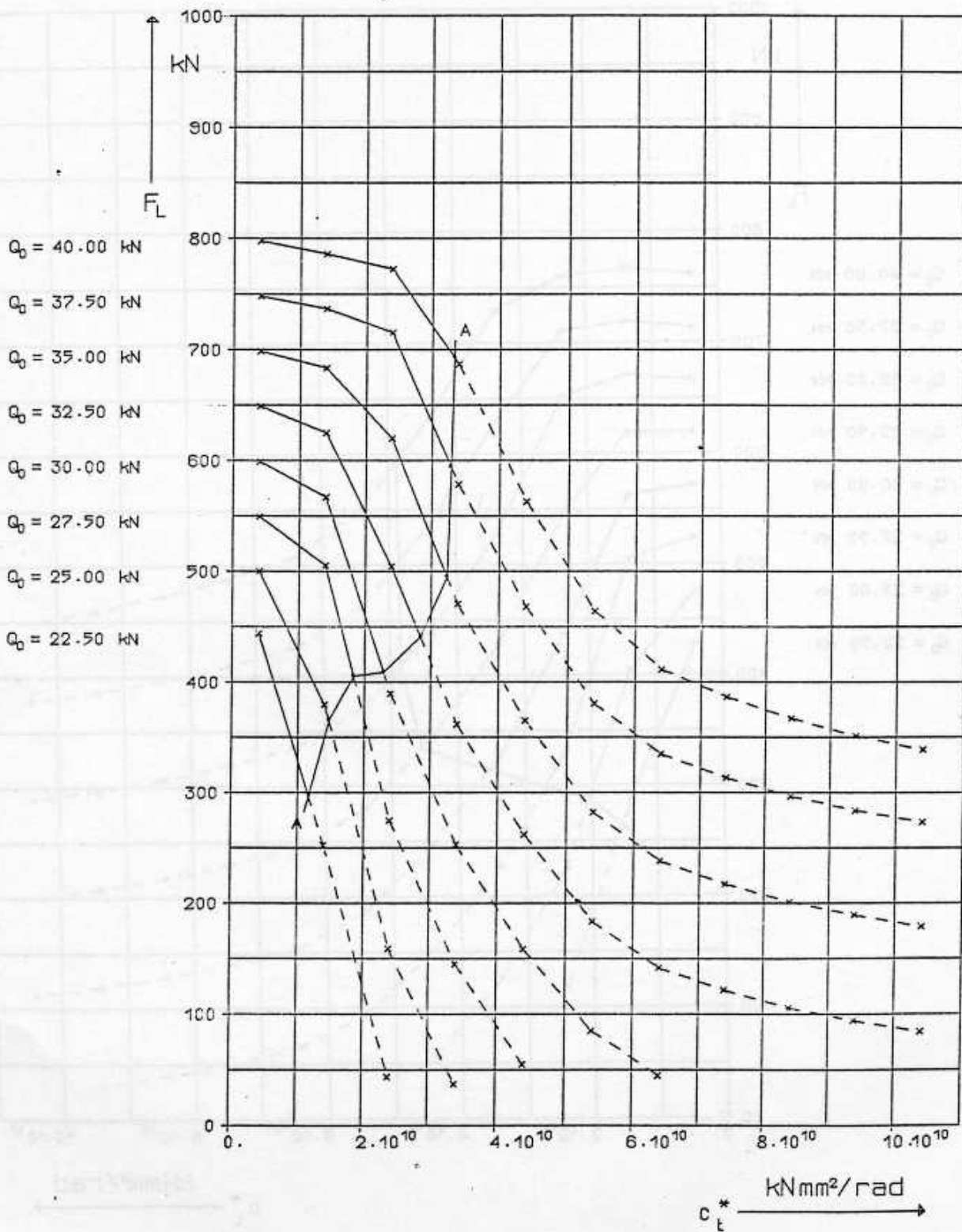
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$$c_{z1} = 1.14 \text{ N/mm}$$

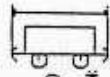
$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$







$$2a^* = 14000 \text{ mm}$$

$$2a^* = 8000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

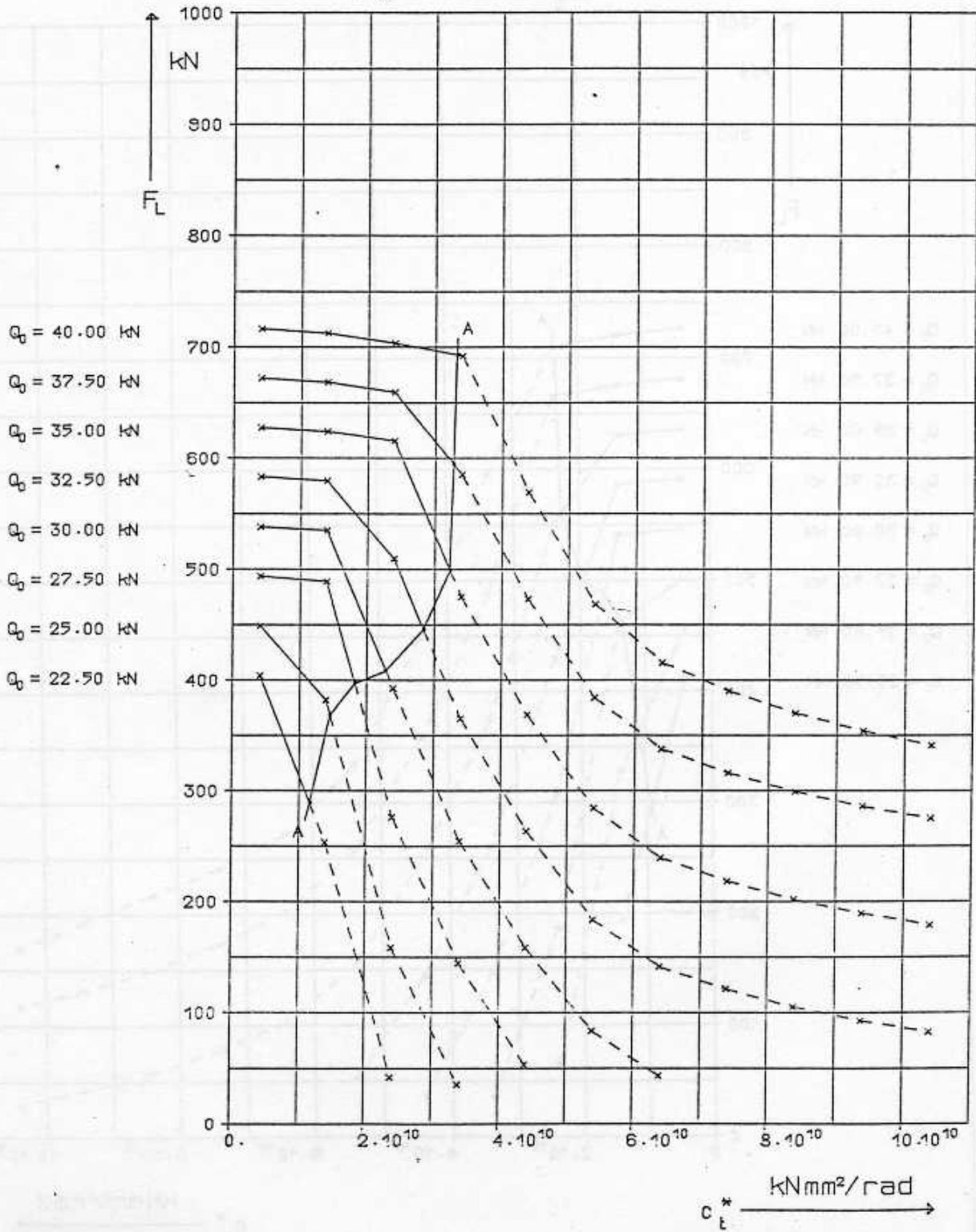
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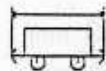
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$2a^* = 14000 \text{ mm}$$

$$2a^* = 9000 \text{ mm}$$

$$\Delta\alpha_0 = f(c_t^*)$$

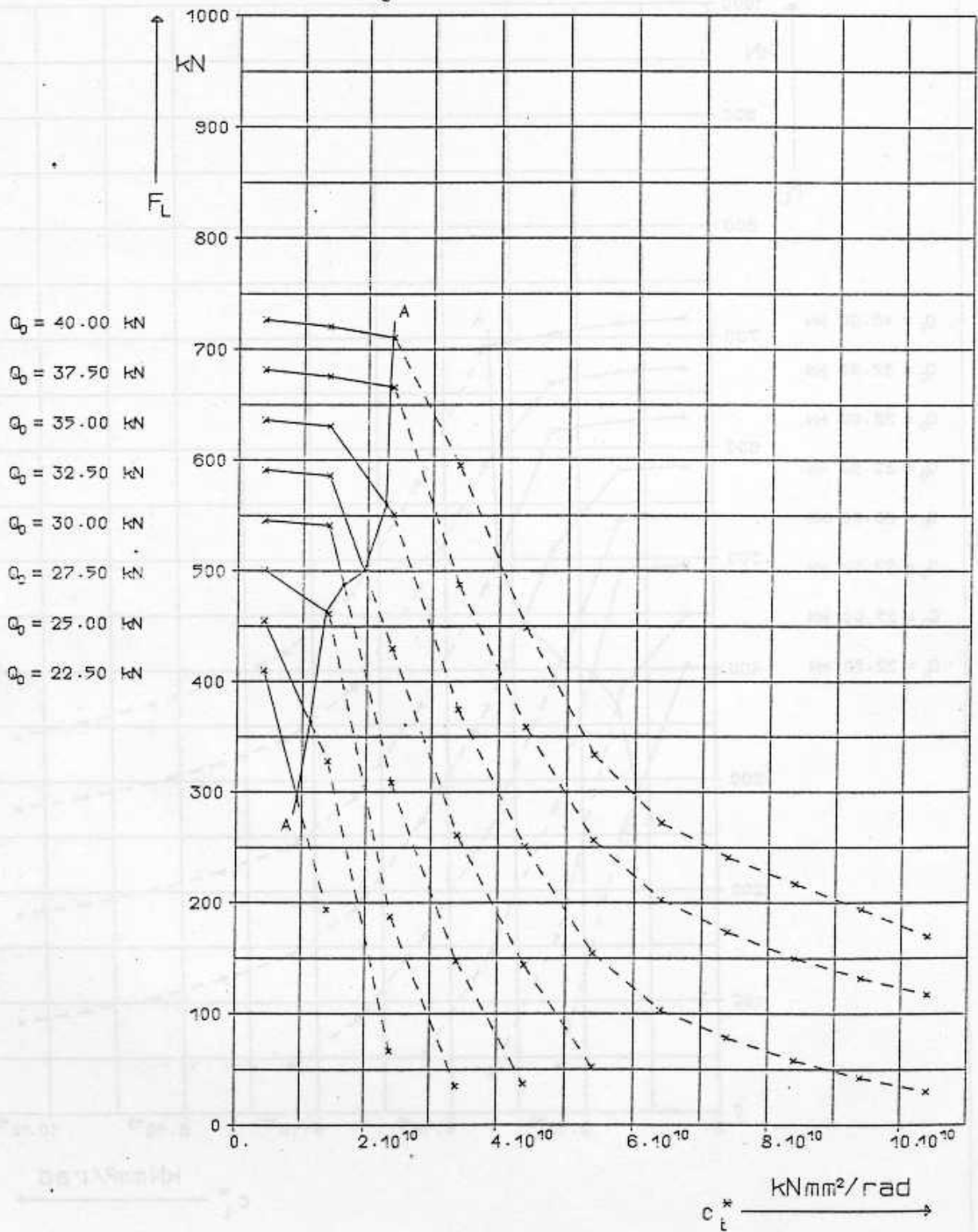
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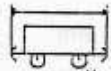
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$b = 14500 \text{ mm}$$

$$2a^* = 8000 \text{ mm}$$

$$\Delta Q_0 = f(c_t^*)$$

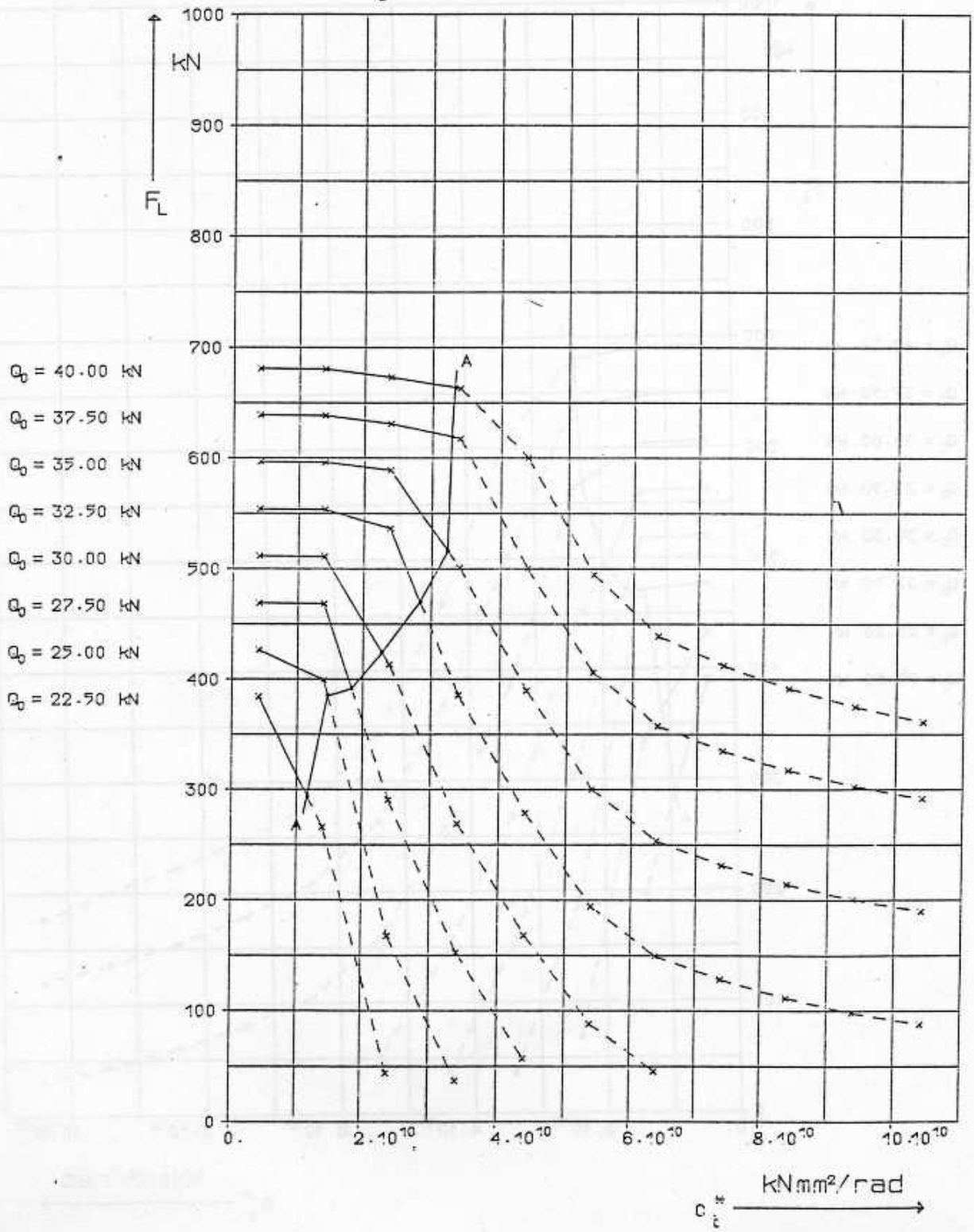
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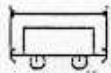
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$2a^* = 14500 \text{ mm}$$

$$2a^* = 9000 \text{ mm}$$

$$\Delta a_0 = f(c_t^*)$$

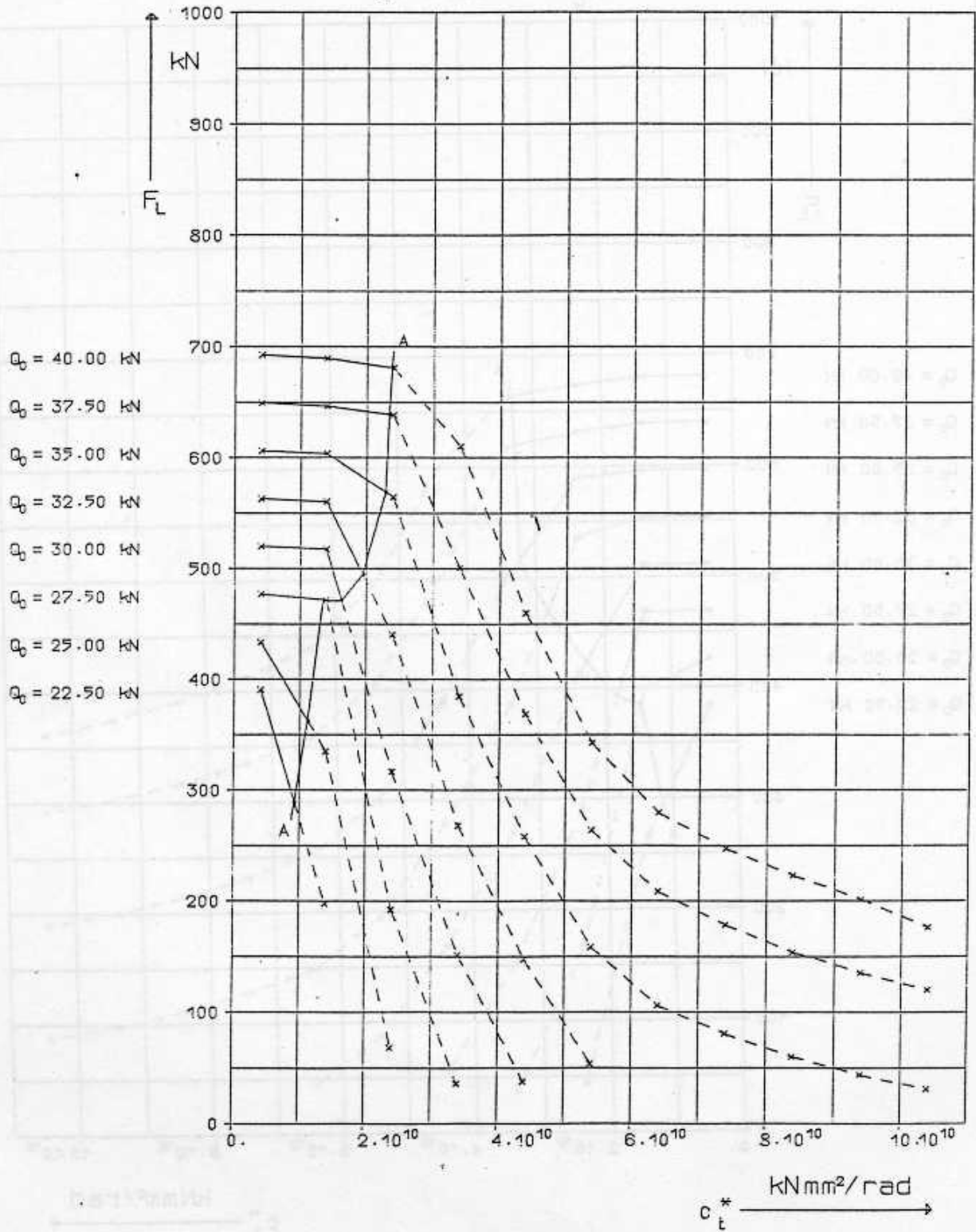
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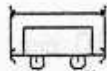
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 15000 \text{ mm}$$

$$2a^* = 9000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

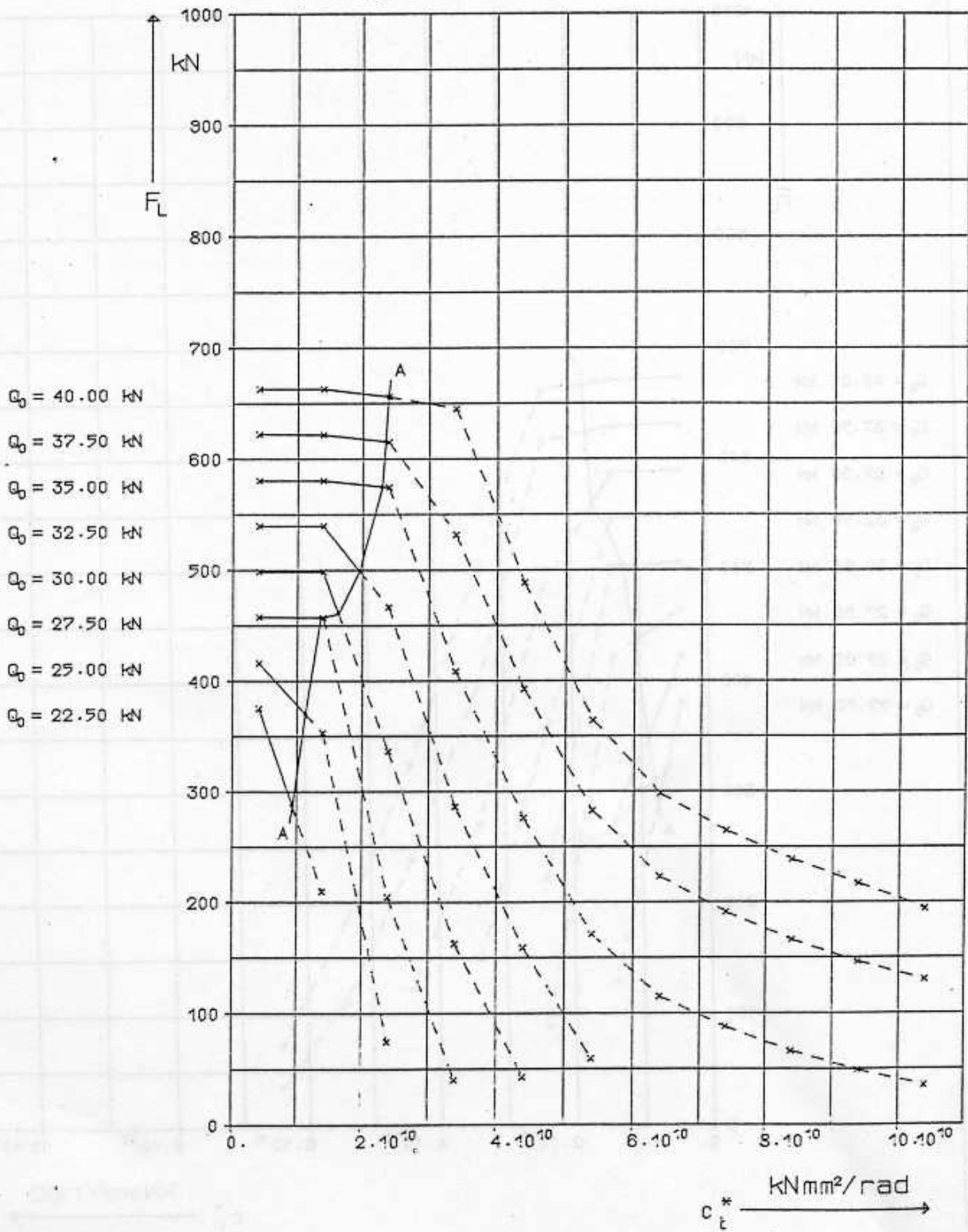
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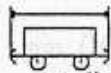
$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

$$z_c = 35,5 \text{ mm}$$





$$= 15000 \text{ mm}$$

$$2a^* = 10000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

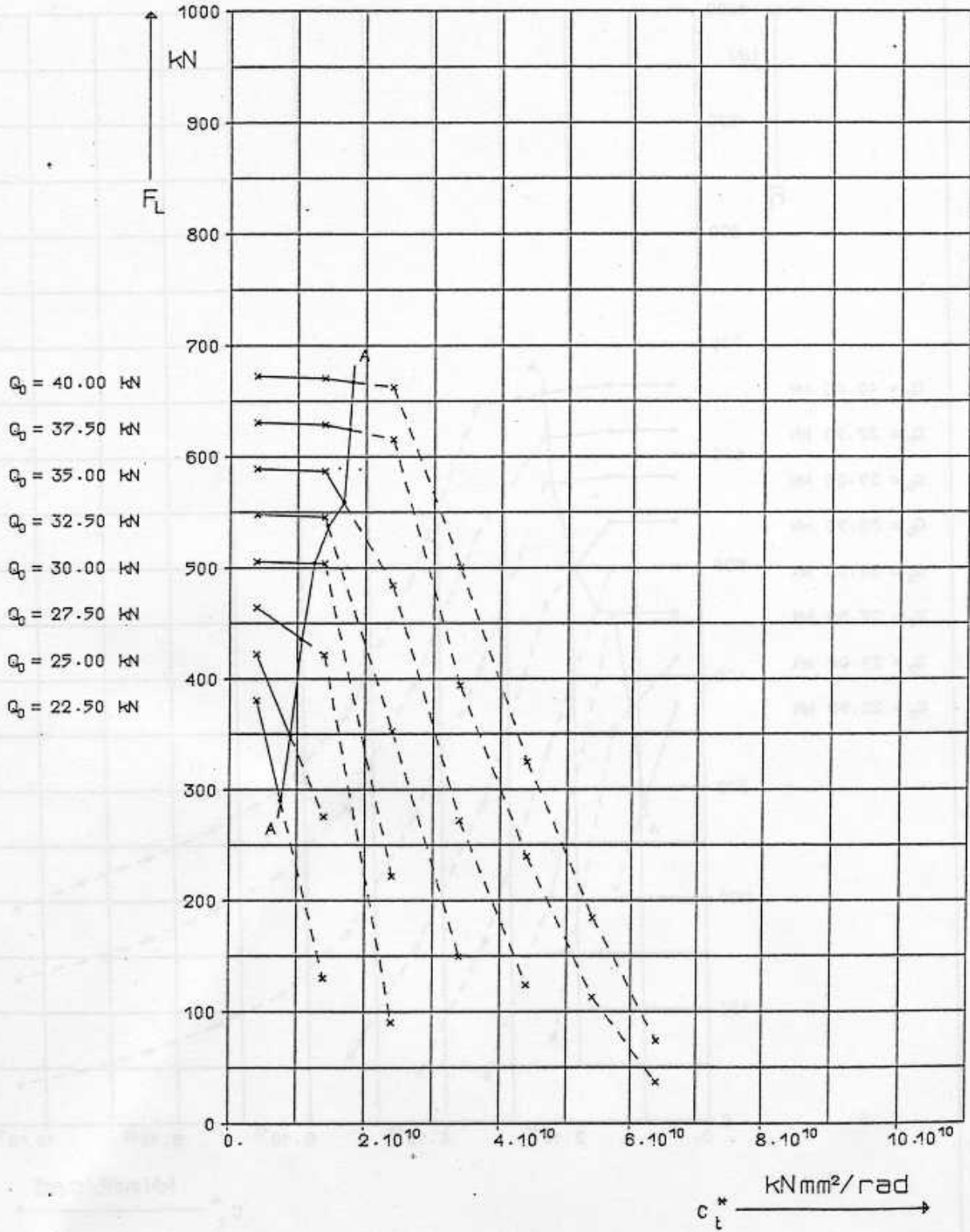
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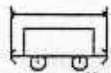
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$2a^* = 15500 \text{ mm}$$

$$2a^* = 9000 \text{ mm}$$

$$\Delta q_0 = f(c_t^*)$$

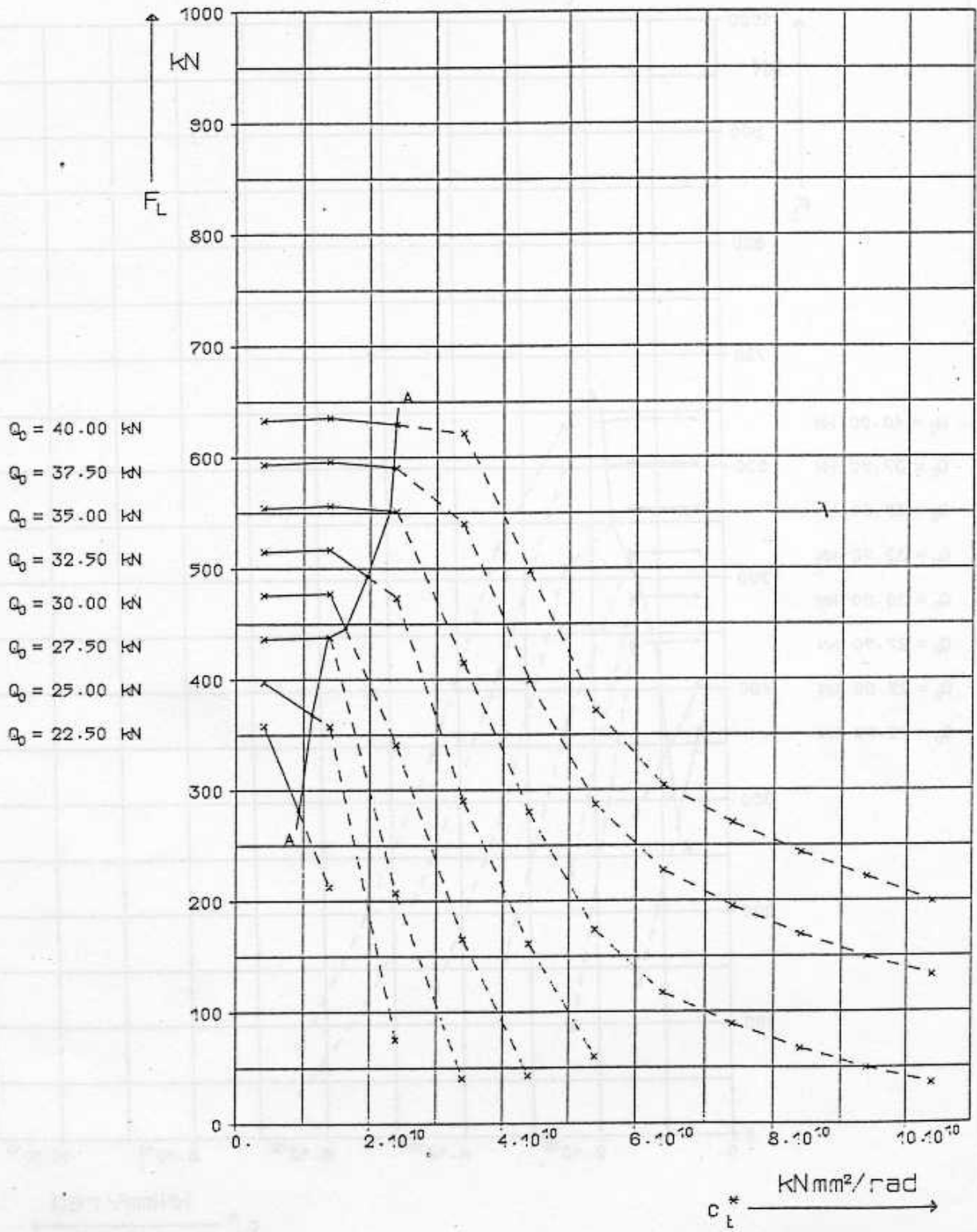
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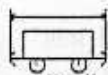
$$c_{z1} = 1.14 \text{ N/mm}$$

$$c_{z2} = 2.08 \text{ N/mm}$$

$$F_{cz} = 40.5 \text{ kN}$$

$$z_c = 35.5 \text{ mm}$$





$$= 15500 \text{ mm}$$

$$2a^* = 10000 \text{ mm}$$

$$\Delta a_0 = f(c_t^*)$$

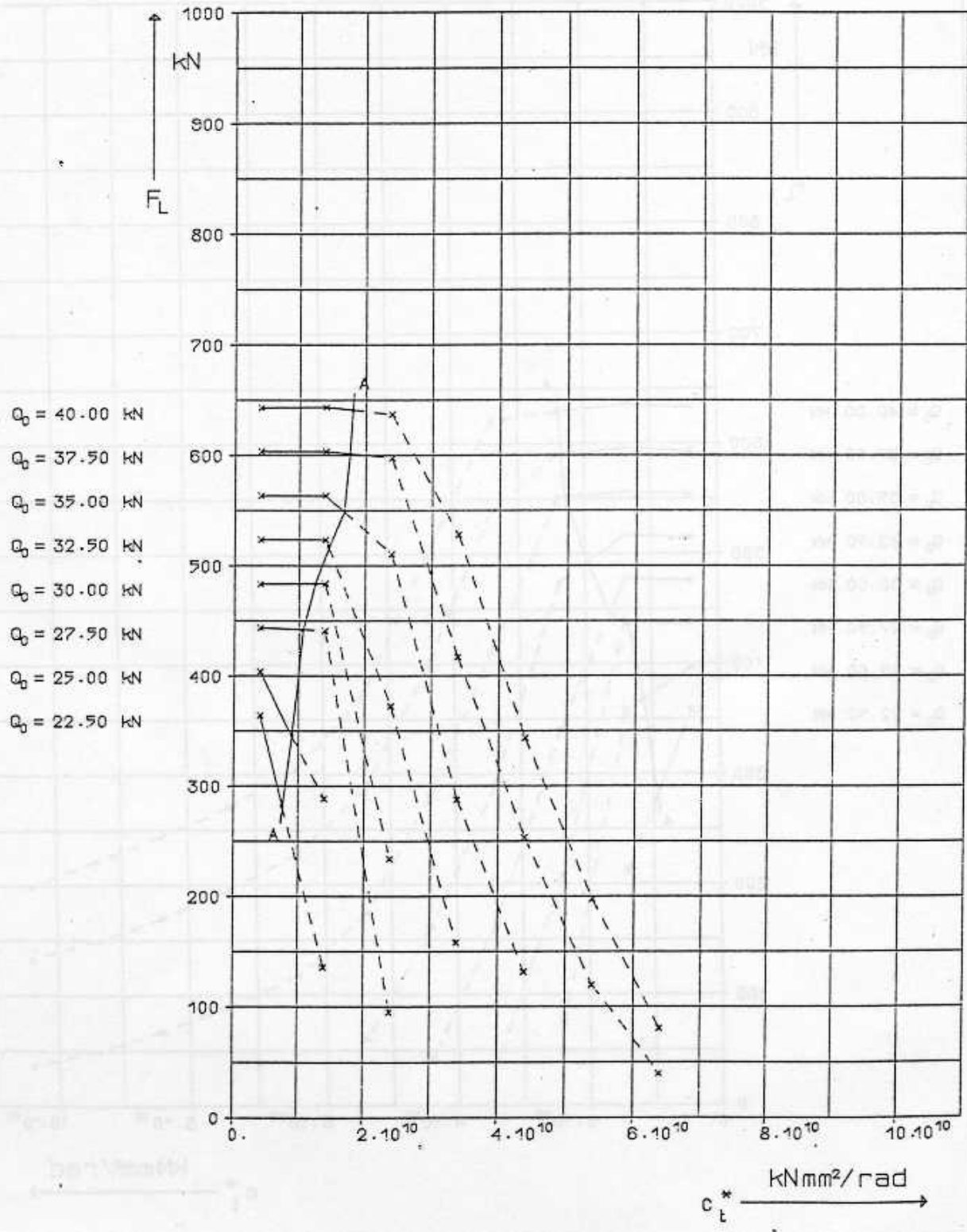
$$0,15 \leq \Delta a_0 \leq 0,23$$

$$c_{z1} = 1,14 \text{ N/mm}$$

$$c_{z2} = 2,08 \text{ N/mm}$$

$$F_{cz} = 40,5 \text{ kN}$$

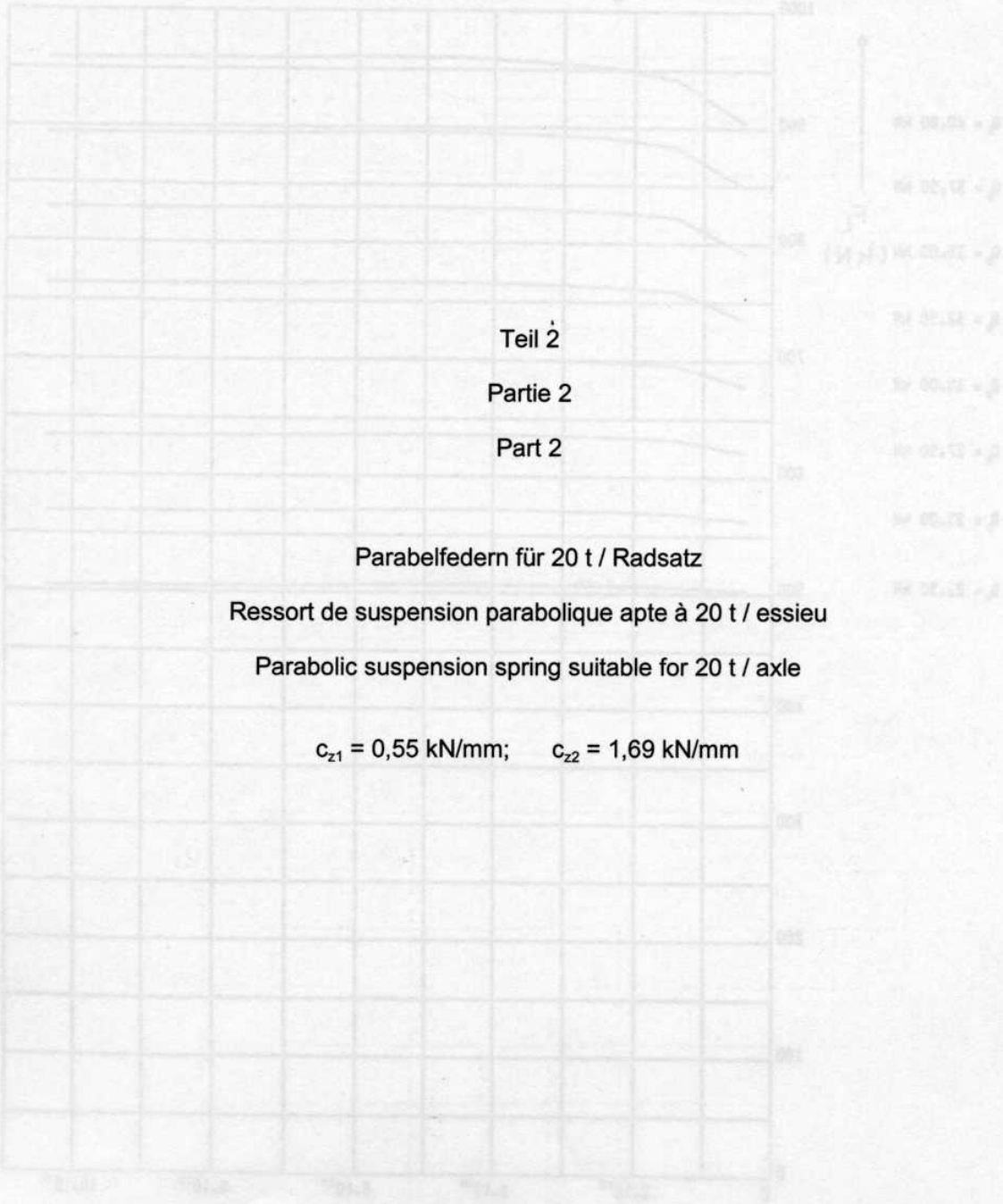
$$z_c = 35,5 \text{ mm}$$

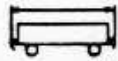






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$$= 9500. \text{ mm}$$

$$2a^* = 5500. \text{ mm}$$

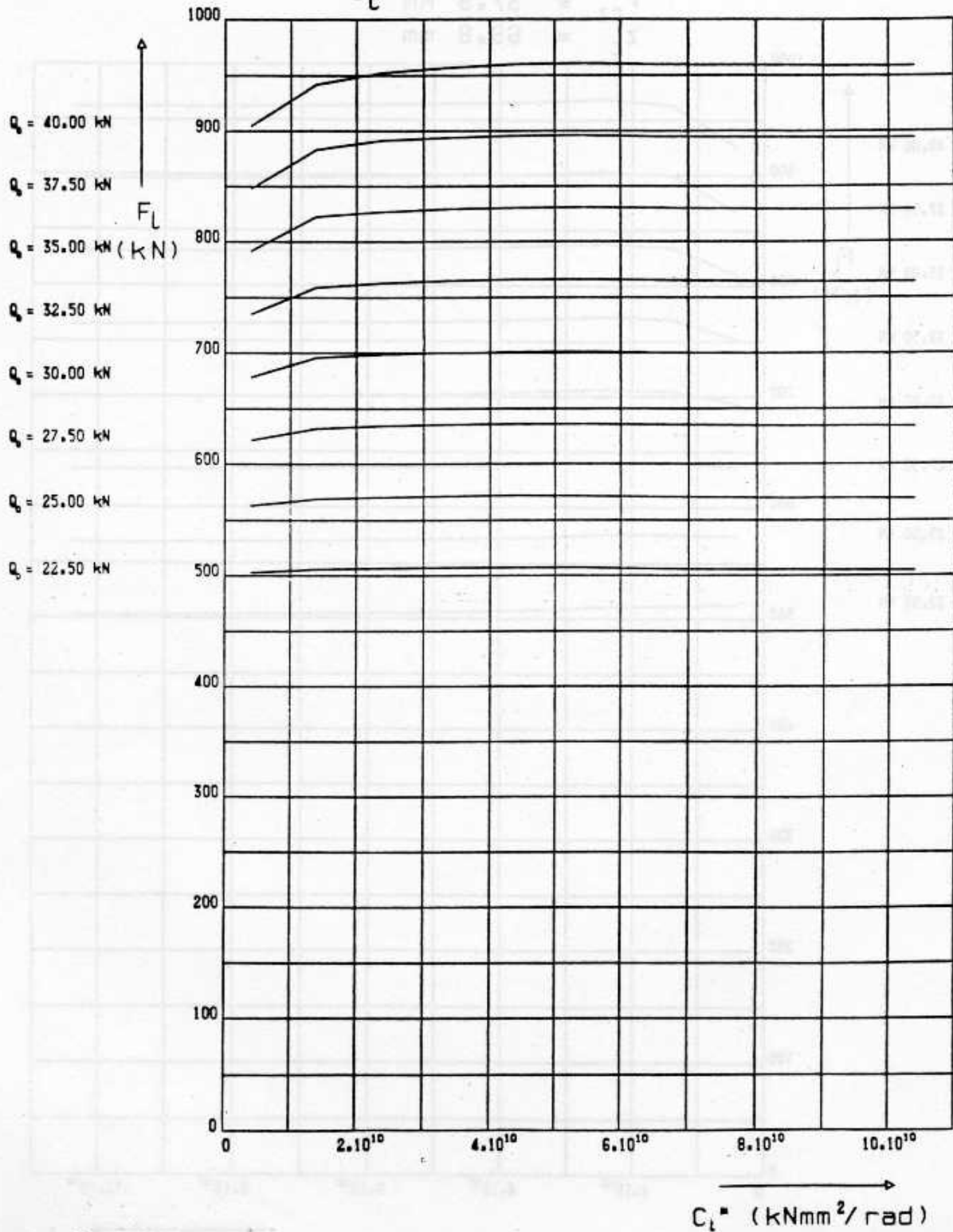
$$\Delta q_0 = 0.15$$

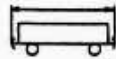
$$c_{z1} = 0.55 \text{ kN/mm}$$

$$c_{z2} = 1.69 \text{ kN/mm}$$

$$F_{cz} = 37.9 \text{ kN}$$

$$z_c = 69.8 \text{ mm}$$





$$= 9500. \text{ mm}$$

$$2a^* = 6000. \text{ mm}$$

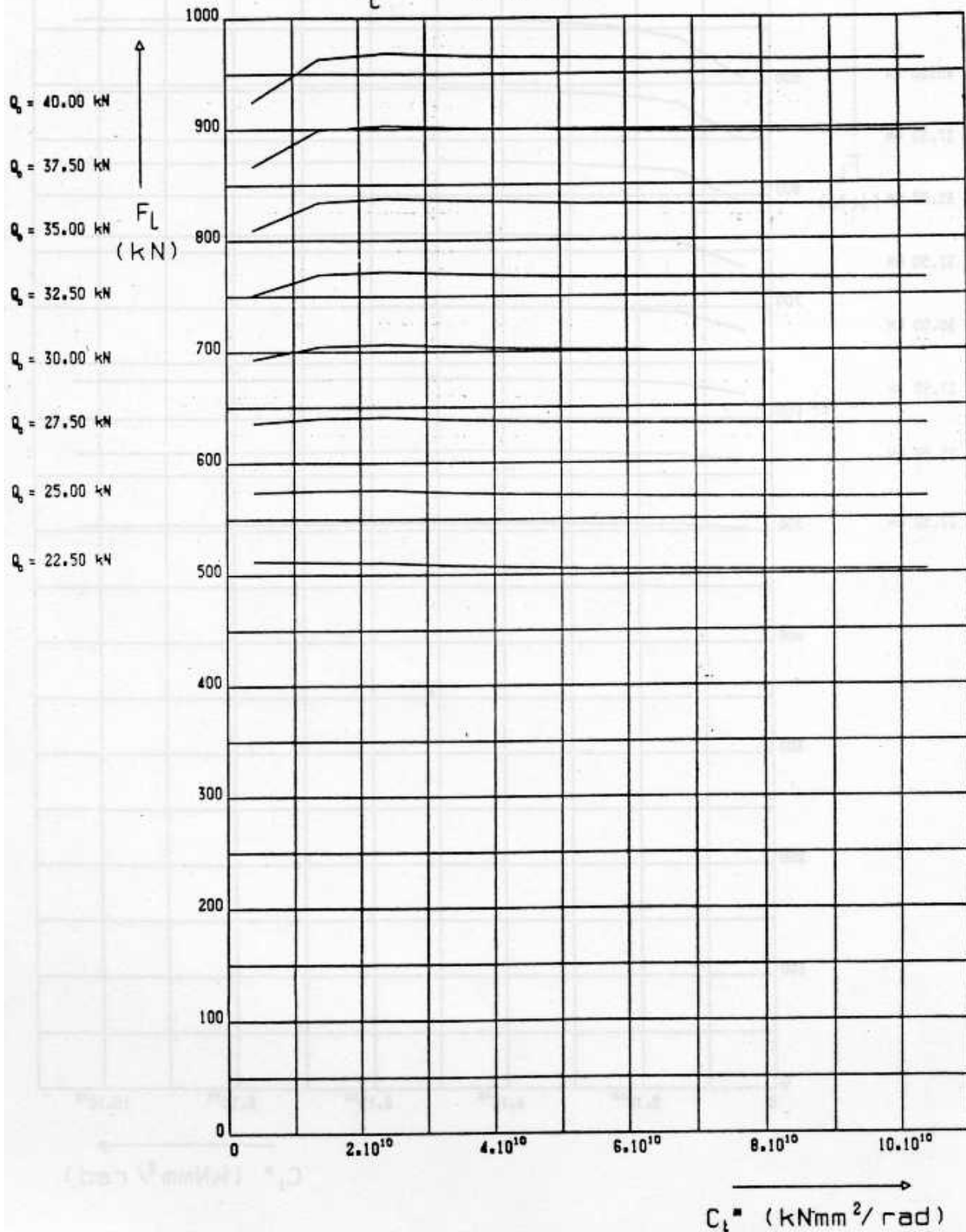
$$\Delta q_0 = 0.15$$

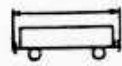
$$c_{z1} = 0.55 \text{ kN/mm}$$

$$c_{z2} = 1.69 \text{ kN/mm}$$

$$F_{cz} = 37.9 \text{ kN}$$

$$z_c = 69.8 \text{ mm}$$





$$= 10000. \text{ mm}$$

$$2a^* = 5500. \text{ mm}$$

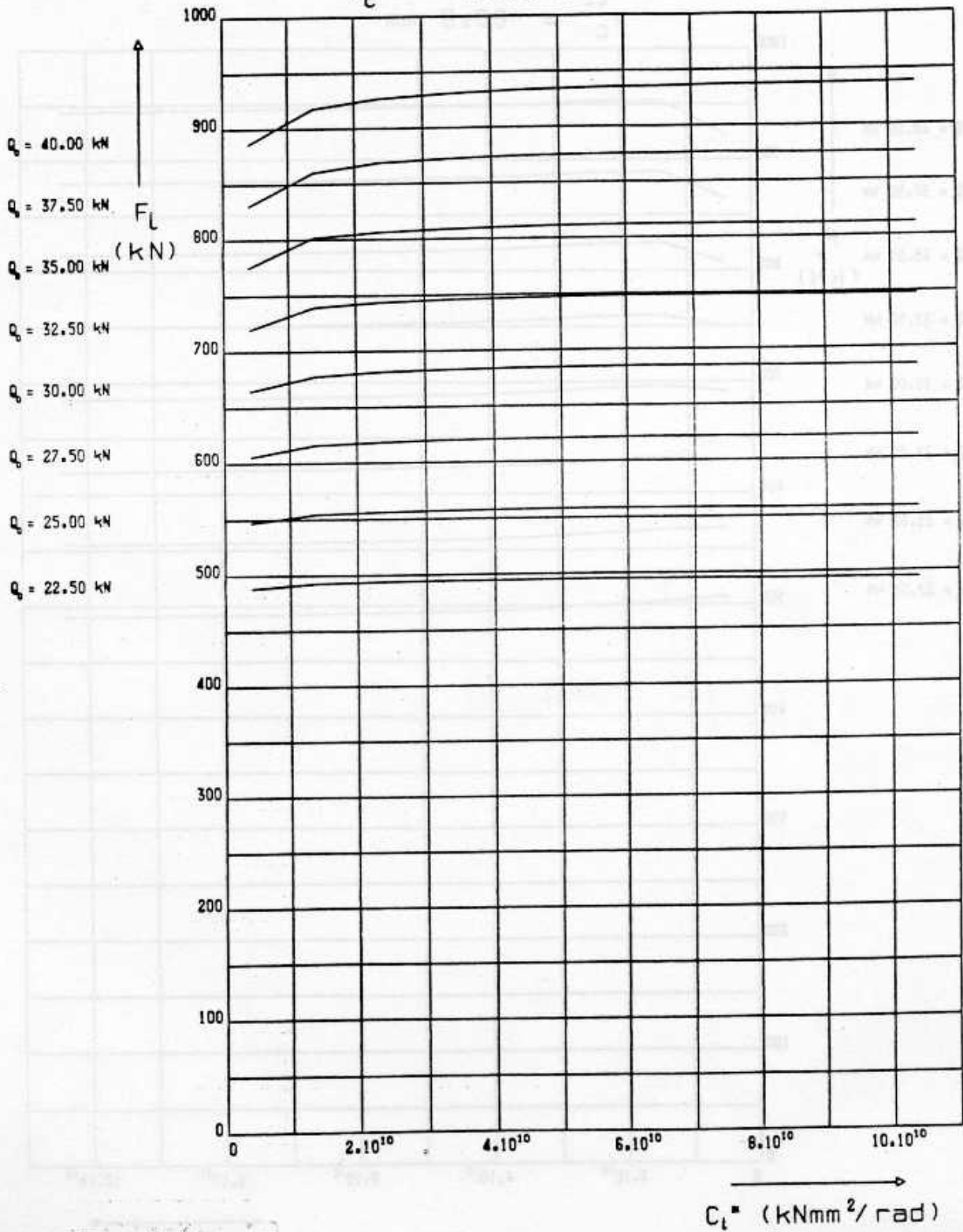
$$\Delta q_0 = 0.15$$

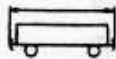
$$c_{z1} = 0.55 \text{ kN/mm}$$

$$c_{z2} = 1.69 \text{ kN/mm}$$

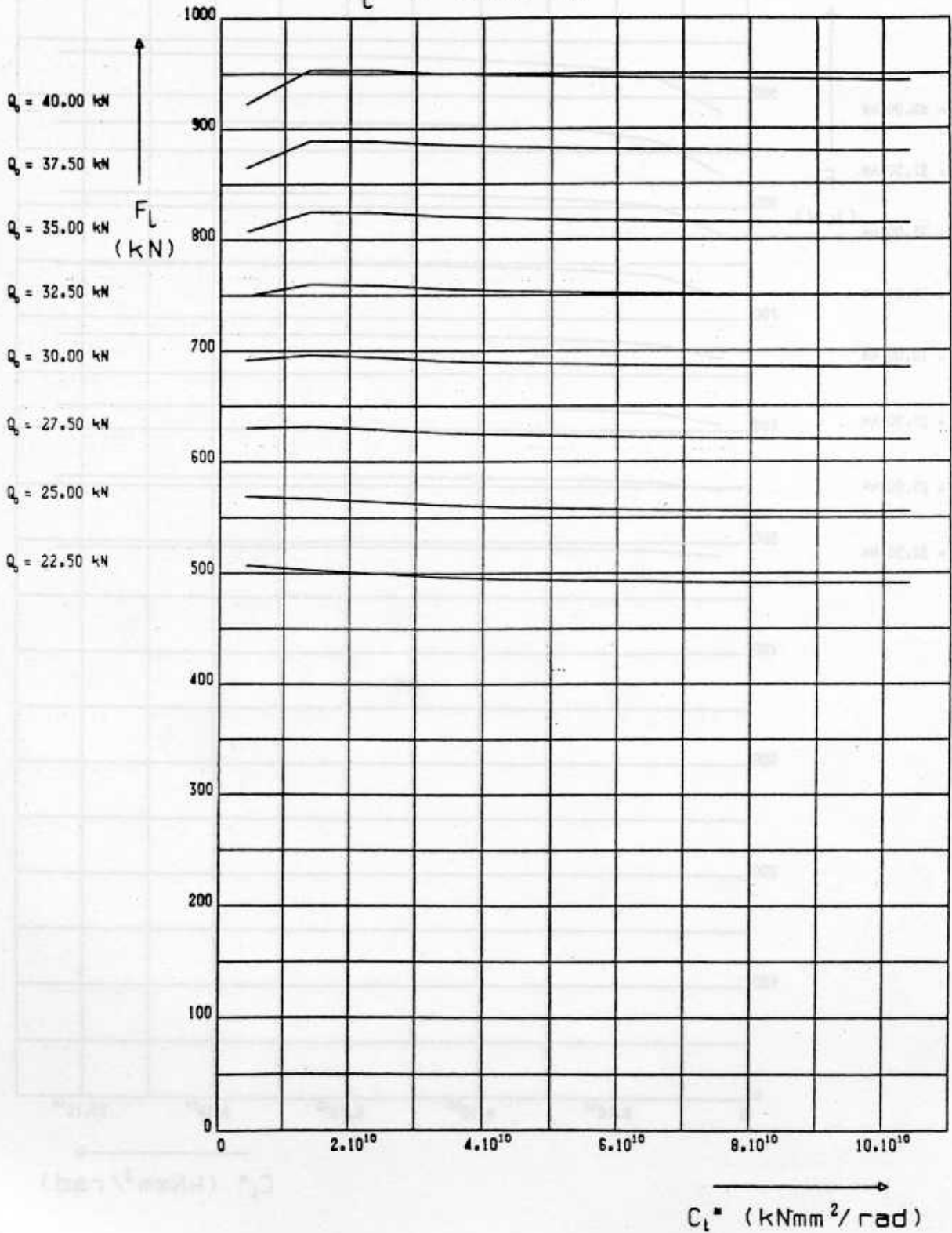
$$F_{cz} = 37.9 \text{ kN}$$

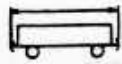
$$z_c = 69.8 \text{ mm}$$





- $l = 10000 \text{ mm}$
- $2a^* = 6500 \text{ mm}$
- $\Delta q_0 = 0.15$
- $c_{z1} = 0.55 \text{ kN/mm}$
- $c_{z2} = 1.69 \text{ kN/mm}$
- $F_{cz} = 37.9 \text{ kN}$
- $z_c = 69.8 \text{ mm}$





$$= 10500. \text{ mm}$$

$$2a^* = 5500. \text{ mm}$$

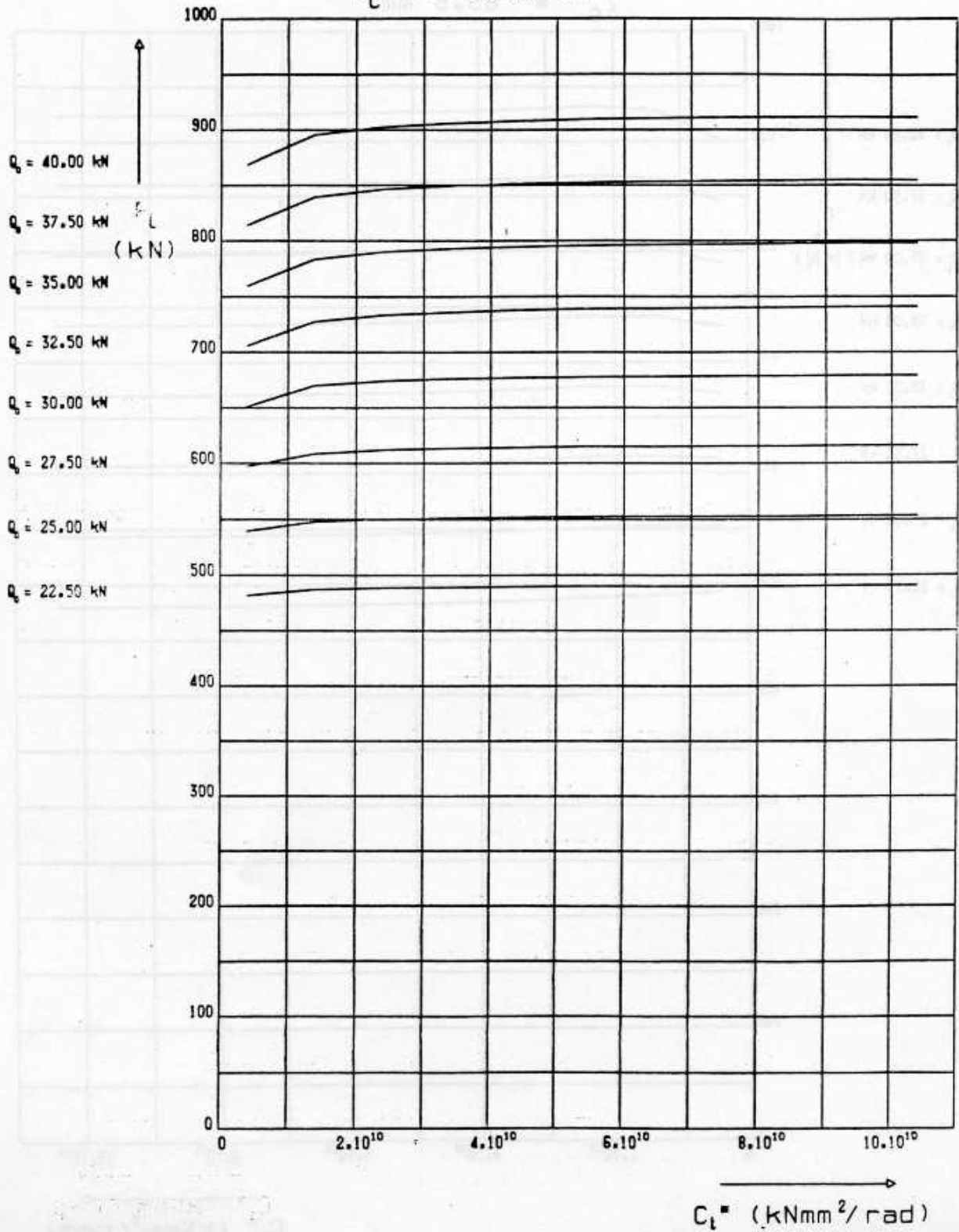
$$\Delta q_0 = 0.15$$

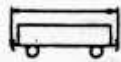
$$c_{z1} = 0.55 \text{ kN/mm}$$

$$c_{z2} = 1.69 \text{ kN/mm}$$

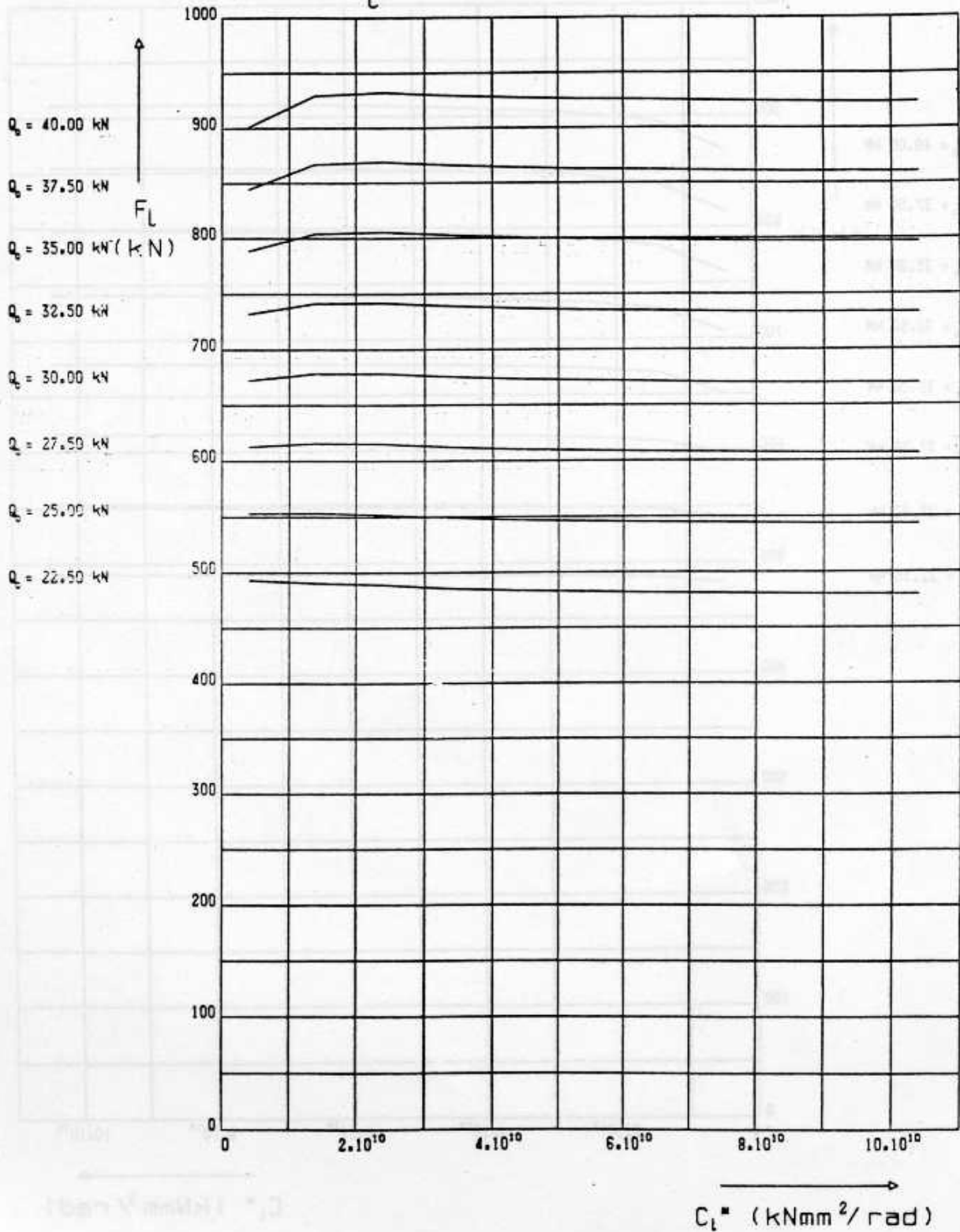
$$F_{cz} = 37.9 \text{ kN}$$

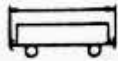
$$z_c = 69.8 \text{ mm}$$





- $= 10500. \text{ mm}$
- $2a^* = 6500. \text{ mm}$
- $\Delta q_0 = 0.15$
- $c_{z1} = 0.55 \text{ kN/mm}$
- $c_{z2} = 1.69 \text{ kN/mm}$
- $F_{cz} = 37.9 \text{ kN}$
- $z_c = 69.8 \text{ mm}$





$$= 11000. \text{ mm}$$

$$2a^* = 6000. \text{ mm}$$

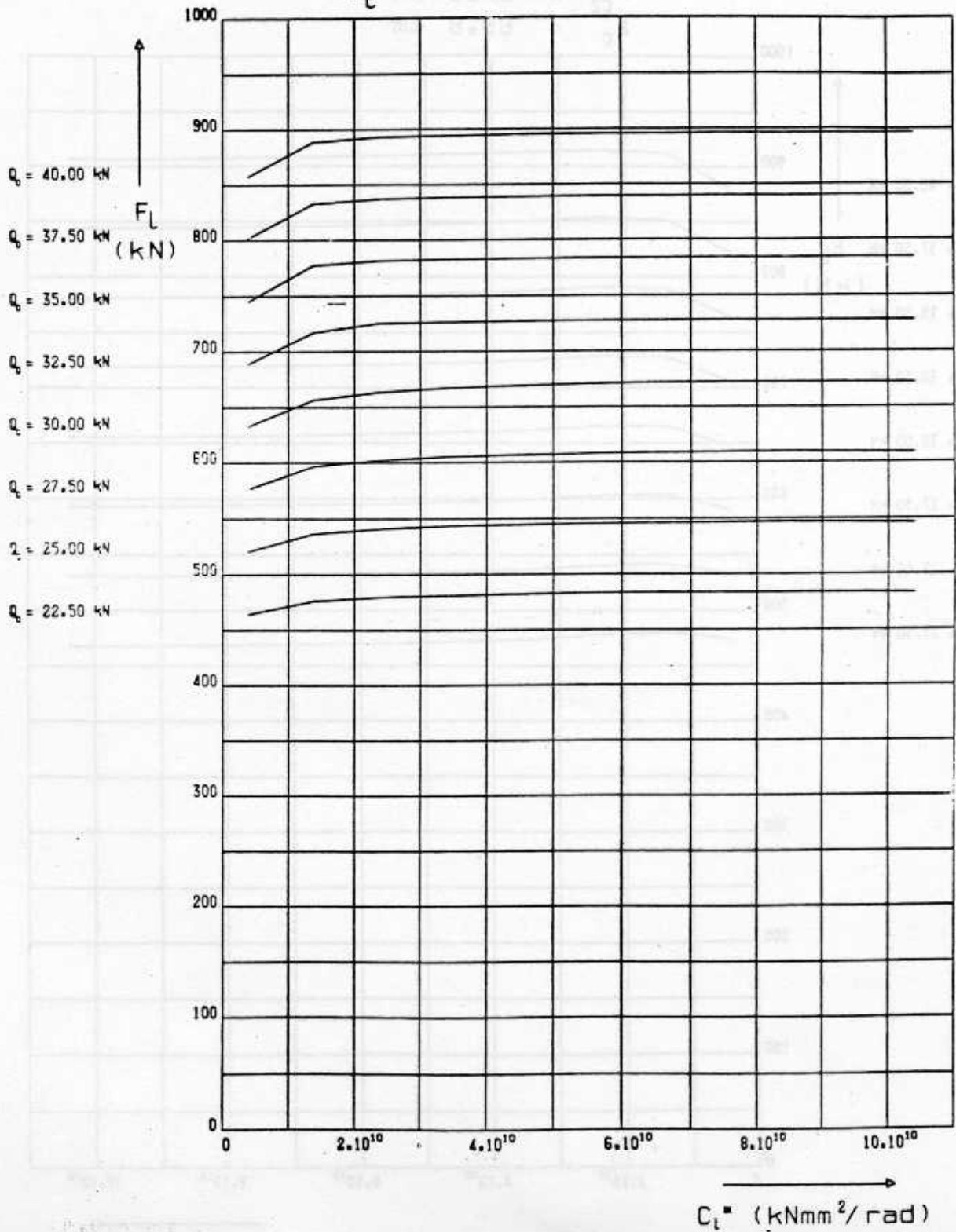
$$\Delta q_0 = 0.15$$

$$c_{z1} = 0.55 \text{ kN/mm}$$

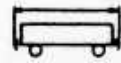
$$c_{z2} = 1.69 \text{ kN/mm}$$

$$F_{cz} = 37.9 \text{ kN}$$

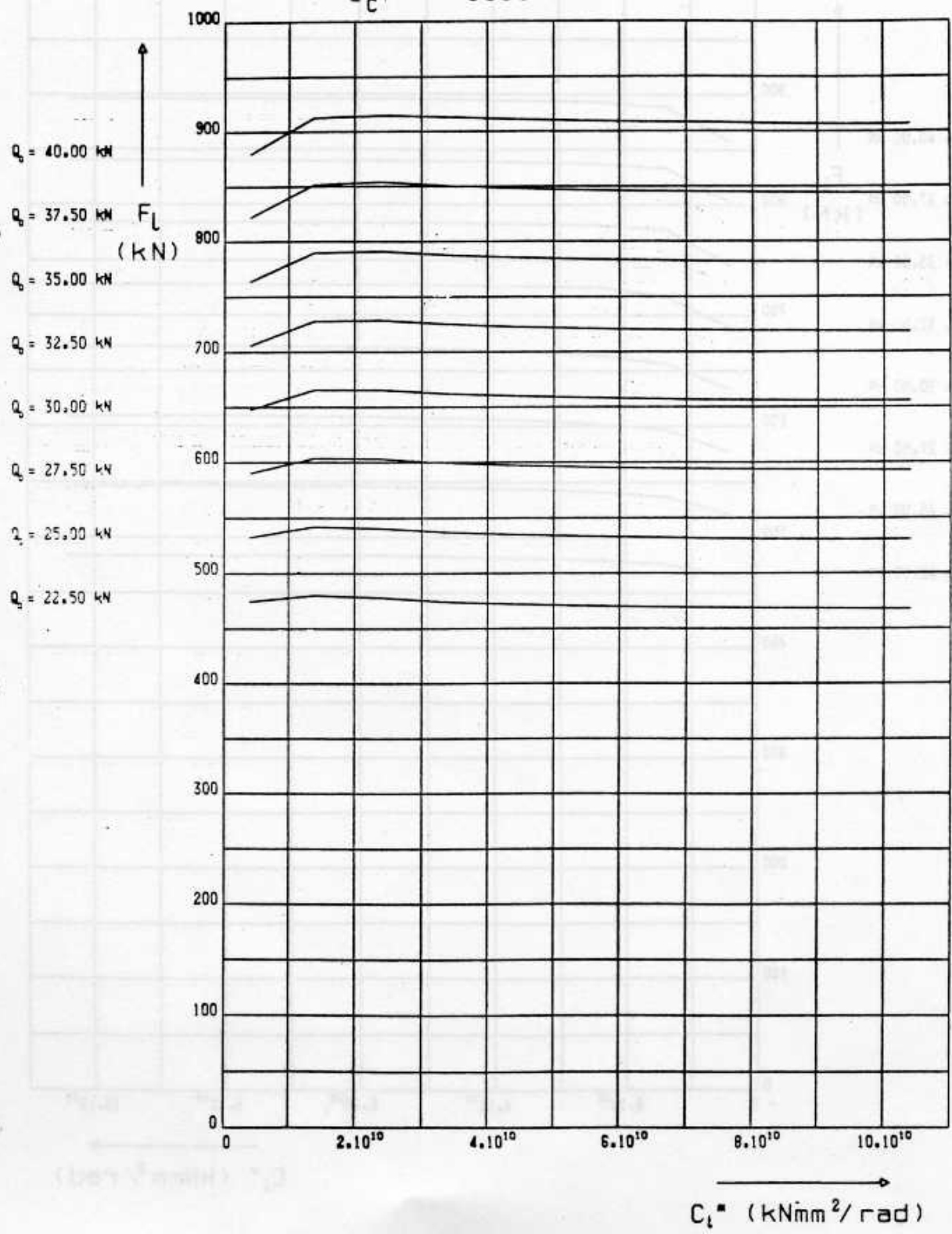
$$z_c = 69.8 \text{ mm}$$



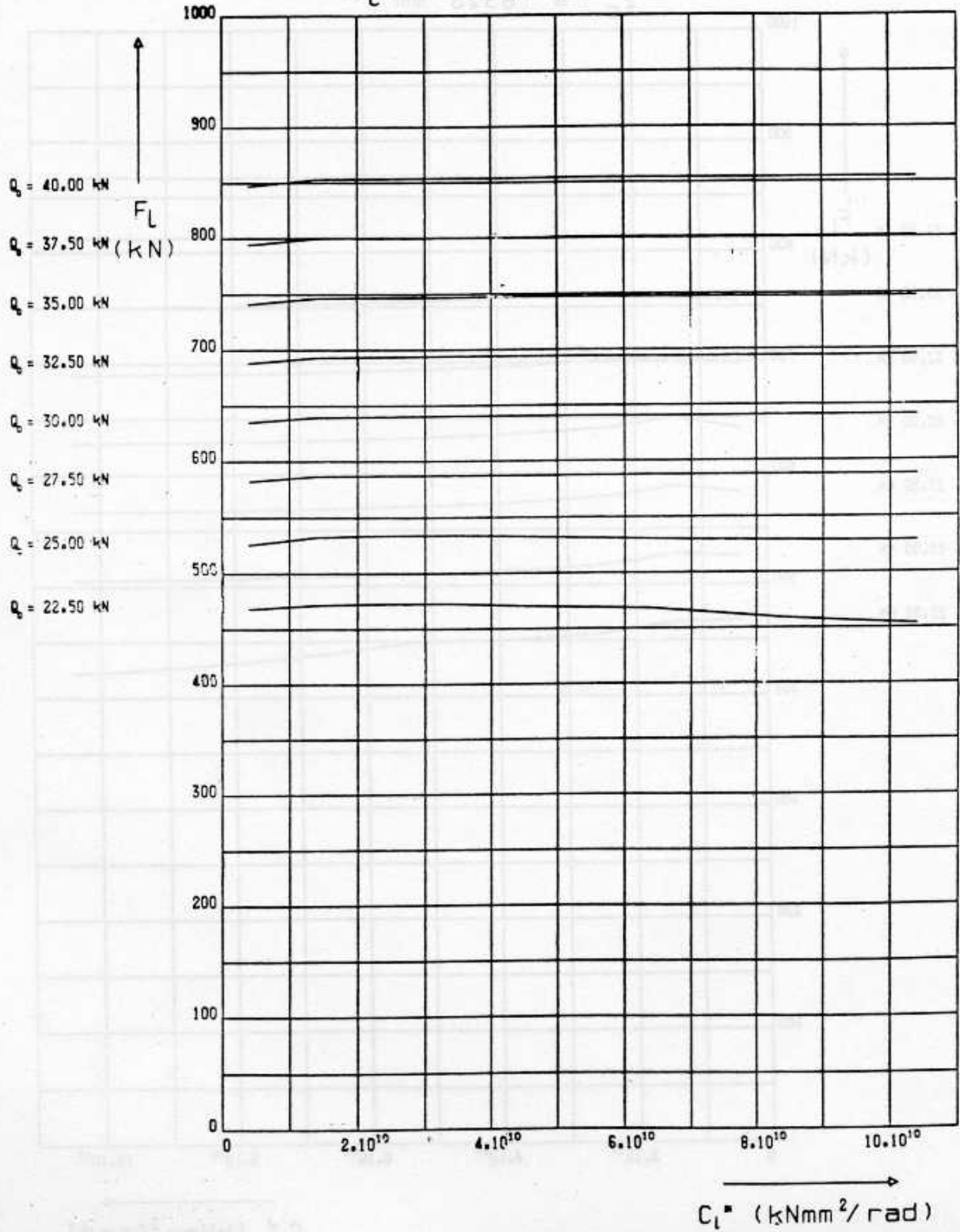


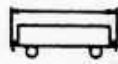


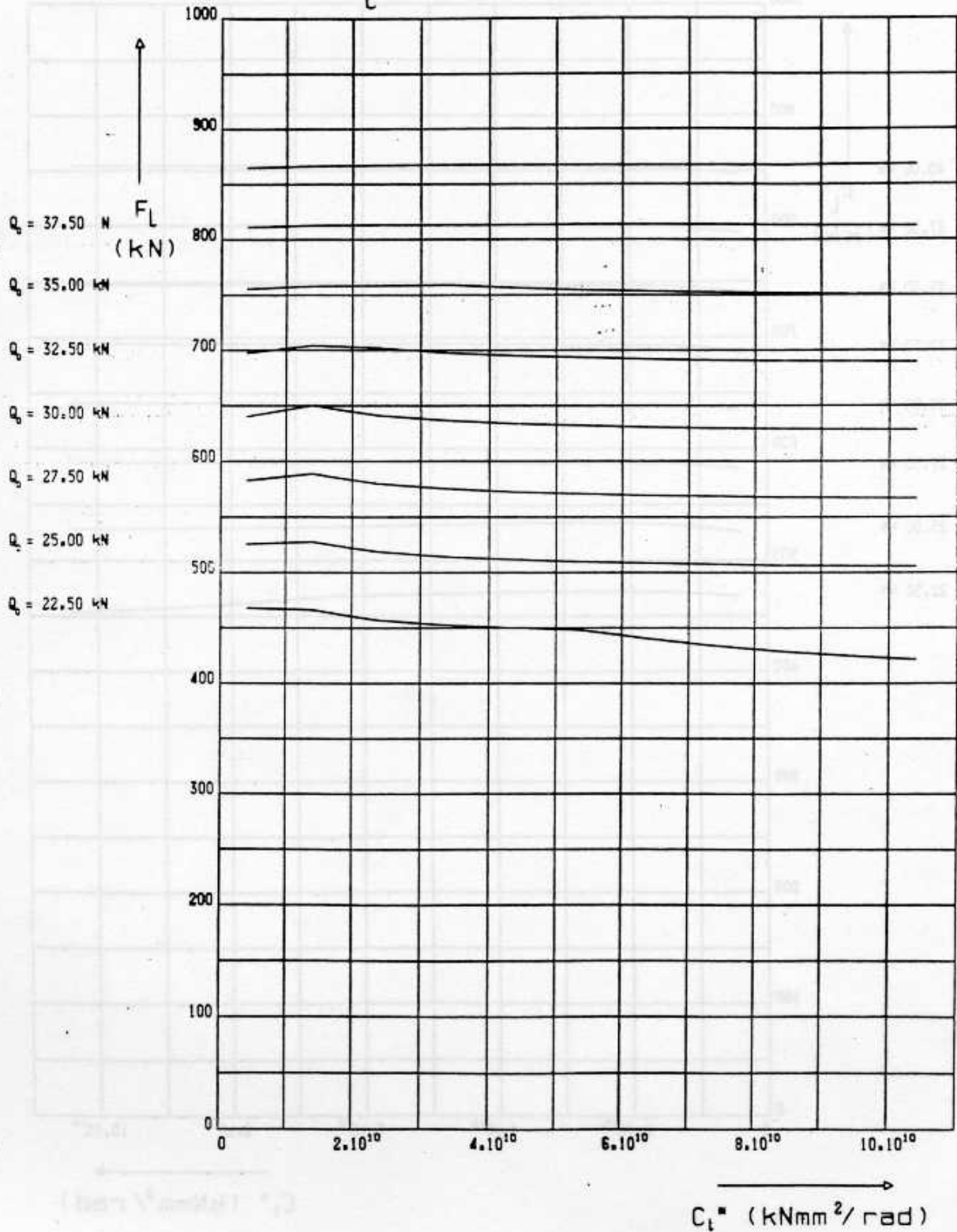
- $= 11000 \text{ mm}$
- $2a^* = 7000 \text{ mm}$
- $\Delta q_0 = 0.15$
- $c_{z1} = 0.55 \text{ kN/mm}$
- $c_{z2} = 1.69 \text{ kN/mm}$
- $F_{cz} = 37.9 \text{ kN}$
- $z_c = 69.8 \text{ mm}$

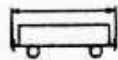


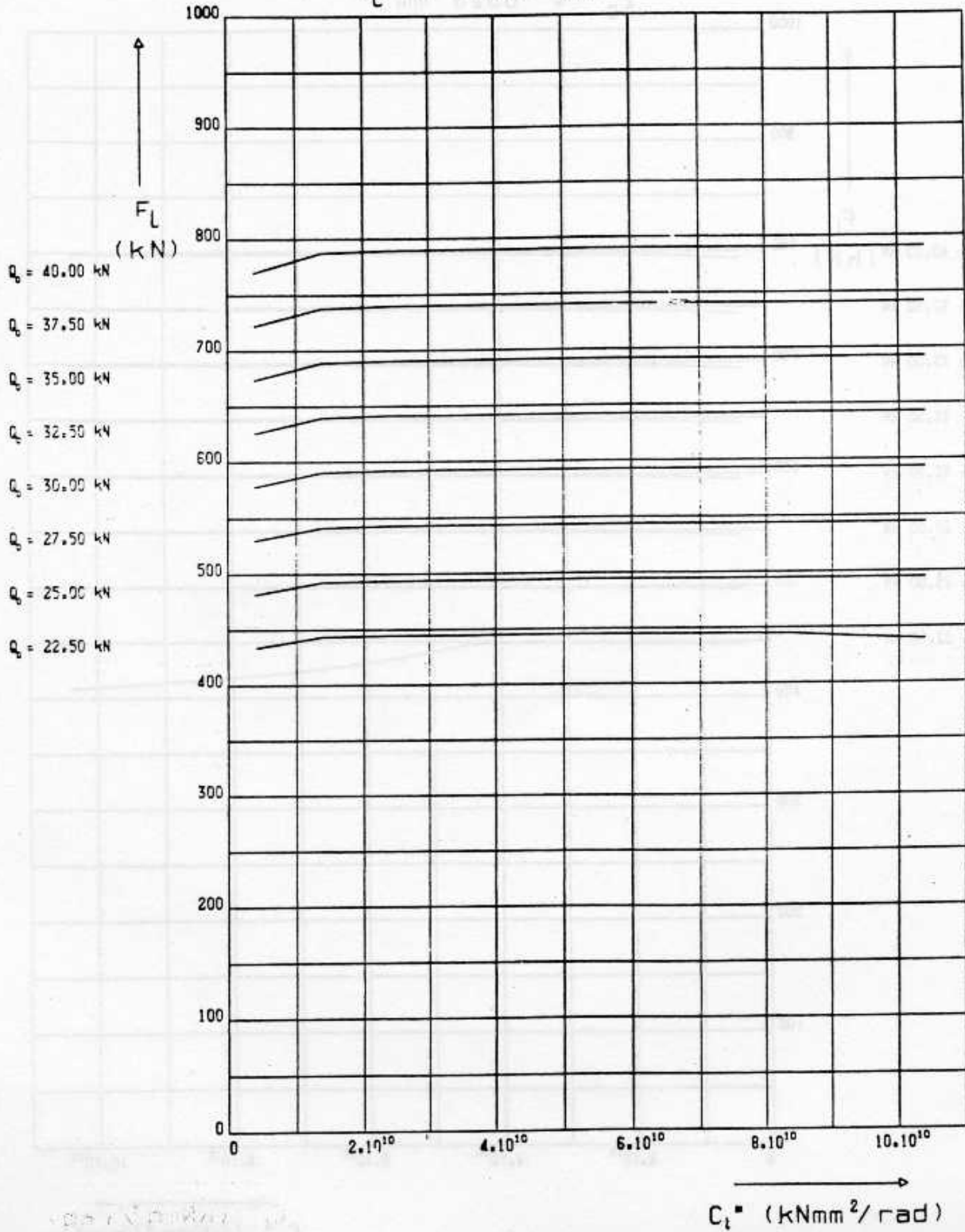
$$\begin{aligned}
 \text{[Diagram]} &= 12000 \text{ mm} \\
 2a^* &= 7000 \text{ mm} \\
 \Delta q_0 &= 0.15 \\
 c_{z1} &= 0.55 \text{ kN/mm} \\
 c_{z2} &= 1.69 \text{ kN/mm} \\
 F_{cz} &= 37.9 \text{ kN} \\
 z_c &= 69.8 \text{ mm}
 \end{aligned}$$

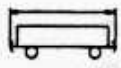


 = 12000. mm  
 $2a^* = 8000. \text{ mm}$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.55 \text{ kN/mm}$   
 $c_{z2} = 1.69 \text{ kN/mm}$   
 $F_{cz} = 37.9 \text{ kN}$   
 $z_c = 69.8 \text{ mm}$

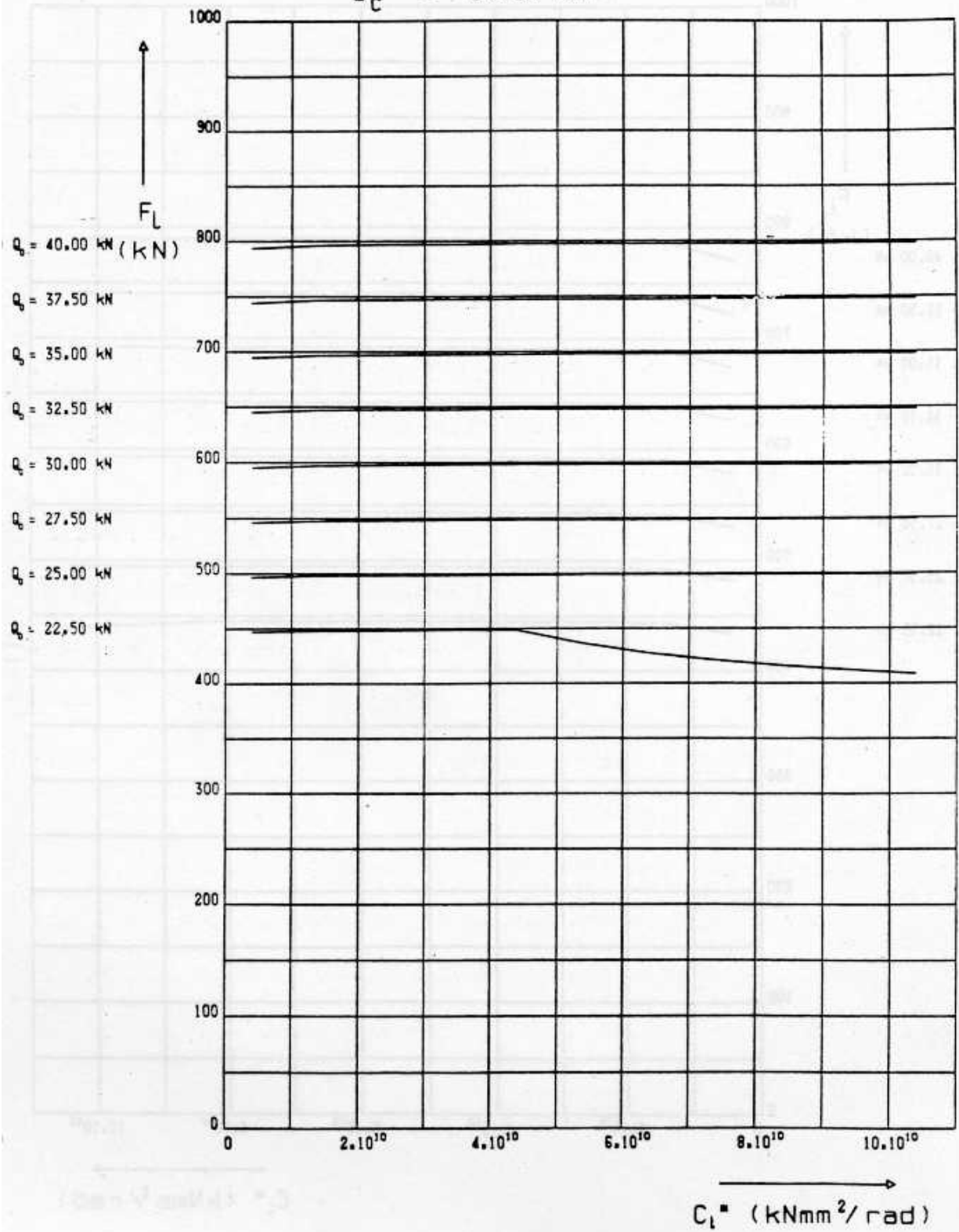


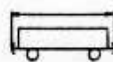
 = 13000. mm  
 $2a^* = 7000. \text{ mm}$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.55 \text{ kN/mm}$   
 $c_{z2} = 1.69 \text{ kN/mm}$   
 $F_{cz} = 37.9 \text{ kN}$   
 $z_c = 69.8 \text{ mm}$

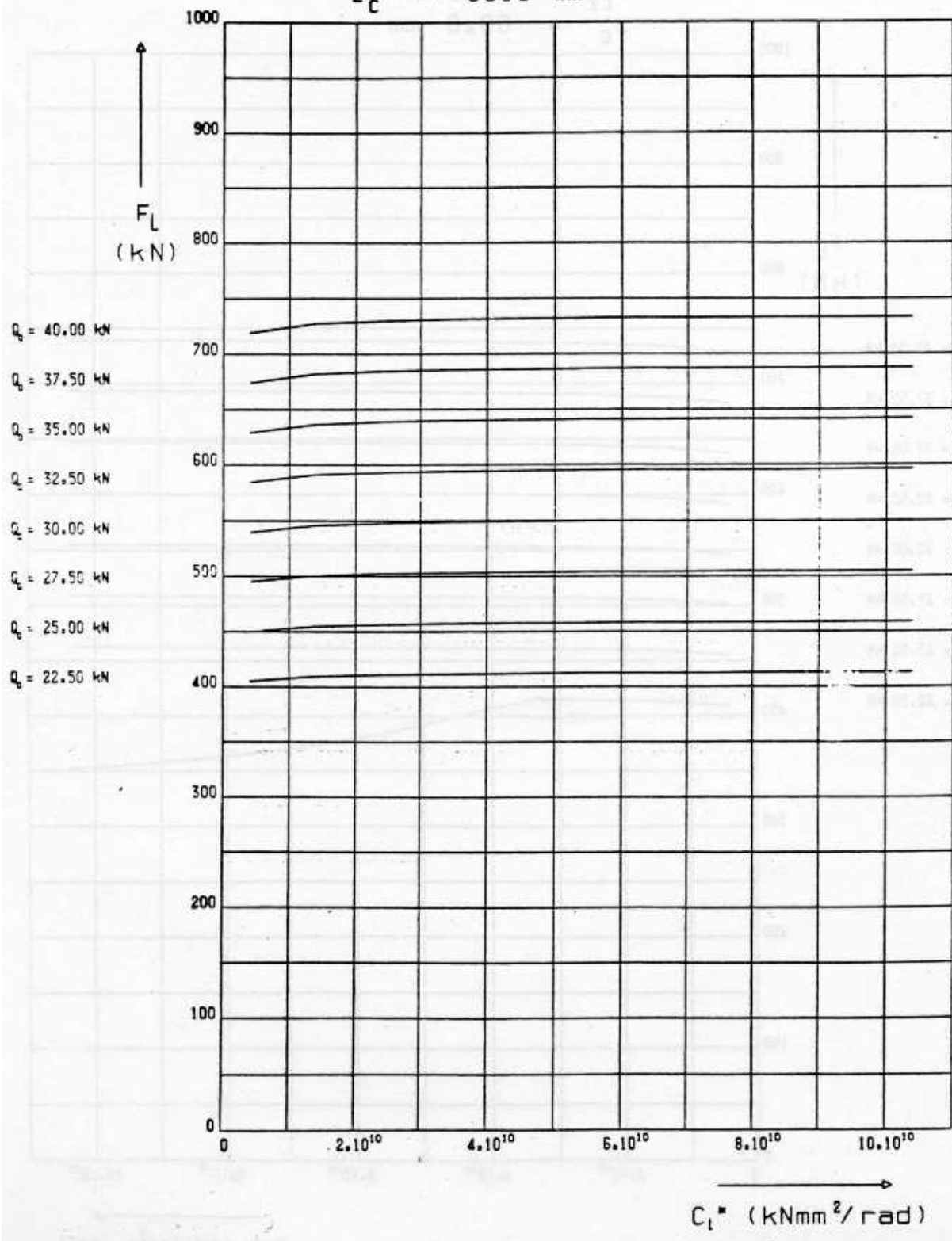


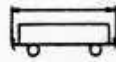


- $= 13000.0 \text{ mm}$
- $2a^* = 8000.0 \text{ mm}$
- $\Delta q_0 = 0.15$
- $c_{z1} = 0.55 \text{ kN/mm}$
- $c_{z2} = 1.69 \text{ kN/mm}$
- $F_{cz} = 37.9 \text{ kN}$
- $z_c = 69.8 \text{ mm}$




 $h = 14000 \text{ mm}$   
 $2a^* = 8000 \text{ mm}$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.55 \text{ kN/mm}$   
 $c_{z2} = 1.69 \text{ kN/mm}$   
 $F_{cz} = 37.9 \text{ kN}$   
 $z_c = 69.8 \text{ mm}$





$$L = 14000 \text{ mm}$$

$$2a^* = 9000 \text{ mm}$$

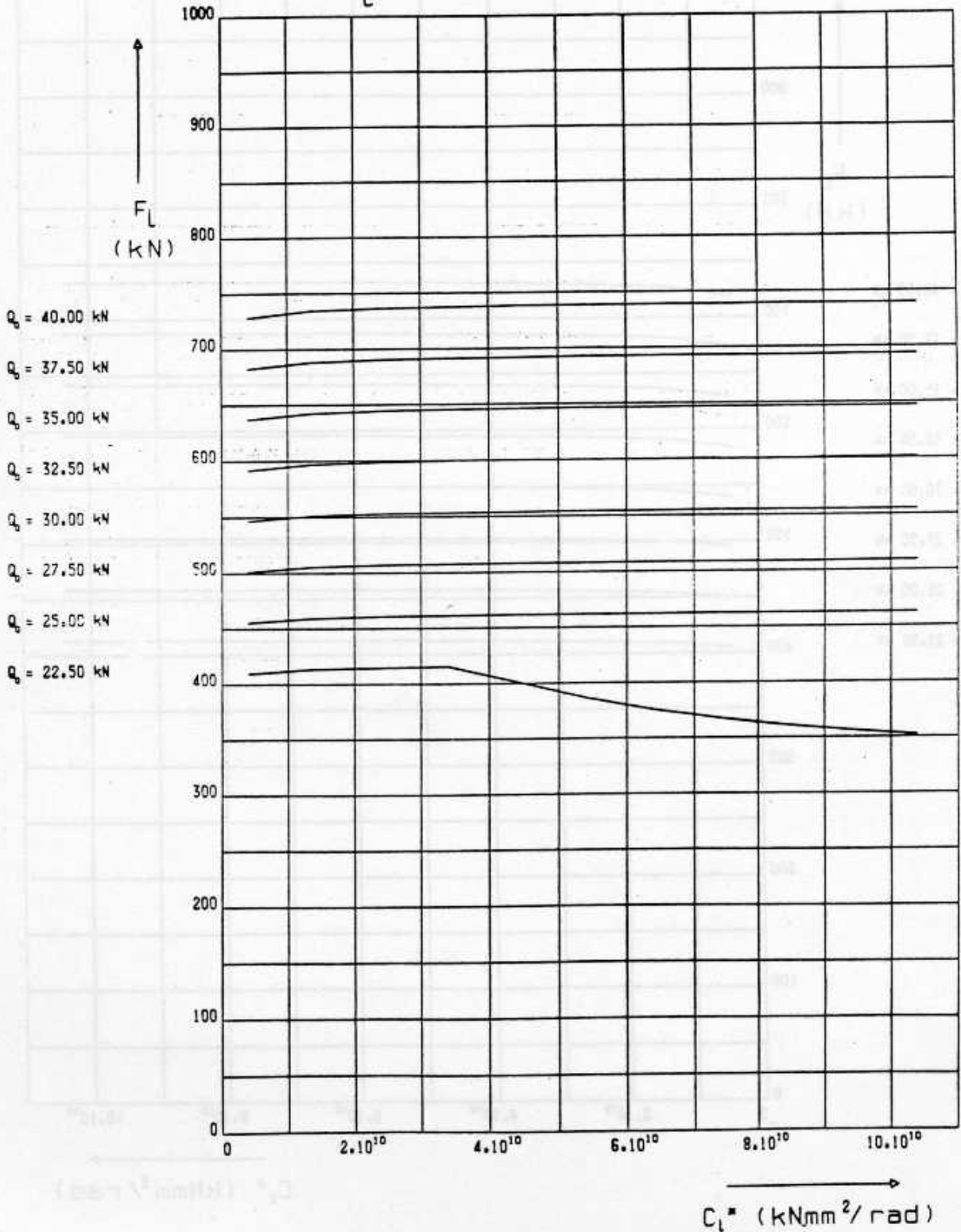
$$\Delta q_0 = 0.15$$

$$c_{z1} = 0.55 \text{ kN/mm}$$

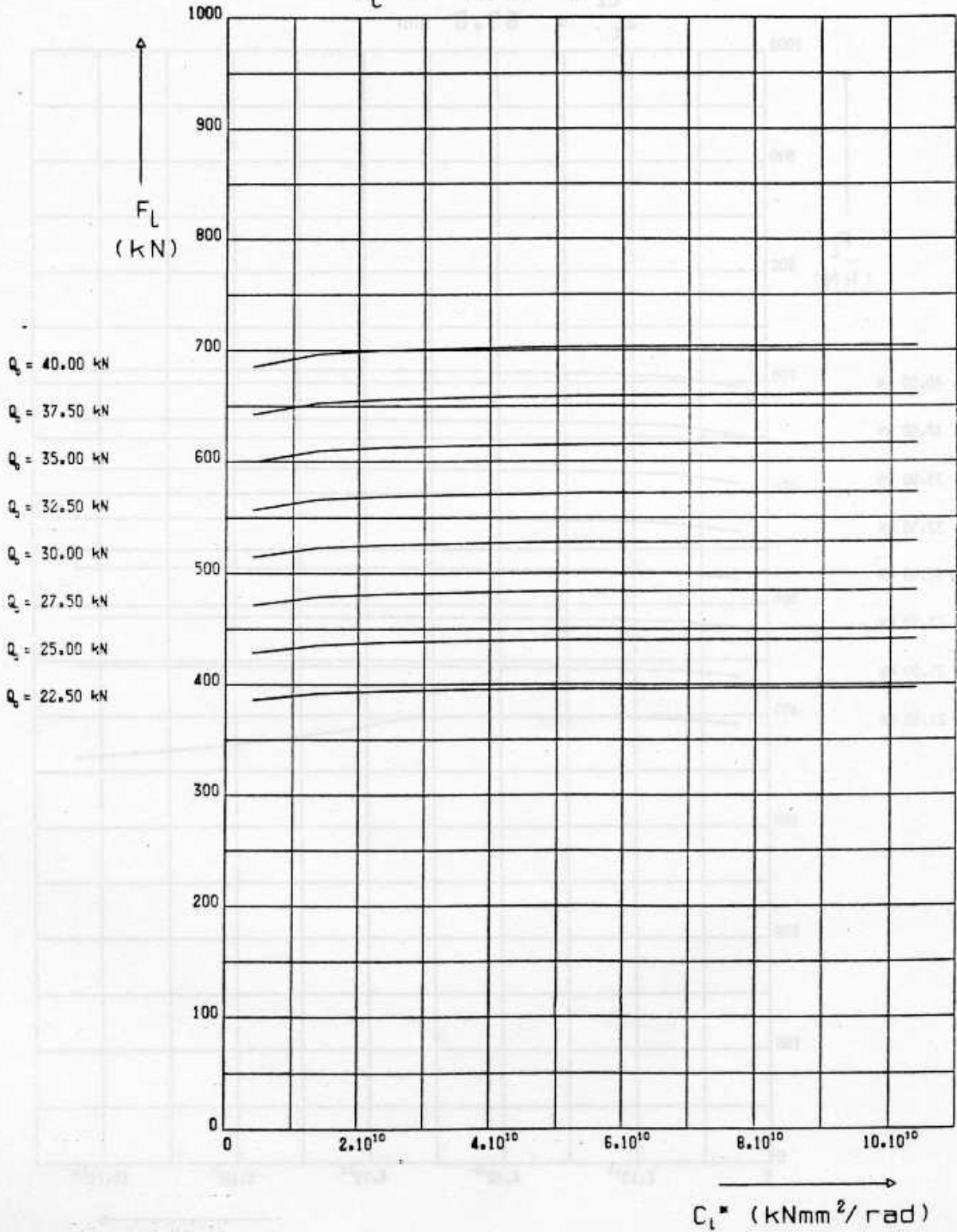
$$c_{z2} = 1.69 \text{ kN/mm}$$

$$F_{cz} = 37.9 \text{ kN}$$

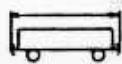
$$z_c = 69.8 \text{ mm}$$



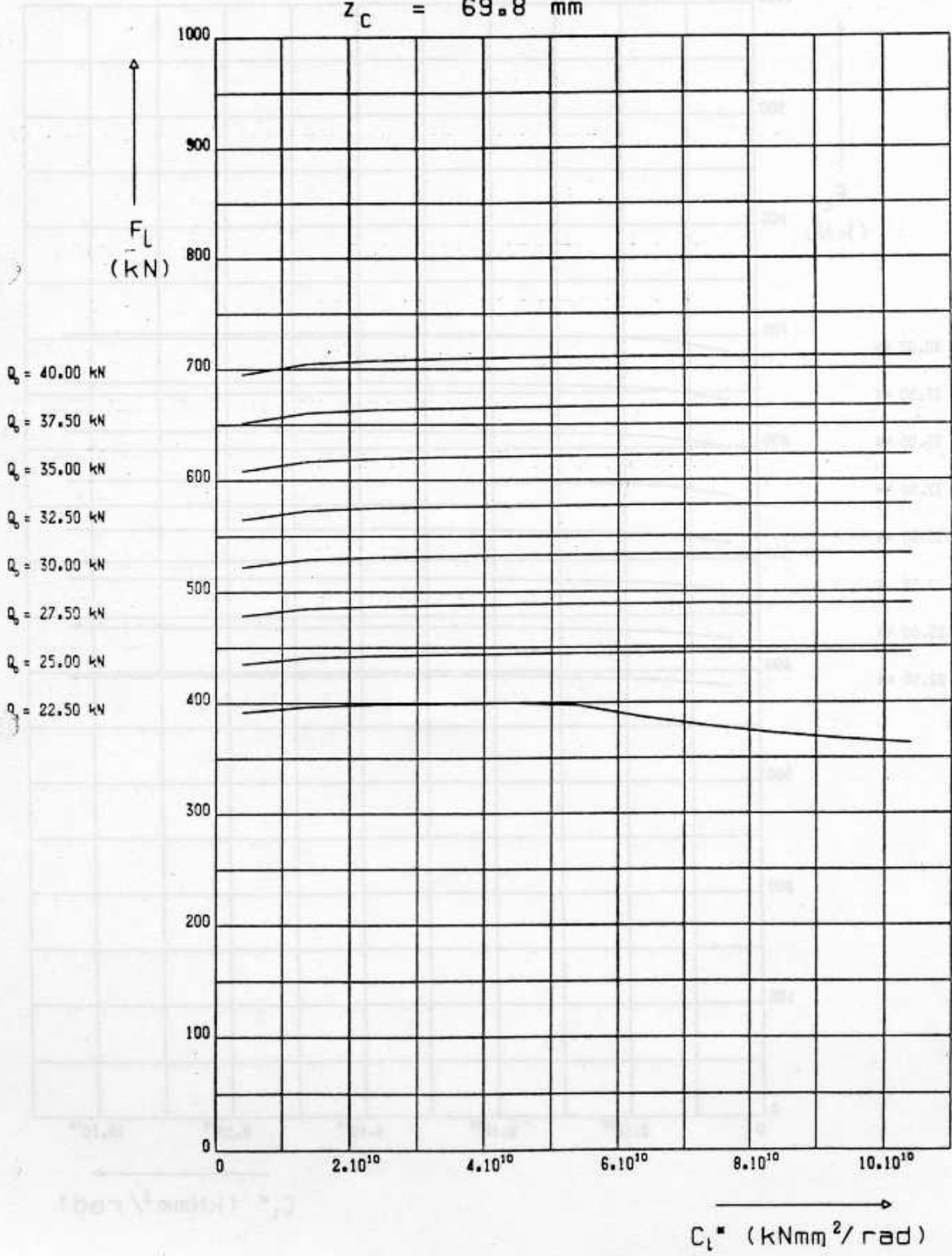
$$\begin{aligned}
 & \text{Diagram} = 14500 \text{ mm} \\
 & 2a^* = 8000 \text{ mm} \\
 & \Delta q_0 = 0.15 \\
 & c_{z1} = 0.55 \text{ kN/mm} \\
 & c_{z2} = 1.69 \text{ kN/mm} \\
 & F_{CZ} = 37.9 \text{ kN} \\
 & z_C = 69.8 \text{ mm}
 \end{aligned}$$



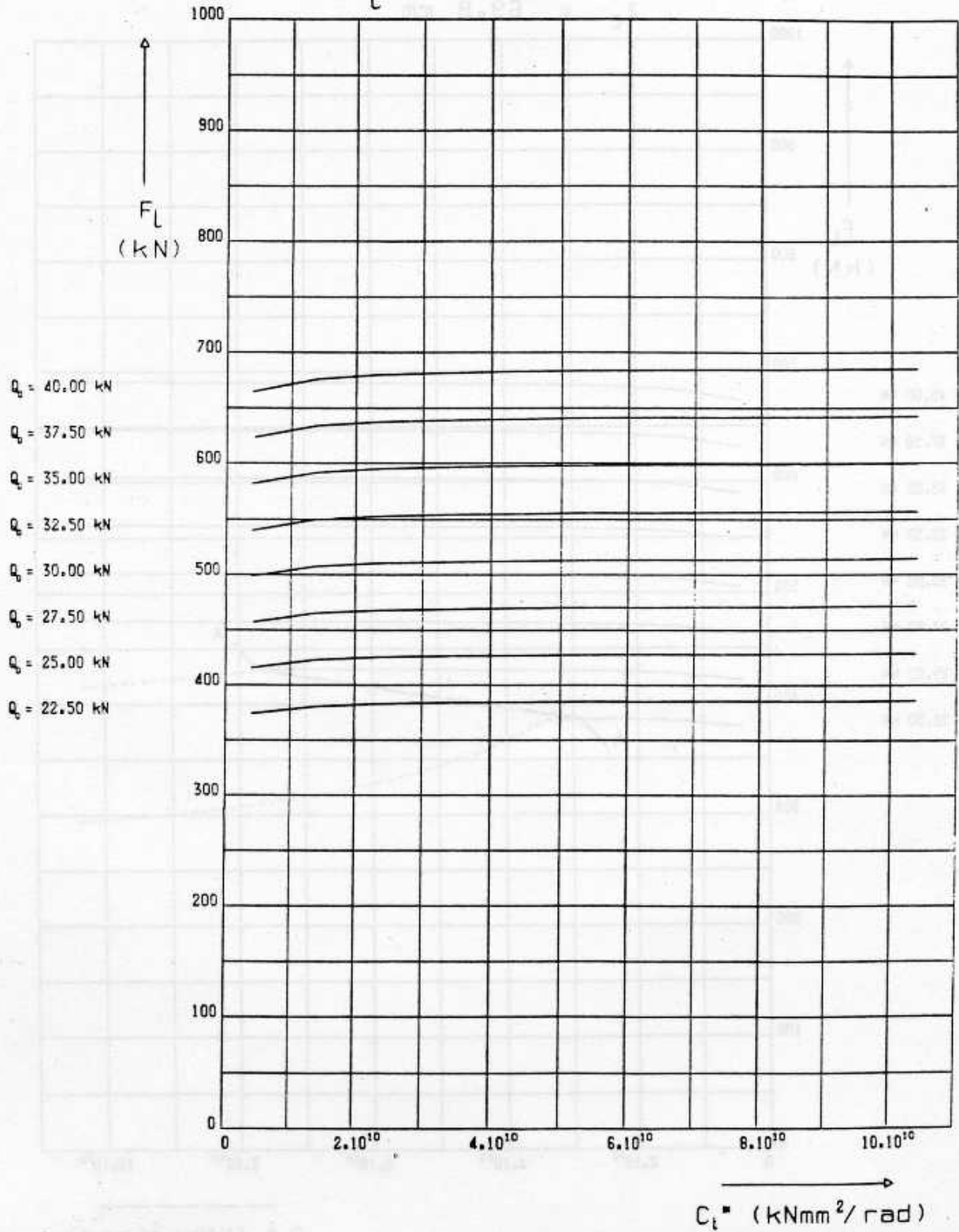


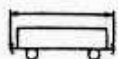


- $= 14500. \text{ mm}$
- $2a^* = 9000. \text{ mm}$
- $\Delta q_0 = 0.15$
- $c_{z1} = 0.55 \text{ kN/mm}$
- $c_{z2} = 1.69 \text{ kN/mm}$
- $F_{cz} = 37.9 \text{ kN}$
- $z_c = 69.8 \text{ mm}$



$$\begin{aligned}
 \text{---} &= 15000. \text{ mm} \\
 2a^* &= 9000. \text{ mm} \\
 \Delta q_0 &= 0.15 \\
 c_{z1} &= 0.55 \text{ kN/mm} \\
 c_{z2} &= 1.69 \text{ kN/mm} \\
 F_{cz} &= 37.9 \text{ kN} \\
 z_c &= 69.8 \text{ mm}
 \end{aligned}$$





$$= 15000. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

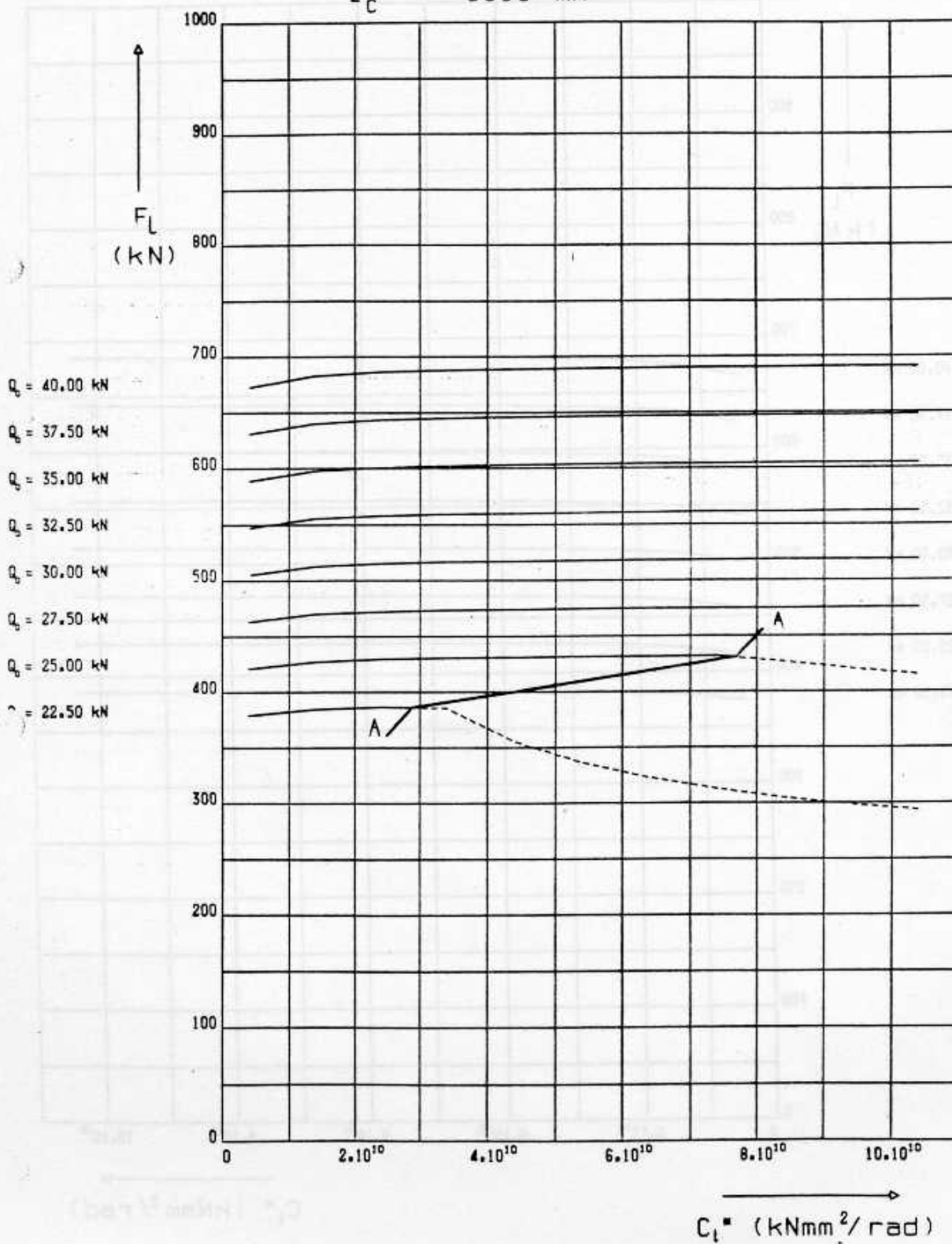
$$\Delta q_0 = 0.15$$

$$c_{z1} = 0.55 \text{ kN/mm}$$

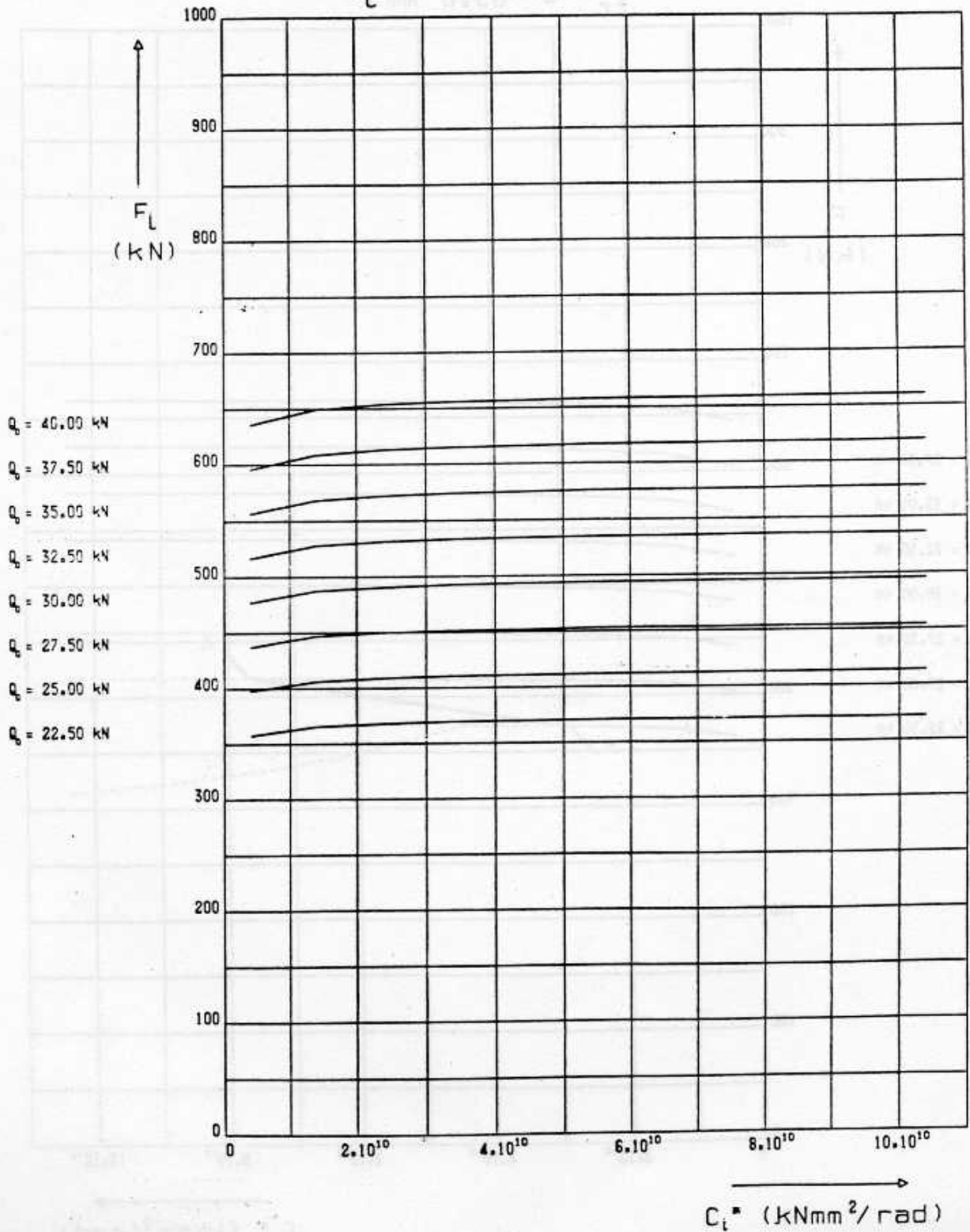
$$c_{z2} = 1.69 \text{ kN/mm}$$

$$F_{cz} = 37.9 \text{ kN}$$

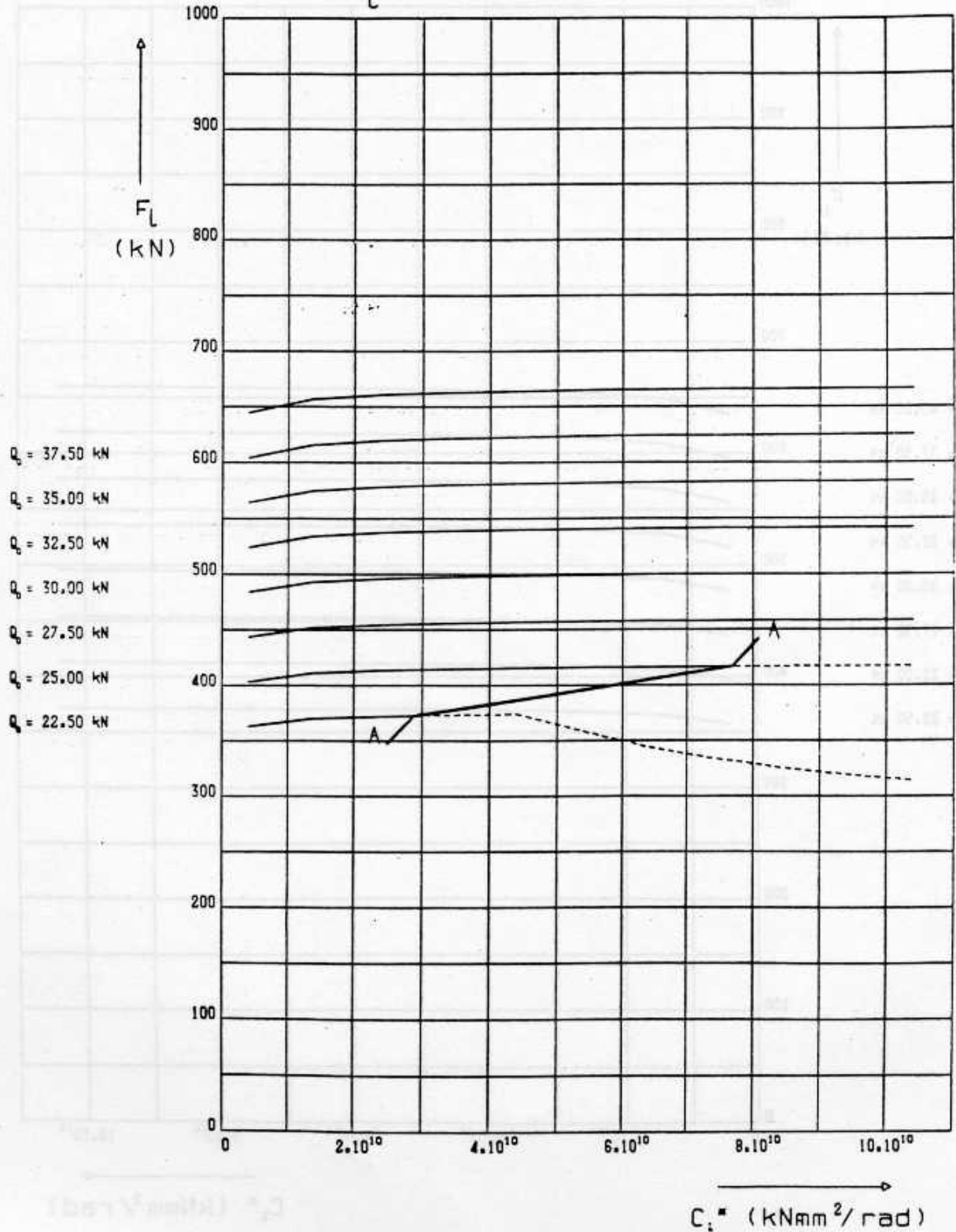
$$z_c = 69.8 \text{ mm}$$

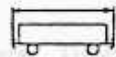


$$\begin{aligned}
 & \text{Diagram} = 15500. \text{ mm} \\
 & 2a^* = 9000. \text{ mm} \\
 & \Delta q_0 = 0.15 \\
 & c_{z1} = 0.55 \text{ kN/mm} \\
 & c_{z2} = 1.69 \text{ kN/mm} \\
 & F_{cz} = 37.9 \text{ kN} \\
 & z_c = 69.8 \text{ mm}
 \end{aligned}$$



$$\begin{aligned}
 & \text{[Diagram of a beam with a rectangular cross-section]} \\
 & = 15500 \text{ mm} \\
 & 2a^* = 10000 \text{ mm} \\
 & \Delta q_0 = 0.15 \\
 & c_{z1} = 0.55 \text{ kN/mm} \\
 & c_{z2} = 1.69 \text{ kN/mm} \\
 & F_{cz} = 37.9 \text{ kN} \\
 & z_c = 69.8 \text{ mm}
 \end{aligned}$$





$$= 16000. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

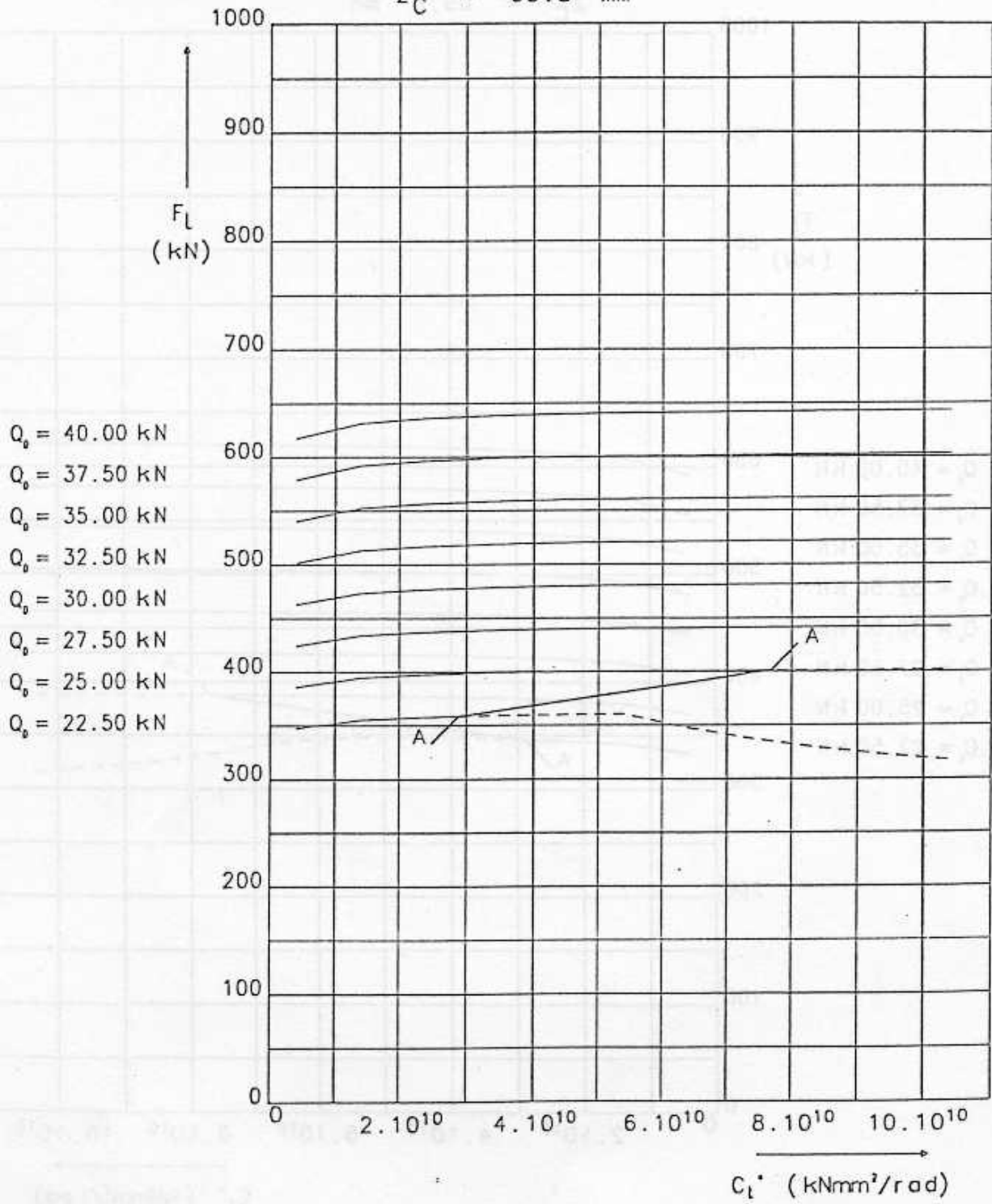
$$\Delta q_0 = 0,15$$

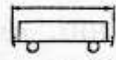
$$C_{Z1} = 0.55 \text{ kN/mm}$$

$$C_{Z2} = 1.69 \text{ kN/mm}$$

$$F_{CZ} = 37.9 \text{ kN}$$

$$Z_C = 69.8 \text{ mm}$$





$$= 16500. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

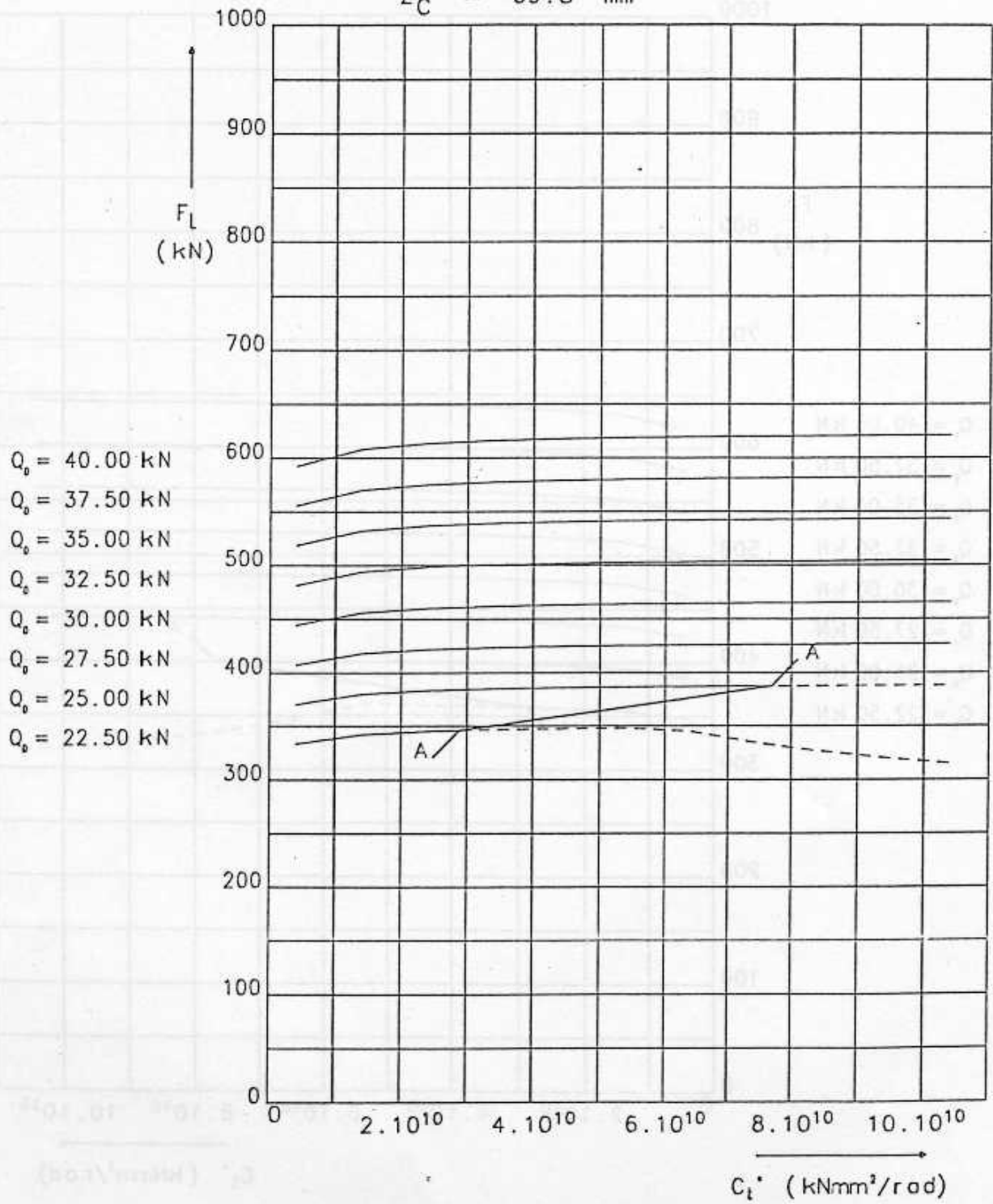
$$\Delta q_0 = 0,15$$

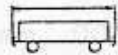
$$C_{Z1} = 0.55 \text{ kN/mm}$$

$$C_{Z2} = 1.69 \text{ kN/mm}$$

$$F_{CZ} = 37.9 \text{ kN}$$

$$Z_C = 69.8 \text{ mm}$$





$$= 17000. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

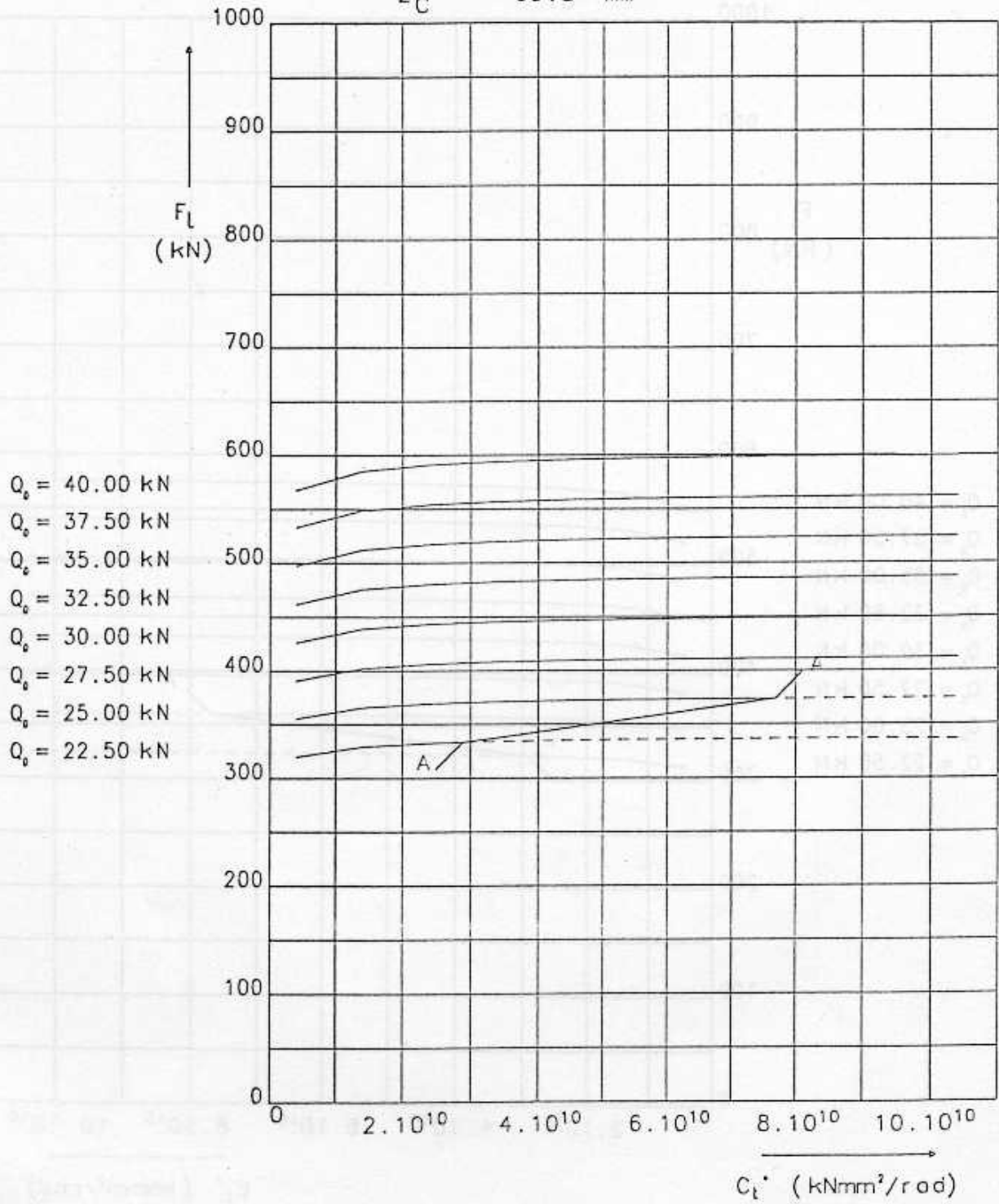
$$\Delta q_0 = 0,15$$

$$C_{Z1} = 0.55 \text{ kN / mm}$$

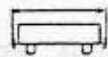
$$C_{Z2} = 1.69 \text{ kN / mm}$$

$$F_{CZ} = 37.9 \text{ kN}$$

$$Z_C = 69.8 \text{ mm}$$







$$= 17300. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

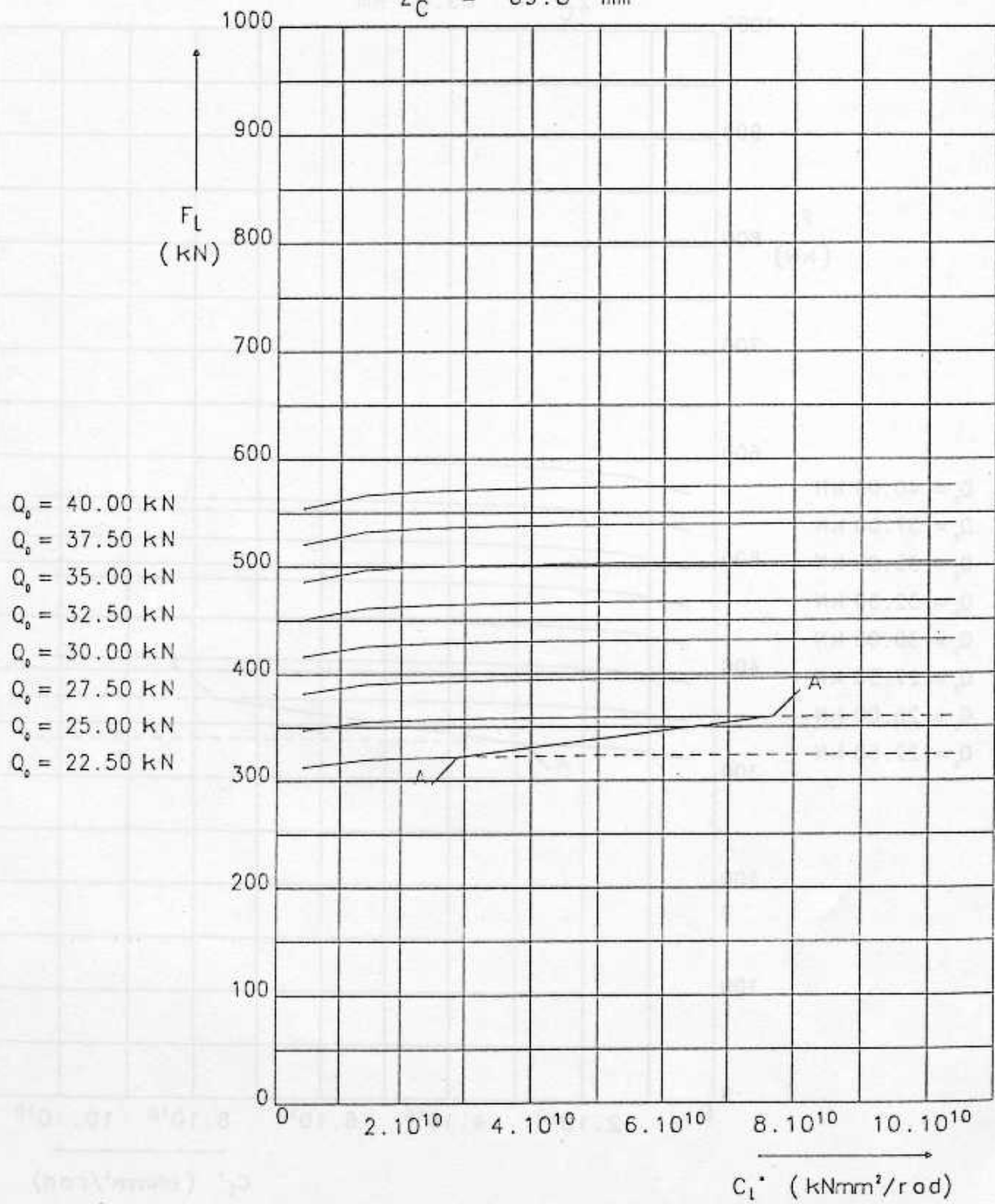
$$\Delta q_0 = 0,15$$

$$C_{Z1} = 0.55 \text{ kN/mm}$$

$$C_{Z2} = 1.69 \text{ kN/mm}$$

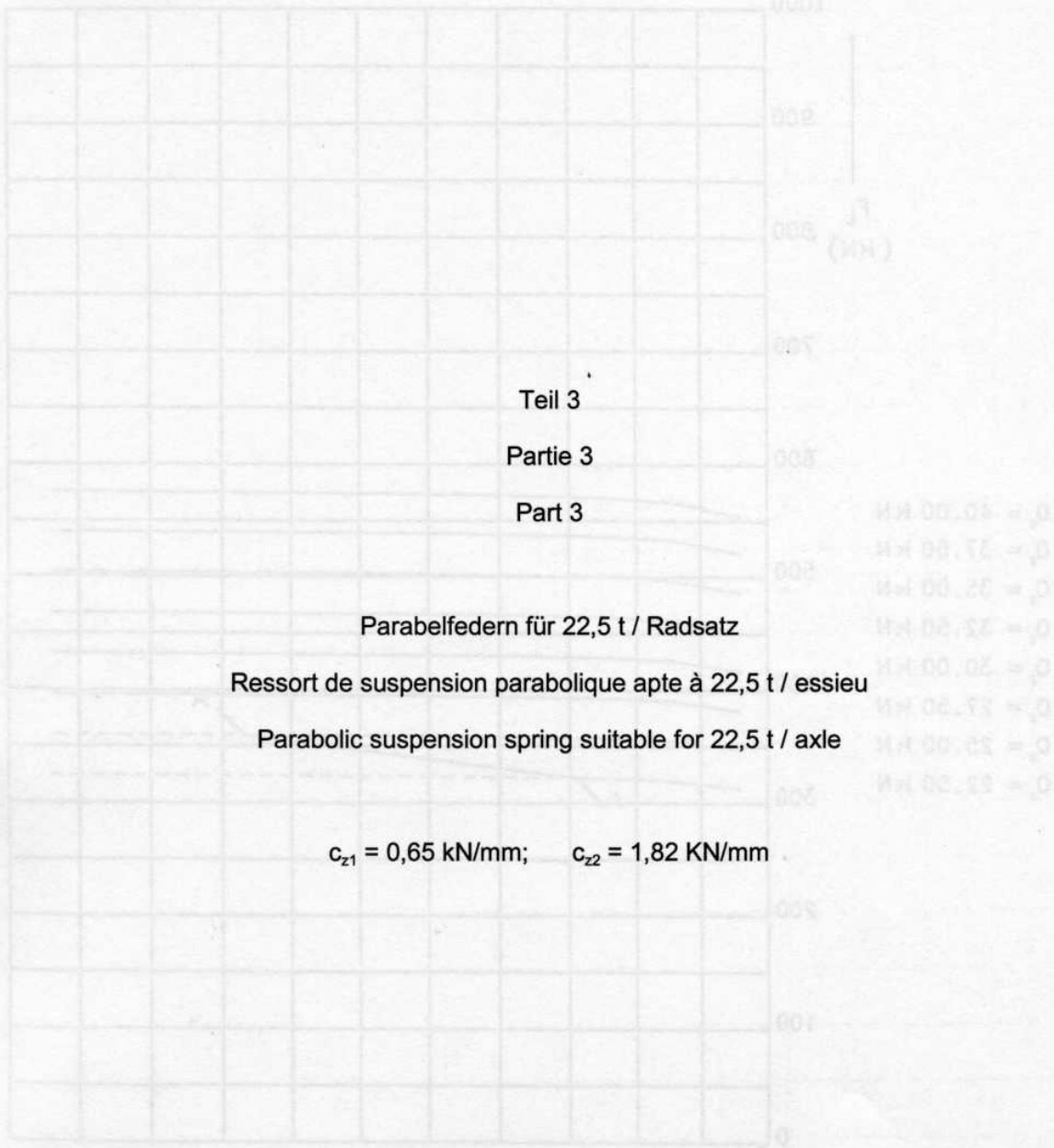
$$F_{CZ} = 37.9 \text{ kN}$$

$$Z_C = 69.8 \text{ mm}$$

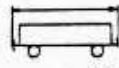


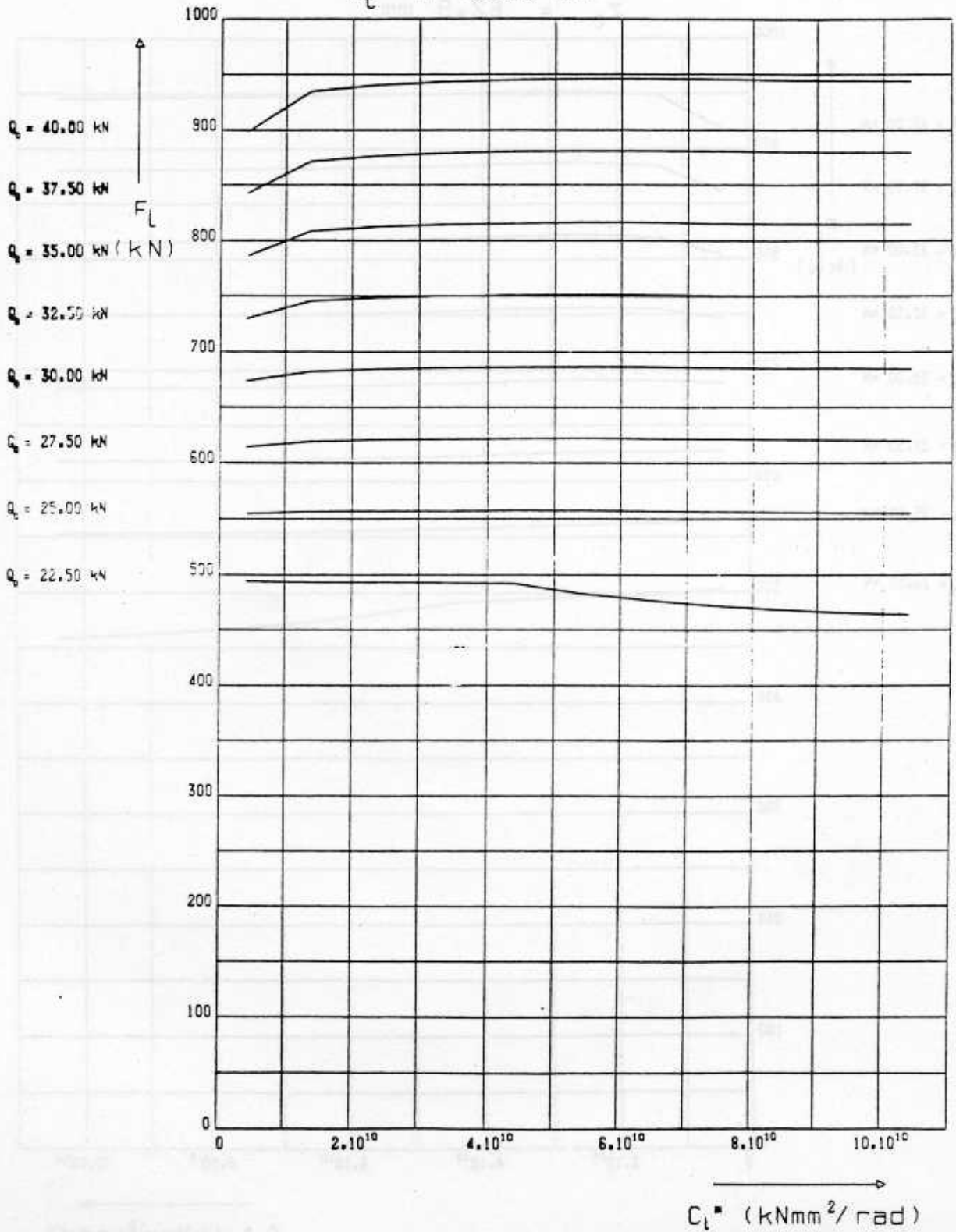


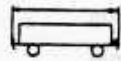
**Anlage B**  
**Annexe B**  
**Appendix B**



$$c_{z1} = 0,65 \text{ kN/mm}; \quad c_{z2} = 1,82 \text{ kN/mm}$$


 $2a^* = 9500.0 \text{ mm}$   
 $\Delta Q_0 = 5500.0 \text{ mm}$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{cz} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$





$$= 9500 \text{ mm}$$

$$2a^* = 6000 \text{ mm}$$

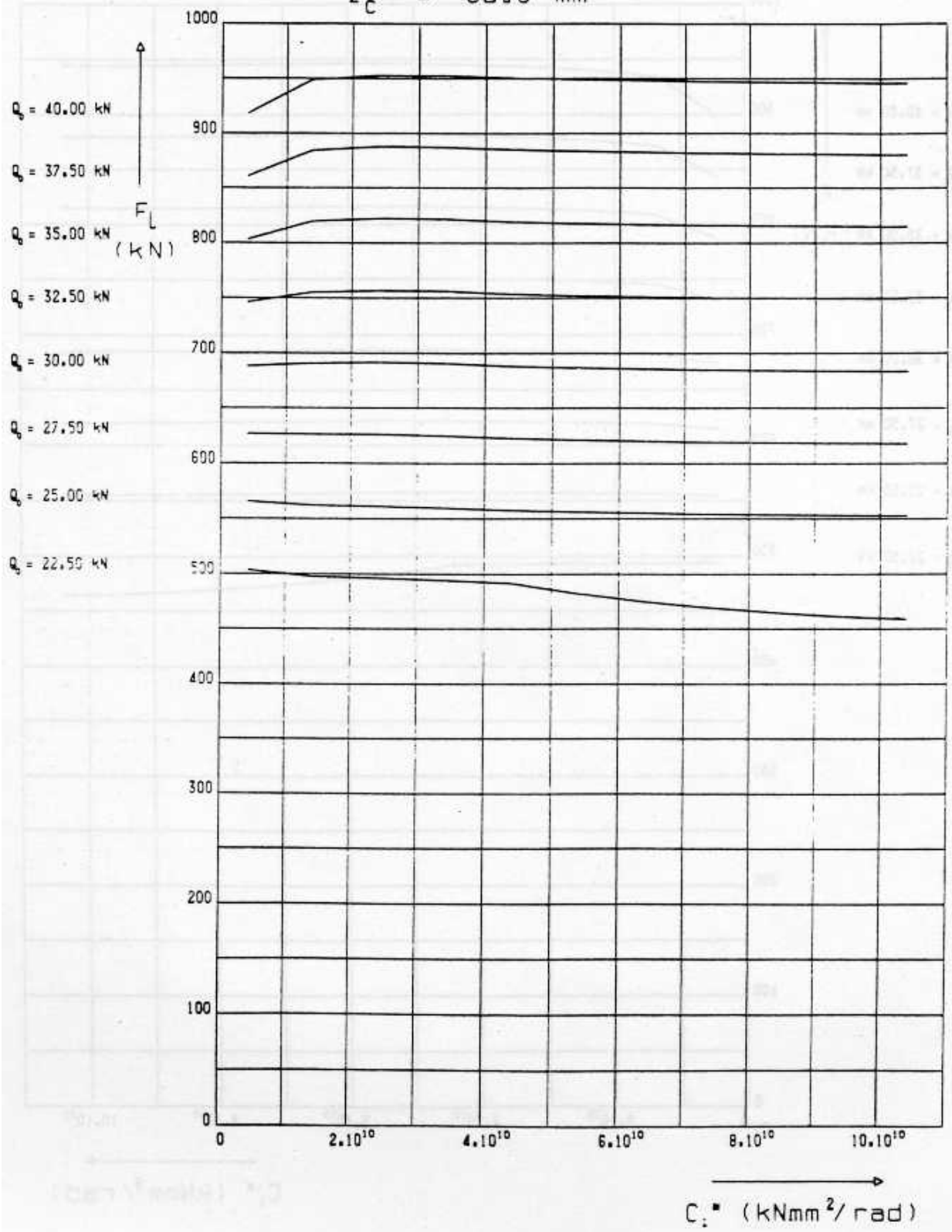
$$\Delta q_0 = 0.15$$

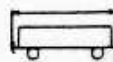
$$c_{z1} = 0.65 \text{ kN/mm}$$

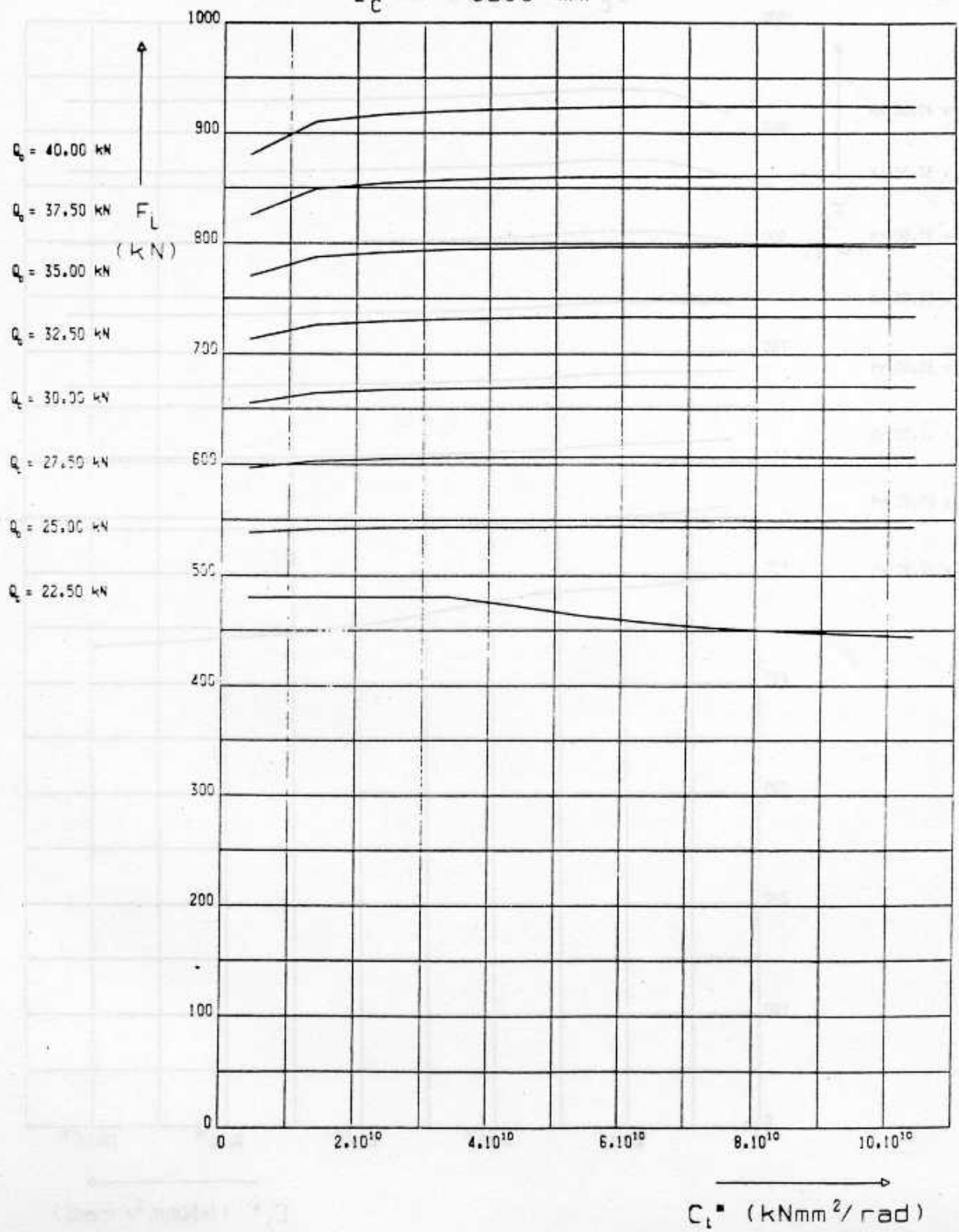
$$c_{z2} = 1.82 \text{ kN/mm}$$


$$F_{CZ} = 41.1 \text{ kN}$$

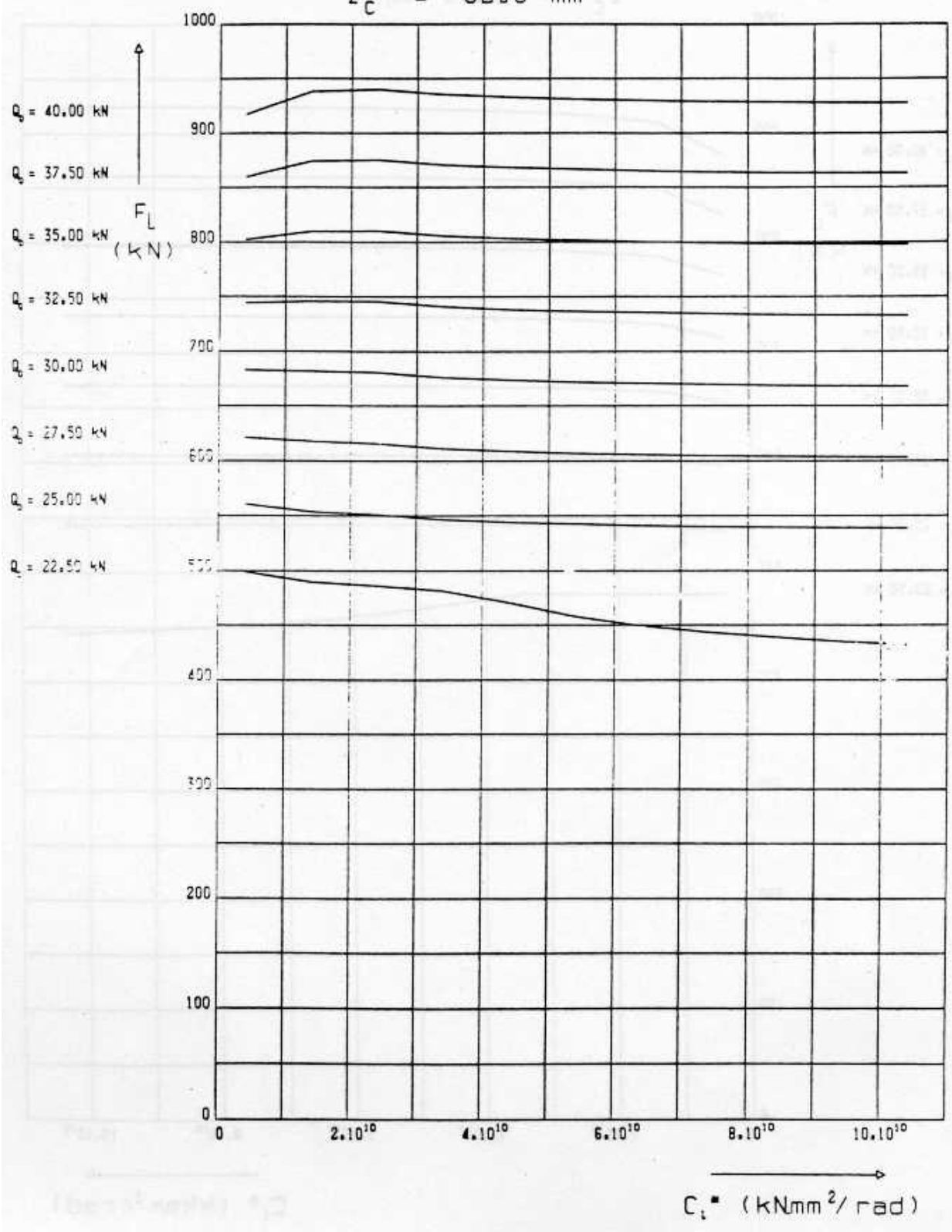
$$z_c = 62.9 \text{ mm}$$

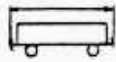


 = 10000 mm  
 $2a^* = 5500$  mm  
 $\Delta \alpha_0 = 0.15$   
 $c_{z1} = 0.65$  kN/mm  
 $c_{z2} = 1.82$  kN/mm  
 $F_{cz} = 41.1$  kN  
 $z_c = 62.9$  mm




 $= 10000. \text{ mm}$   
 $2a^* = 6500. \text{ mm}$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{CZ} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$





$$= 10500 \text{ mm}$$

$$2a^* = 5500 \text{ mm}$$

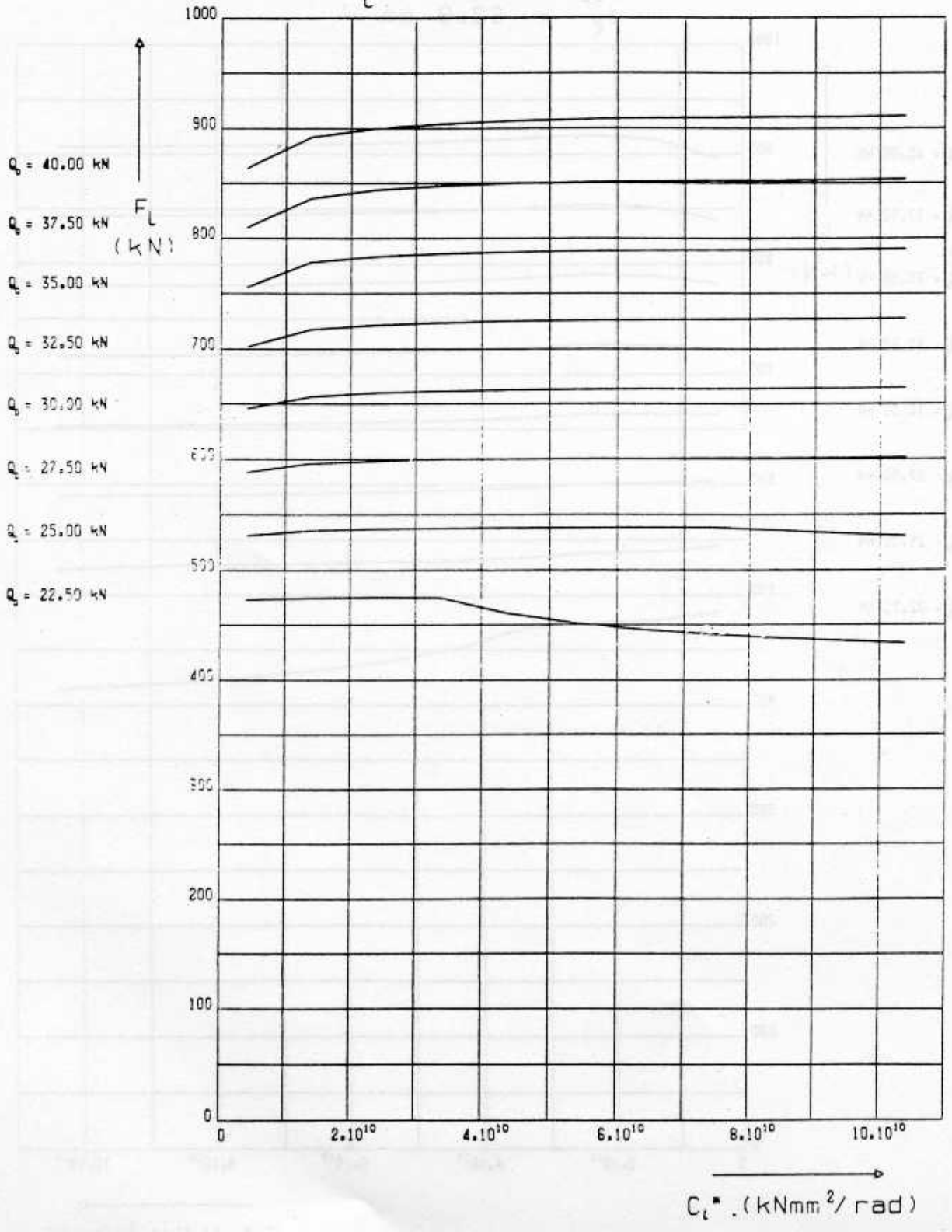
$$\Delta q_0 = 0.15$$

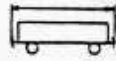
$$c_{z1} = 0.65 \text{ kN/mm}$$

$$c_{z2} = 1.82 \text{ kN/mm}$$

$$F_{cz} = 41.1 \text{ kN}$$

$$z_c = 62.9 \text{ mm}$$





$$= 10500 \text{ mm}$$

$$2a^* = 6500 \text{ mm}$$

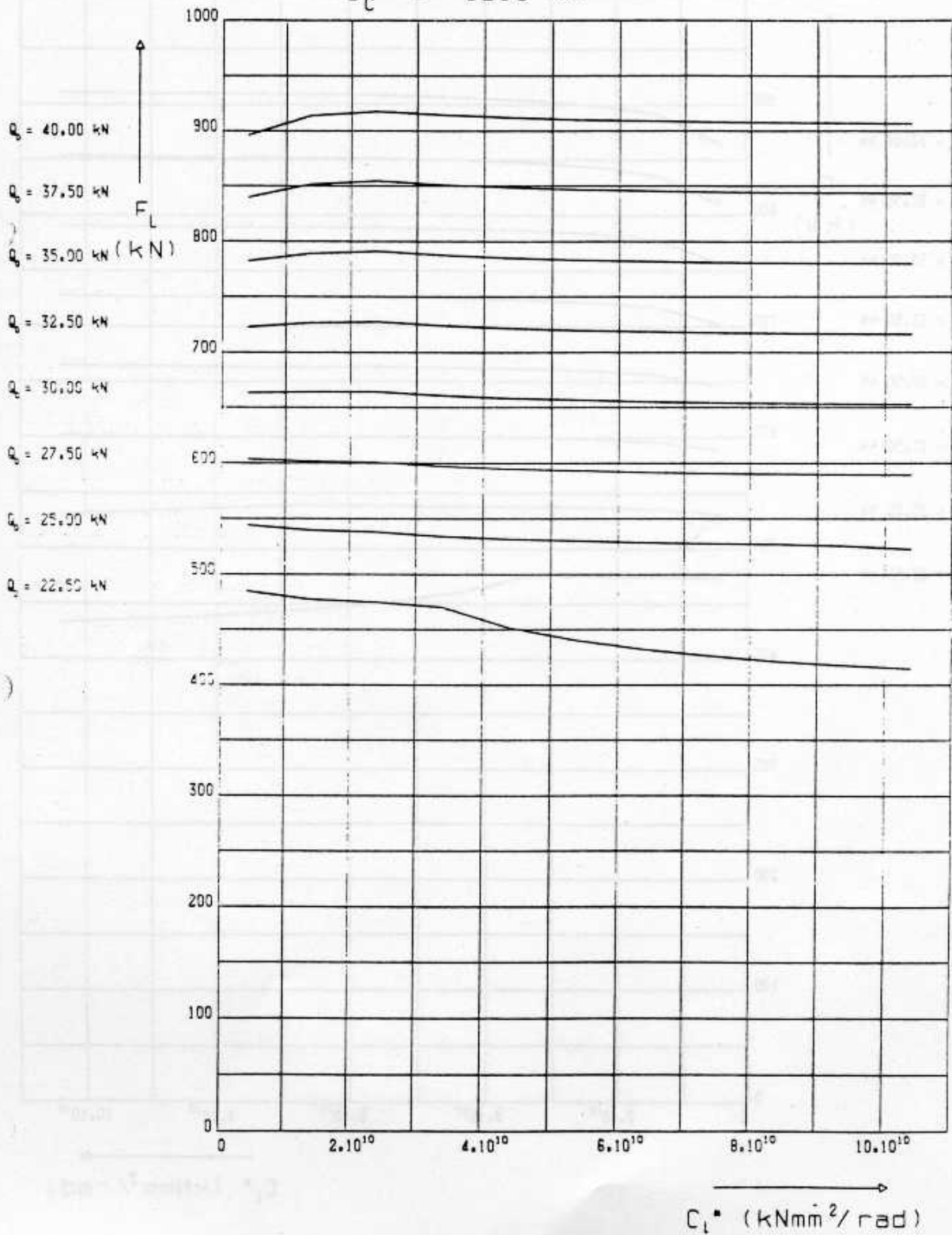
$$\Delta q_0 = 0.15$$

$$c_{z1} = 0.65 \text{ kN/mm}$$

$$c_{z2} = 1.82 \text{ kN/mm}$$

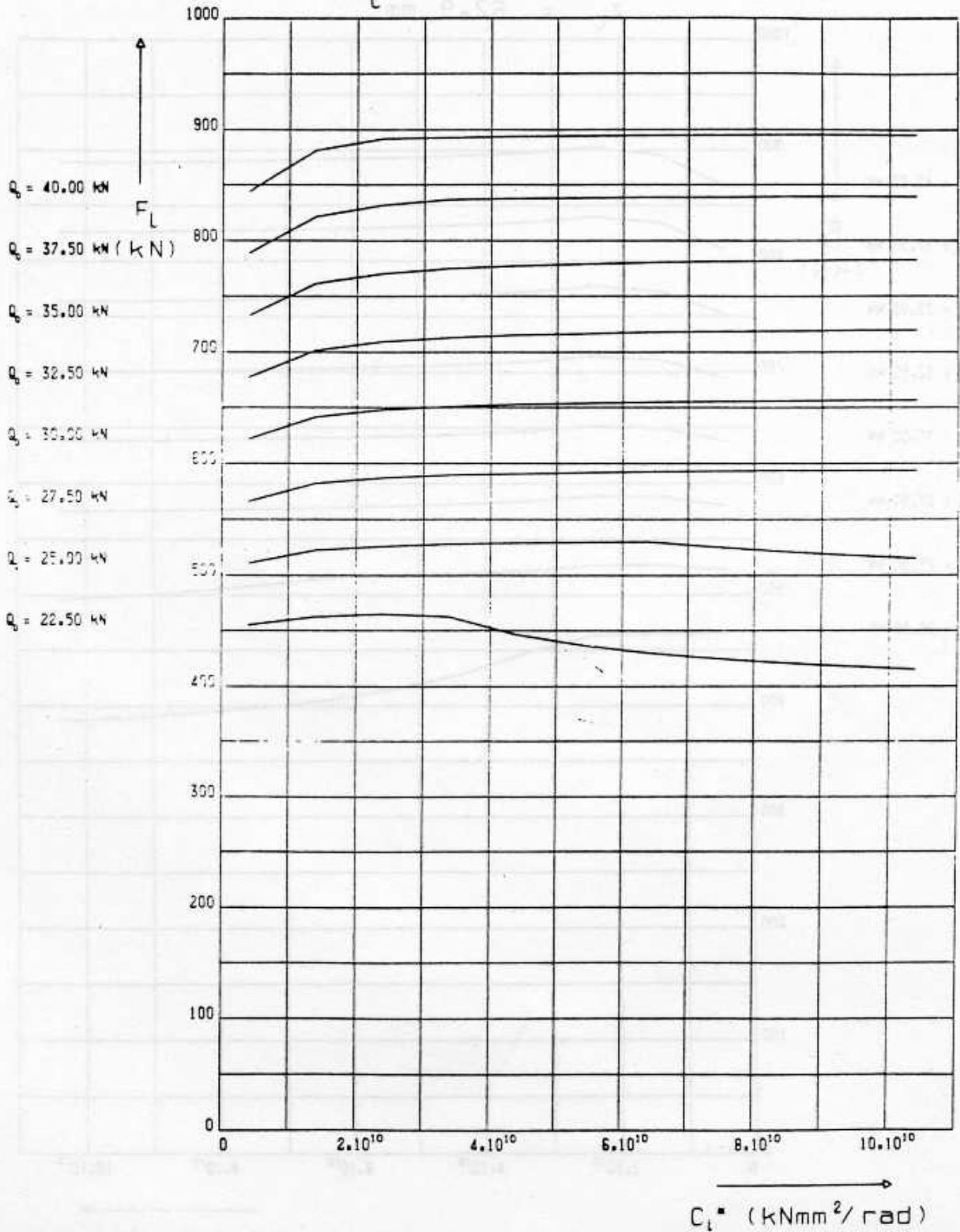
$$F_{cz} = 41.1 \text{ kN}$$

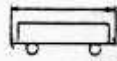
$$z_c = 62.9 \text{ mm}$$





$\square$  = 11000 mm  
 $2a^*$  = 6000 mm  
 $\Delta q_0$  = 0.15  
 $c_{z1}$  = 0.65 kN/mm  
 $c_{z2}$  = 1.82 kN/mm  
 $F_{cz}$  = 41.1 kN  
 $z_c$  = 62.9 mm





$$= 11000 \text{ mm}$$

$$2a^* = 7000 \text{ mm}$$

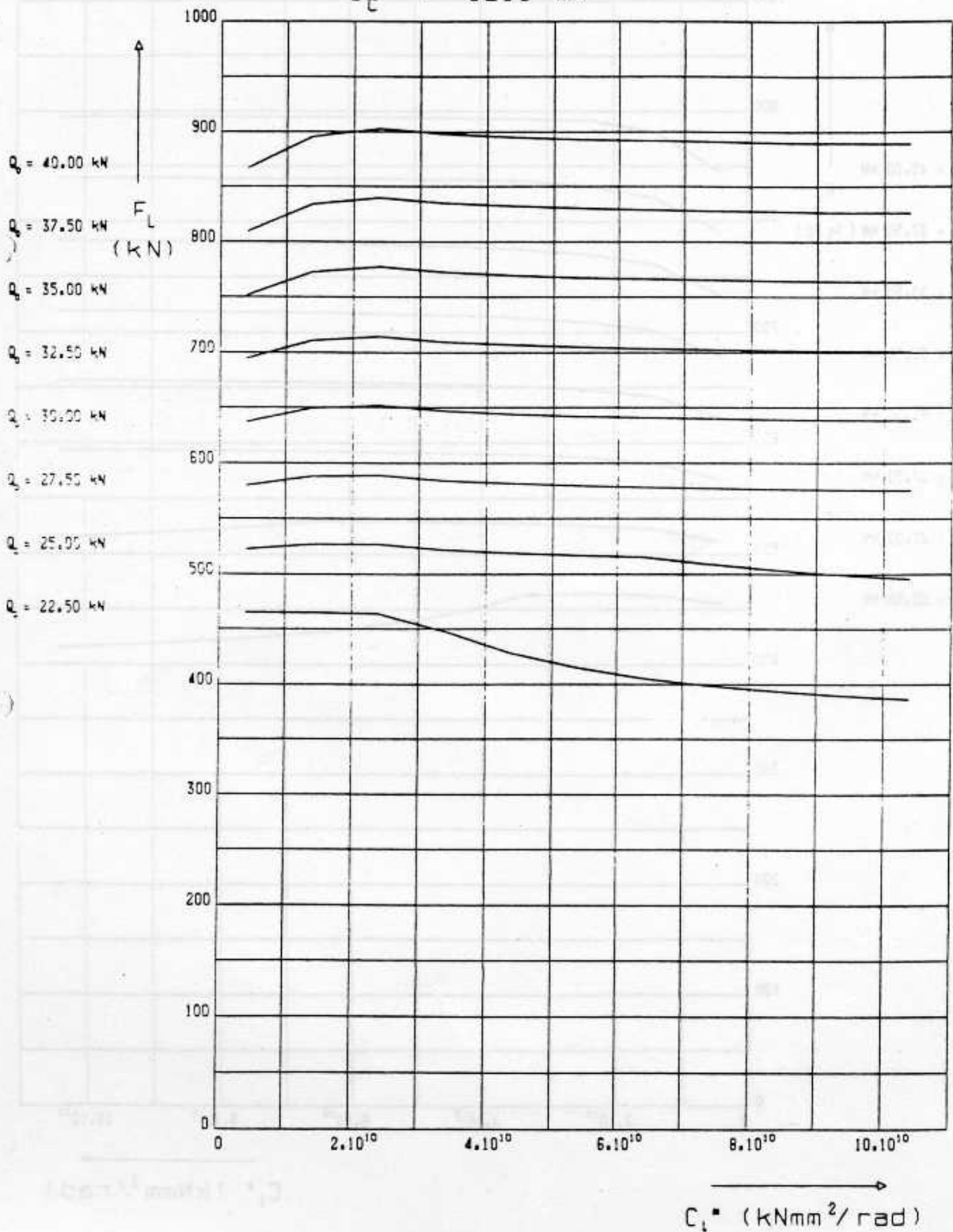
$$\Delta a_0 = 0.15$$

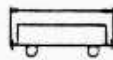
$$c_{z1} = 0.65 \text{ kN/mm}$$

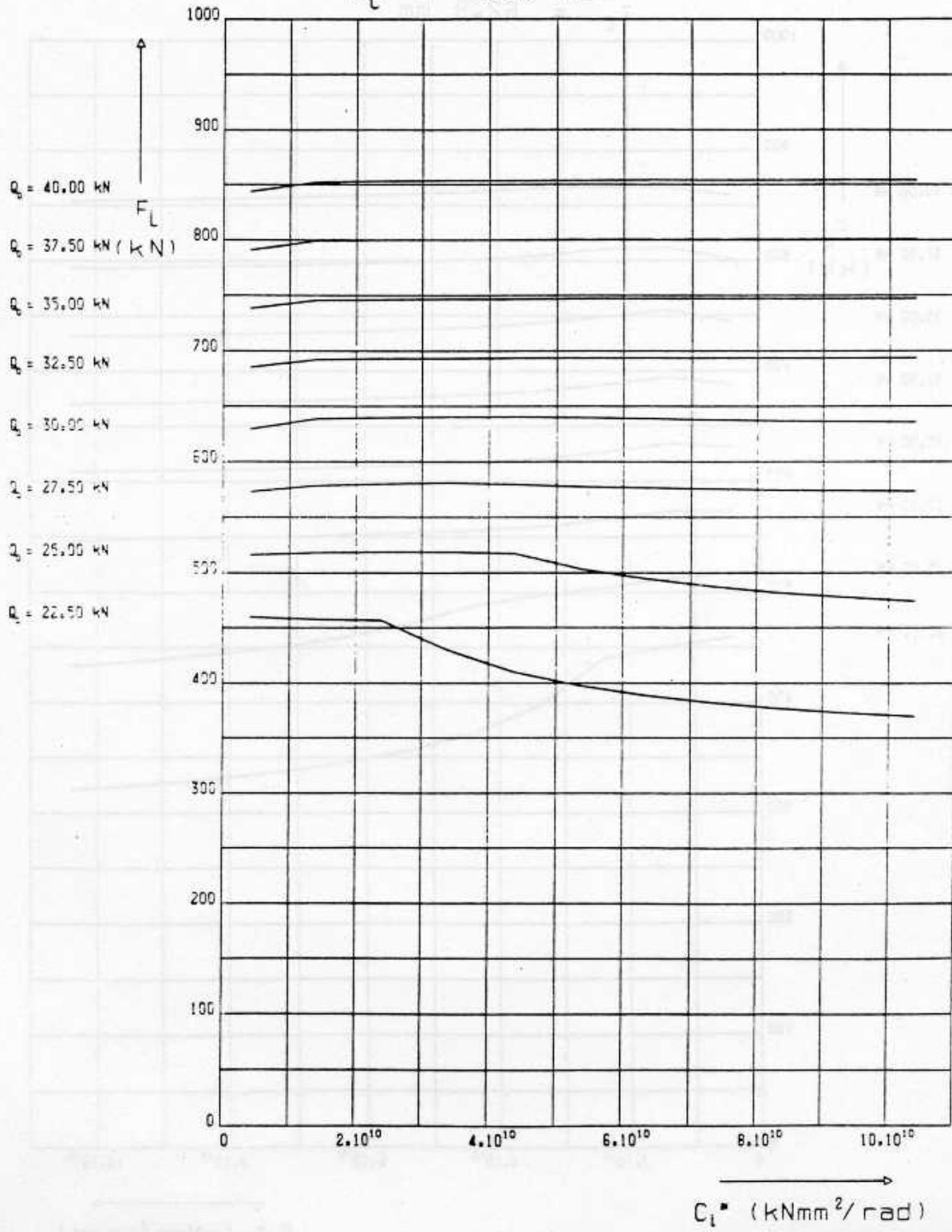
$$c_{z2} = 1.82 \text{ kN/mm}$$

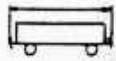
$$F_{CZ} = 41.1 \text{ kN}$$

$$z_c = 62.9 \text{ mm}$$



 = 12000. mm  
 $2a^* = 7000. mm$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{CZ} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$





$$= 12000. \text{ mm}$$

$$2a^* = 8000. \text{ mm}$$

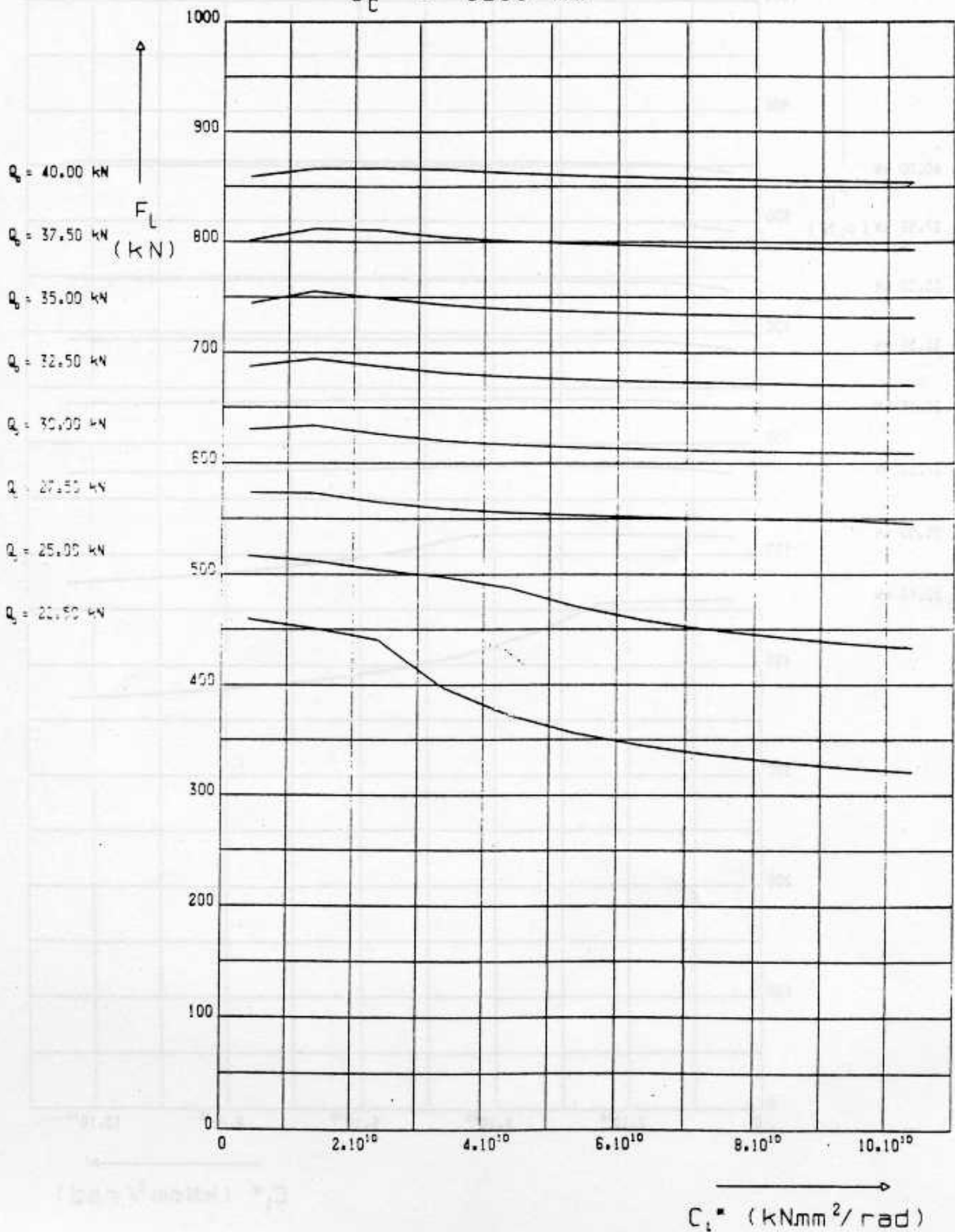
$$\Delta q_0 = 0.15$$

$$c_{z1} = 0.65 \text{ kN/mm}$$

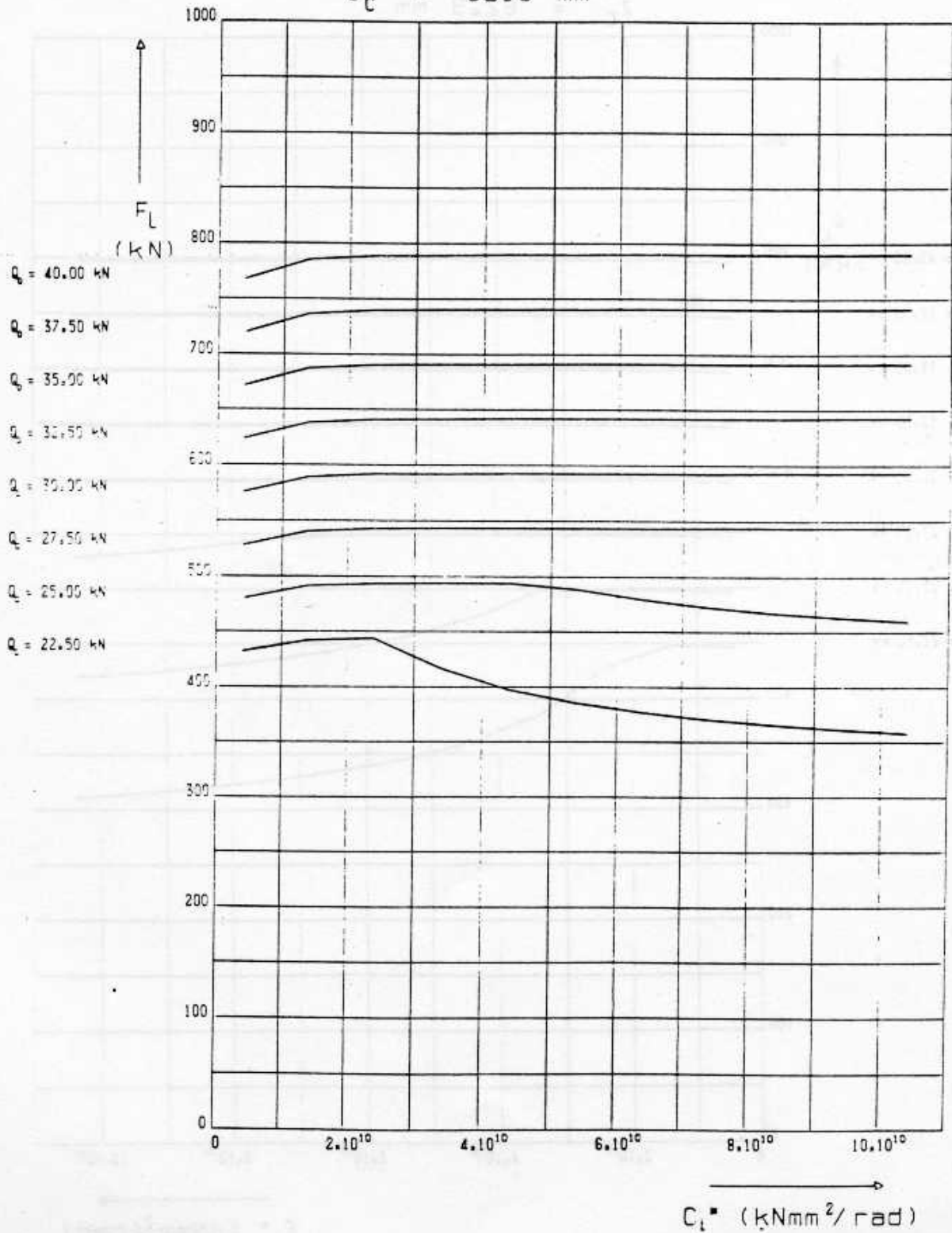
$$c_{z2} = 1.82 \text{ kN/mm}$$

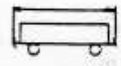
$$F_{CZ} = 41.1 \text{ kN}$$

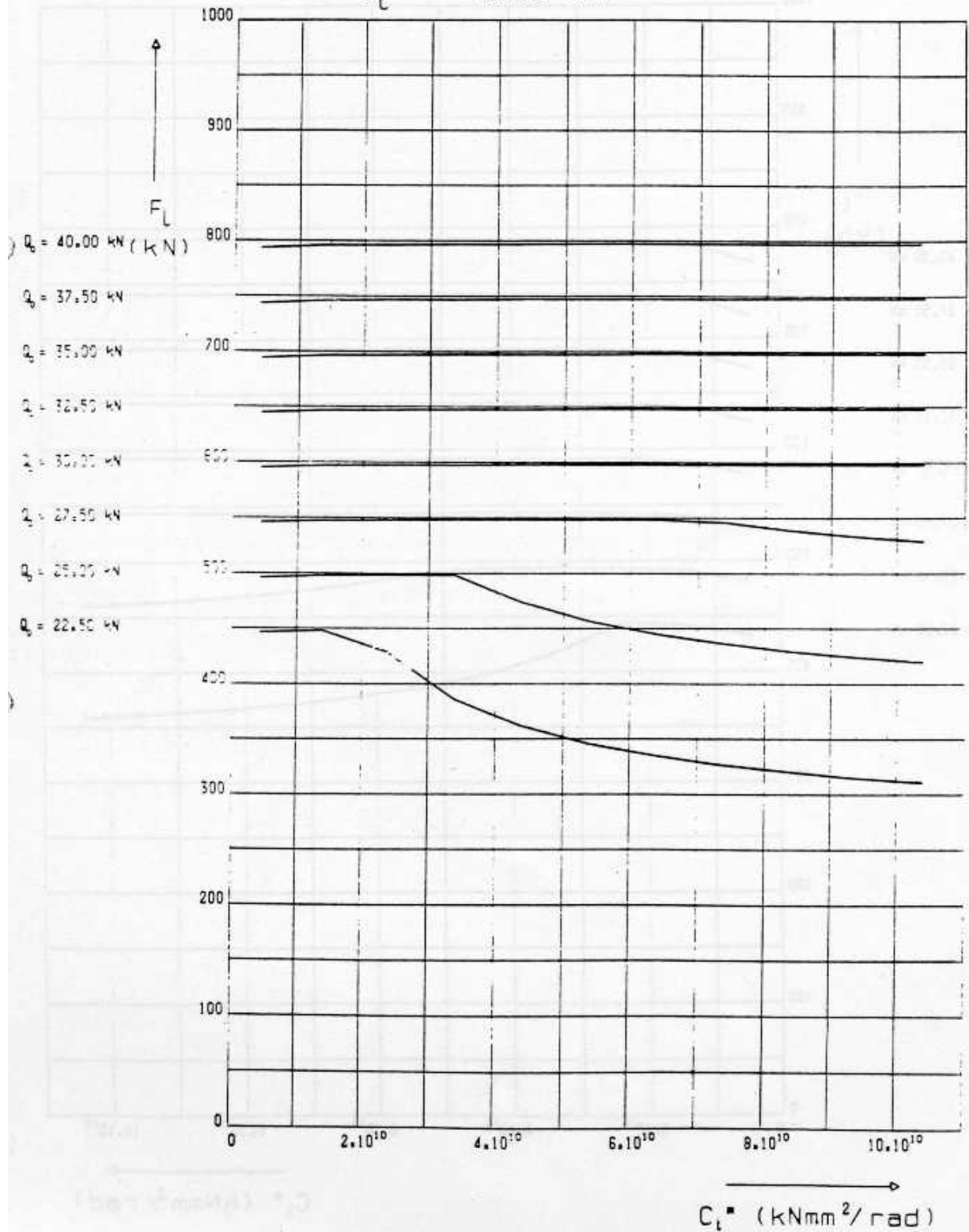
$$z_c = 62.9 \text{ mm}$$

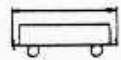


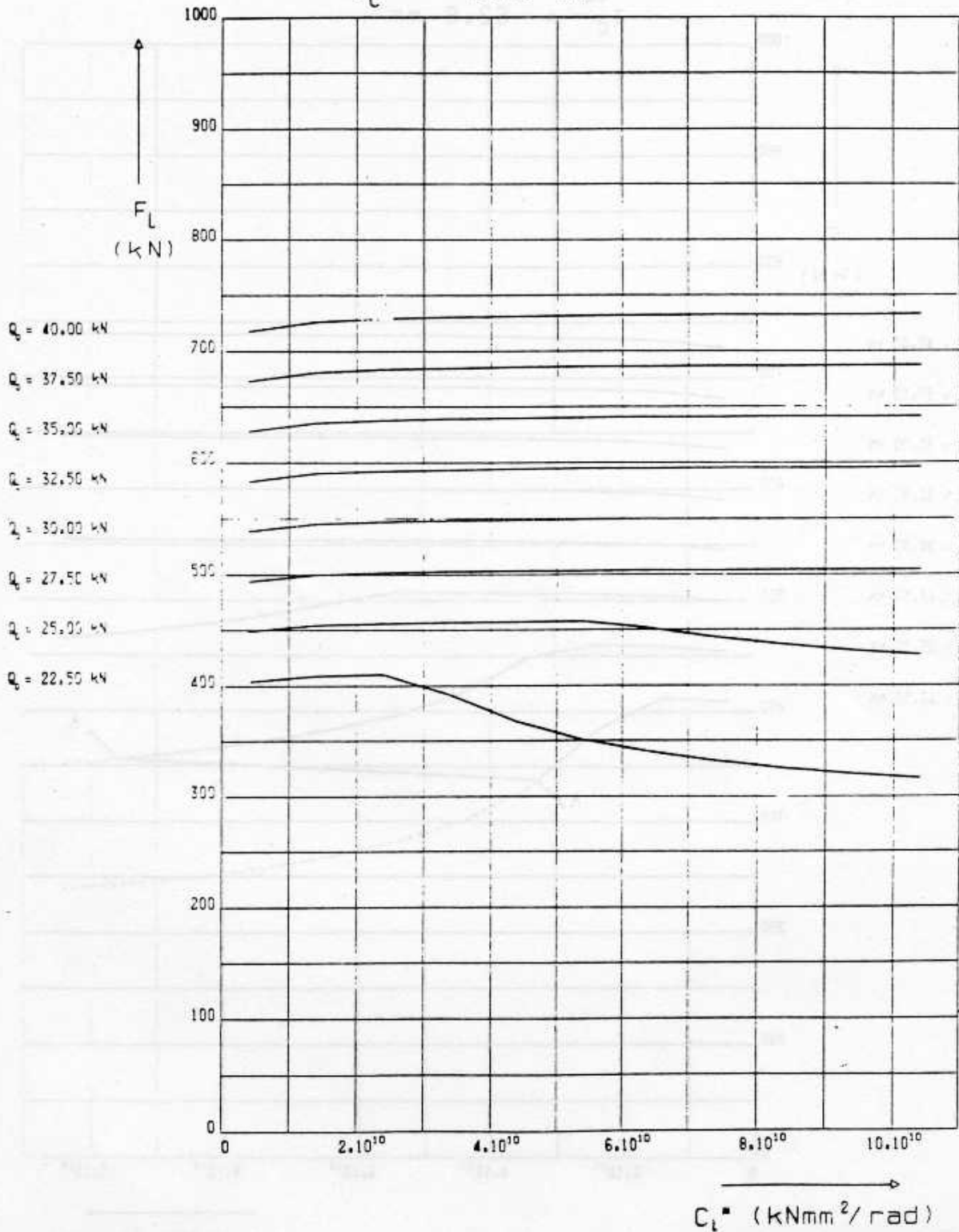
$$\begin{aligned}
 \overline{b} &= 13000 \text{ mm} \\
 2a^* &= 7000 \text{ mm} \\
 \Delta q_0 &= 0.15 \\
 c_{z1} &= 0.65 \text{ kN/mm} \\
 c_{z2} &= 1.82 \text{ kN/mm} \\
 F_{CZ} &= 41.1 \text{ kN} \\
 z_c &= 62.9 \text{ mm}
 \end{aligned}$$



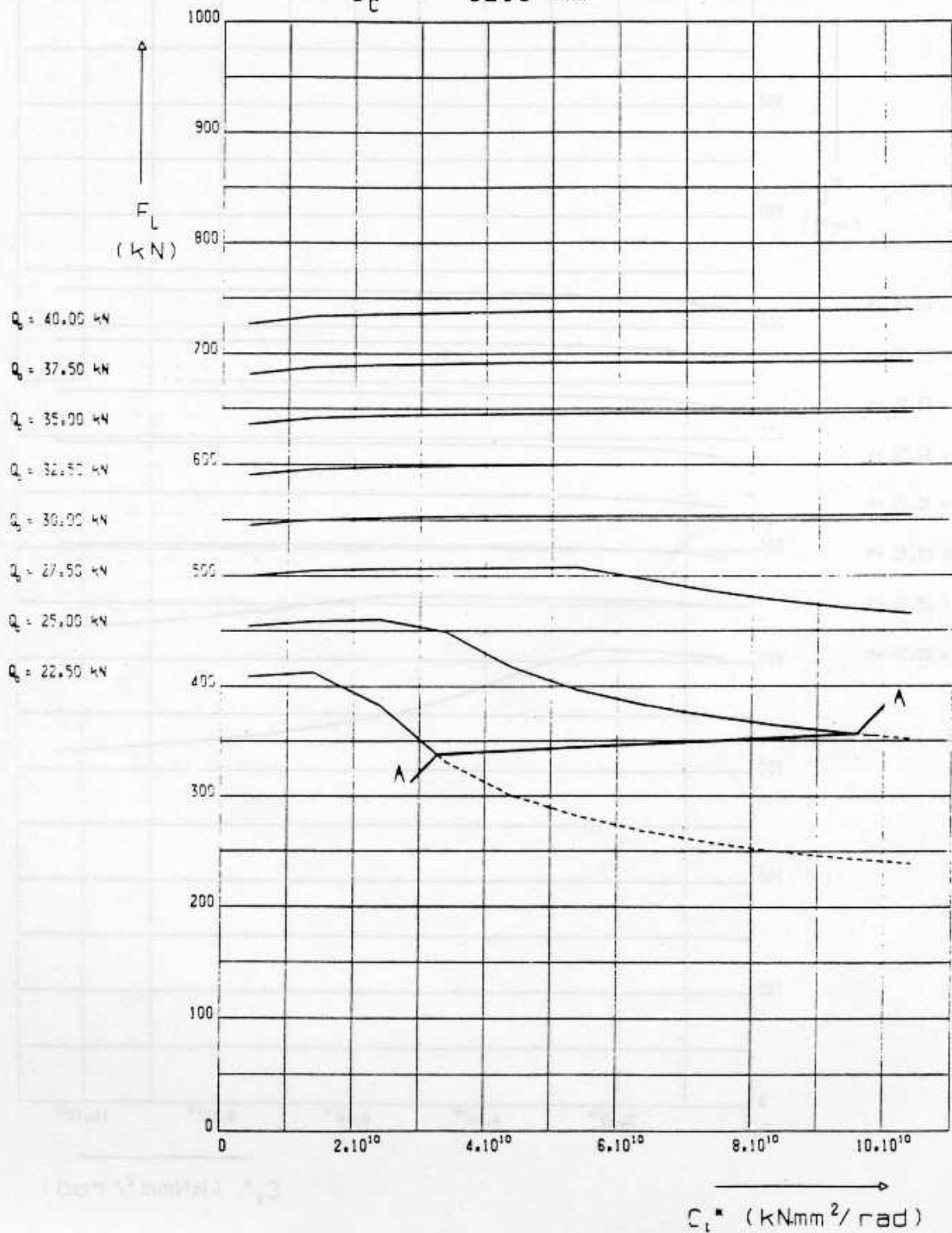

 $= 13000 \text{ mm}$   
 $2a^* = 8000 \text{ mm}$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{CZ} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$




 $b = 14000 \text{ mm}$   
 $2a^* = 8000 \text{ mm}$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{CZ} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$

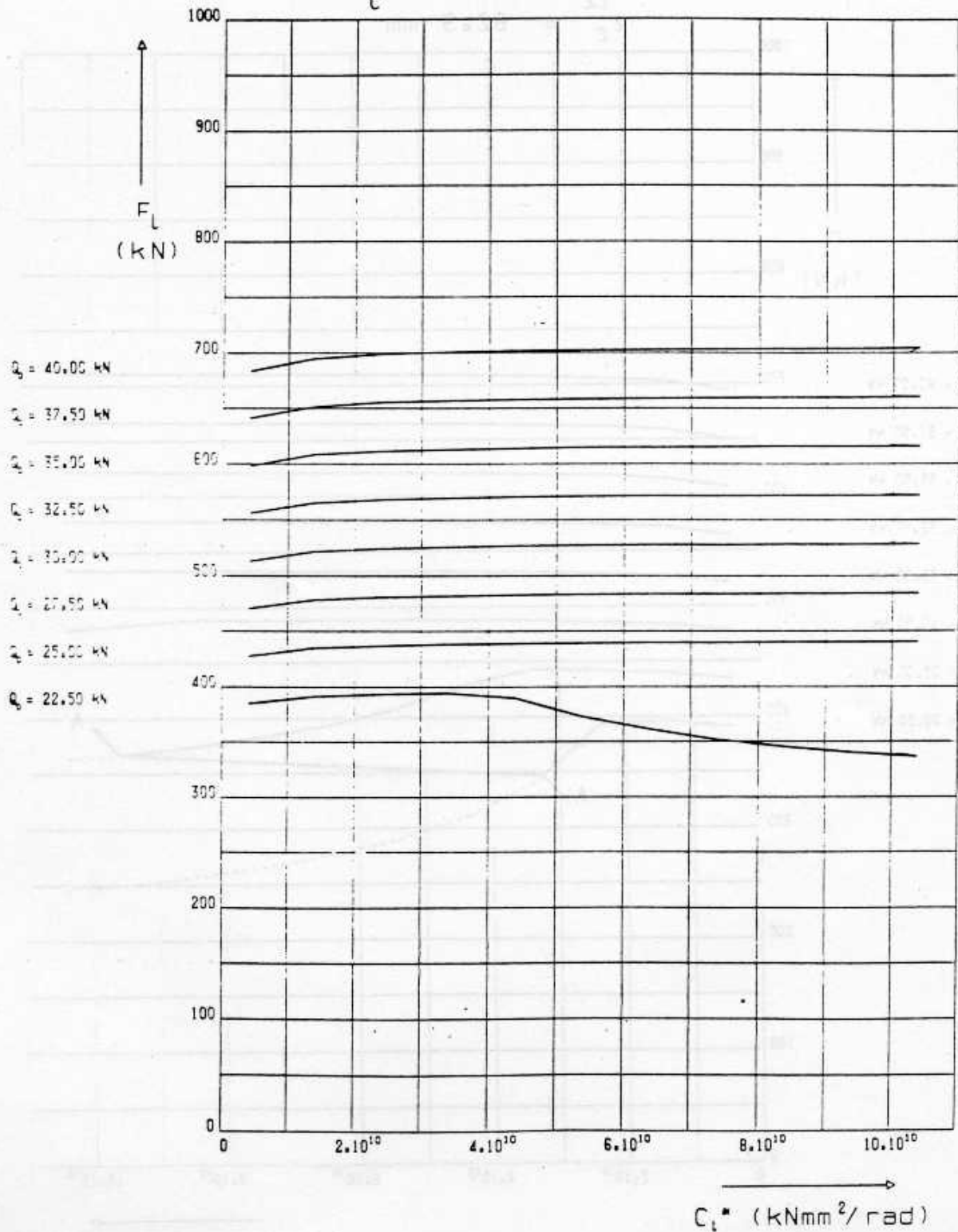


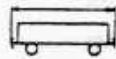
$$\begin{aligned}
 & \text{Diagram of a beam with two supports} \\
 & 2a^* = 14000.0 \text{ mm} \\
 & 2a^* = 9000.0 \text{ mm} \\
 & \Delta q_0 = 0.15 \\
 & c_{z1} = 0.65 \text{ kN/mm} \\
 & c_{z2} = 1.82 \text{ kN/mm} \\
 & F_{CZ} = 41.1 \text{ kN} \\
 & z_c = 62.9 \text{ mm}
 \end{aligned}$$



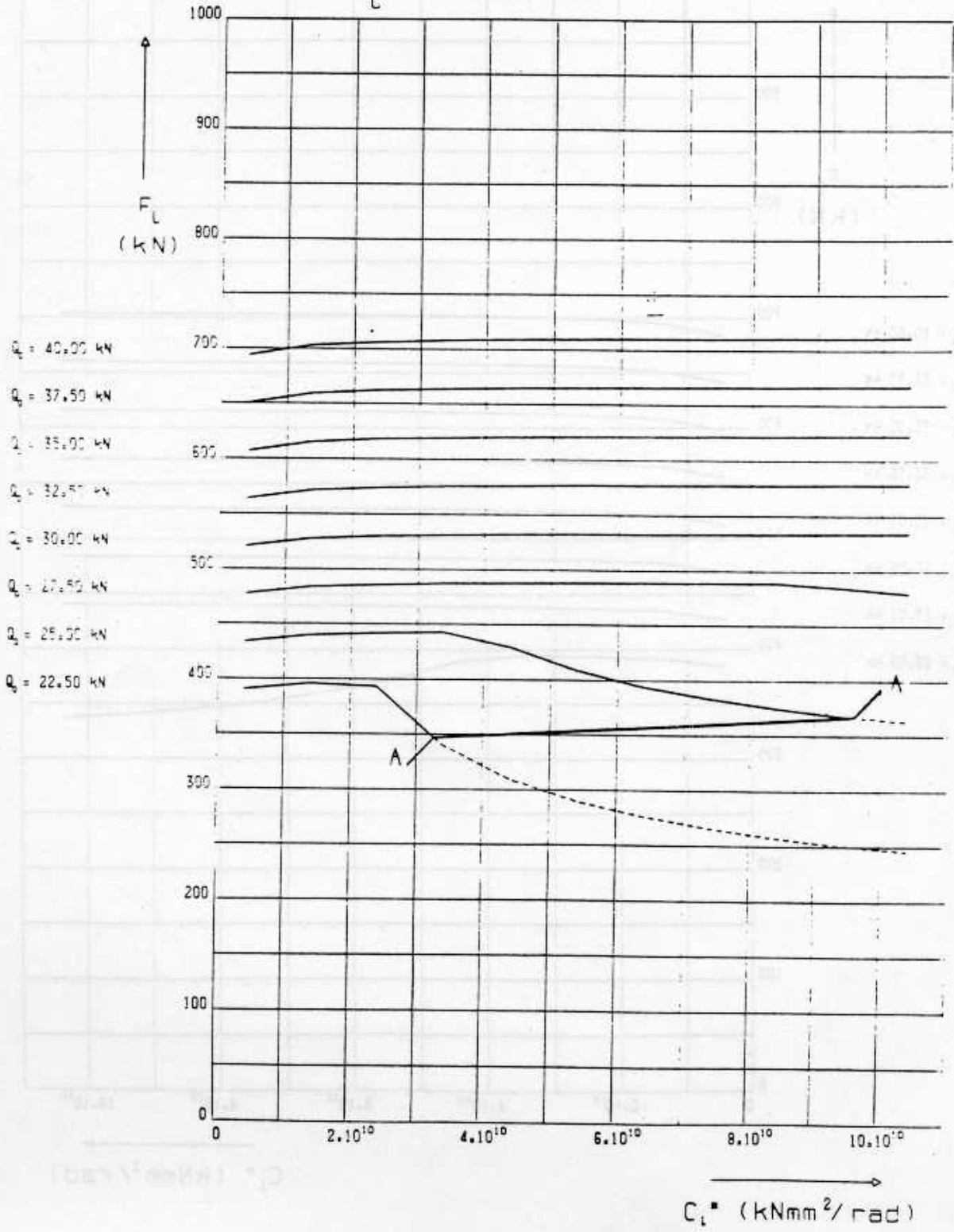


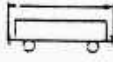
$$\begin{aligned}
 \bar{c}_0 &= 14500 \text{ mm} \\
 2a^* &= 8000 \text{ mm} \\
 \Delta a_0 &= 0.15 \\
 c_{z1} &= 0.65 \text{ kN/mm} \\
 c_{z2} &= 1.82 \text{ kN/mm} \\
 F_{CZ} &= 41.1 \text{ kN} \\
 z_C &= 62.9 \text{ mm}
 \end{aligned}$$

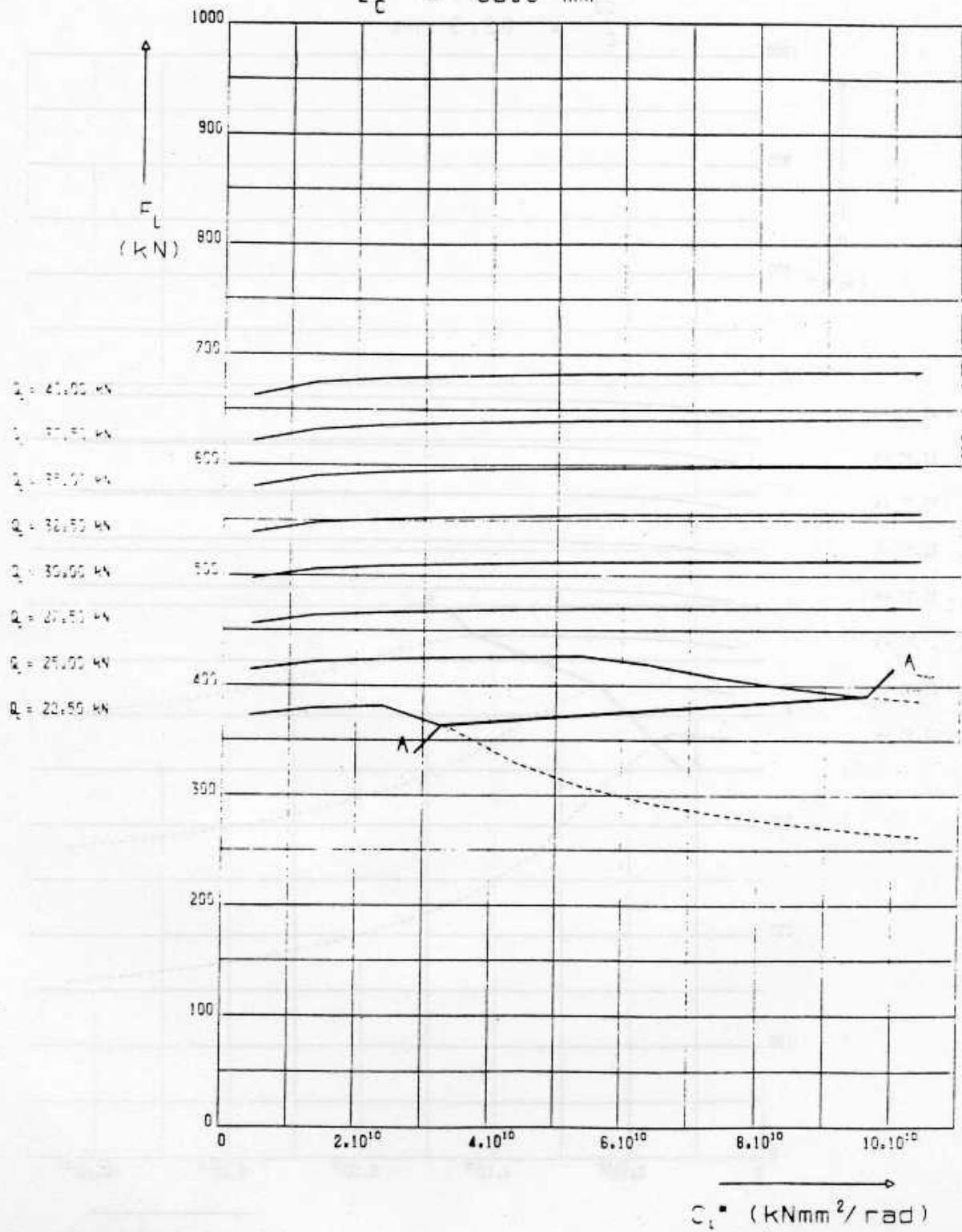




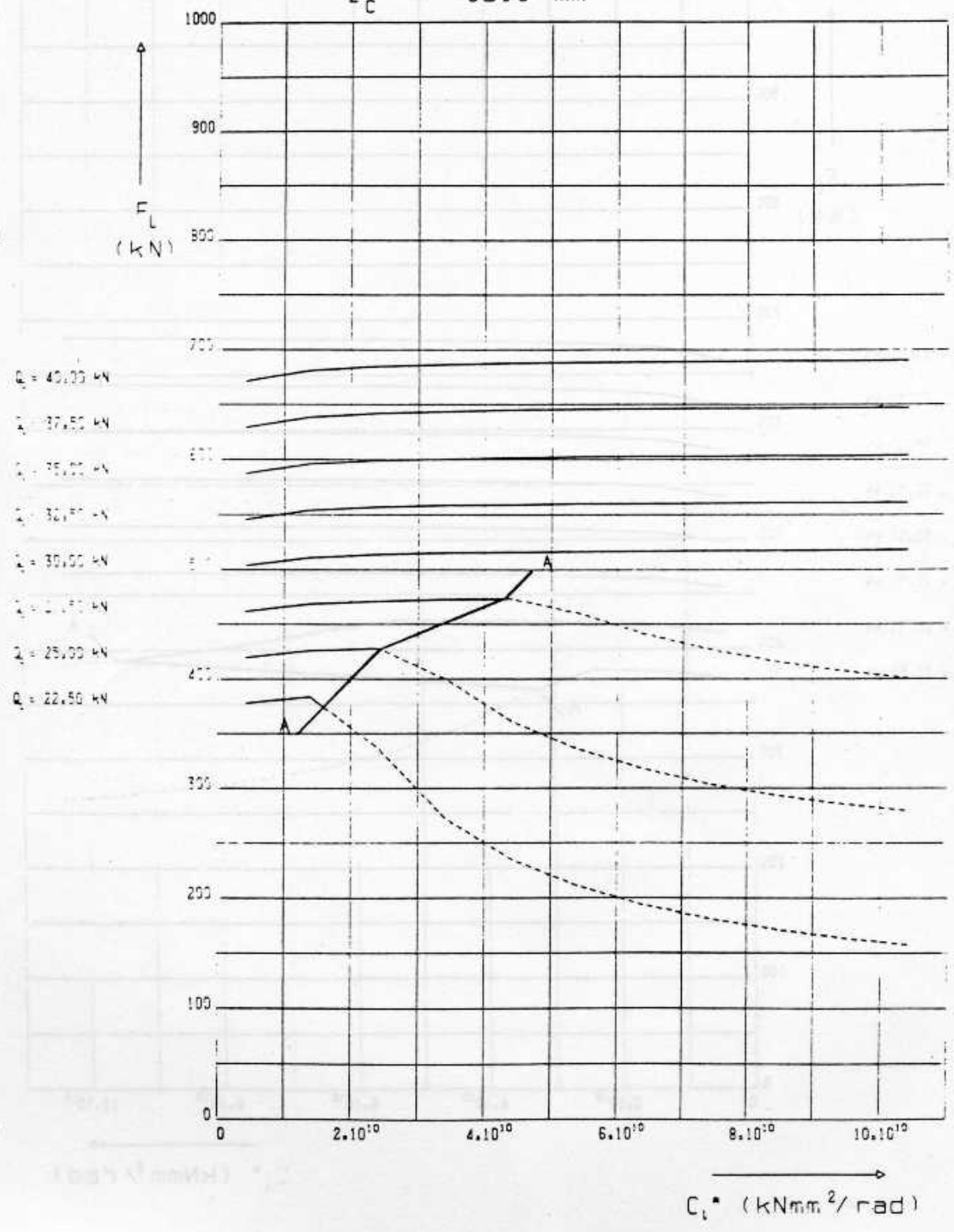
- $l = 14500 \text{ mm}$
- $2a^* = 9000 \text{ mm}$
- $\Delta q_0 = 0.15$
- $c_{z1} = 0.65 \text{ kN/mm}$
- $c_{z2} = 1.82 \text{ kN/mm}$
- $F_{cz} = 41.1 \text{ kN}$
- $z_c = 62.9 \text{ mm}$

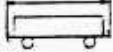


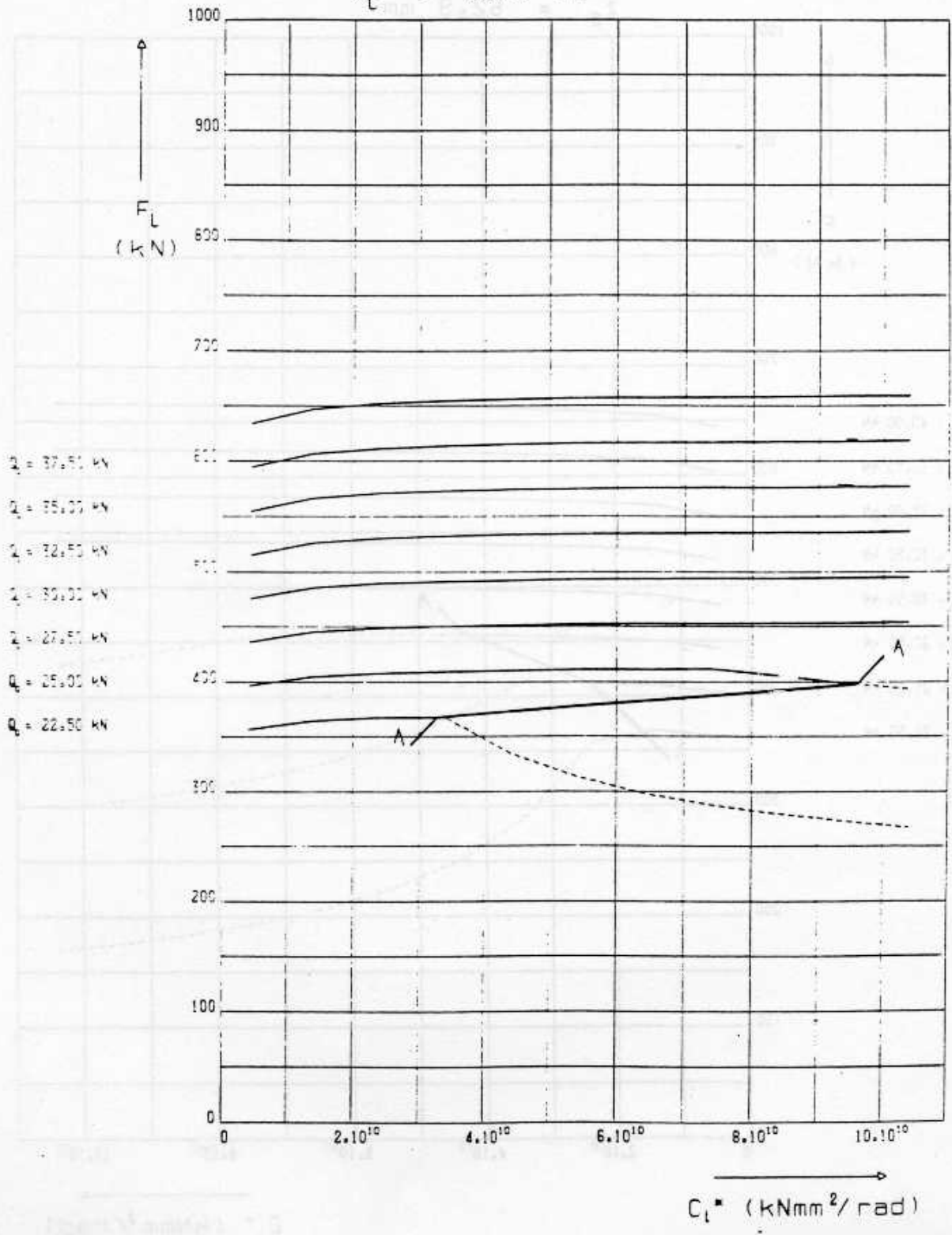

 $b = 15000 \text{ mm}$   
 $2a^* = 9000 \text{ mm}$   
 $\Delta \sigma_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{cz} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$

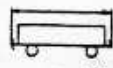


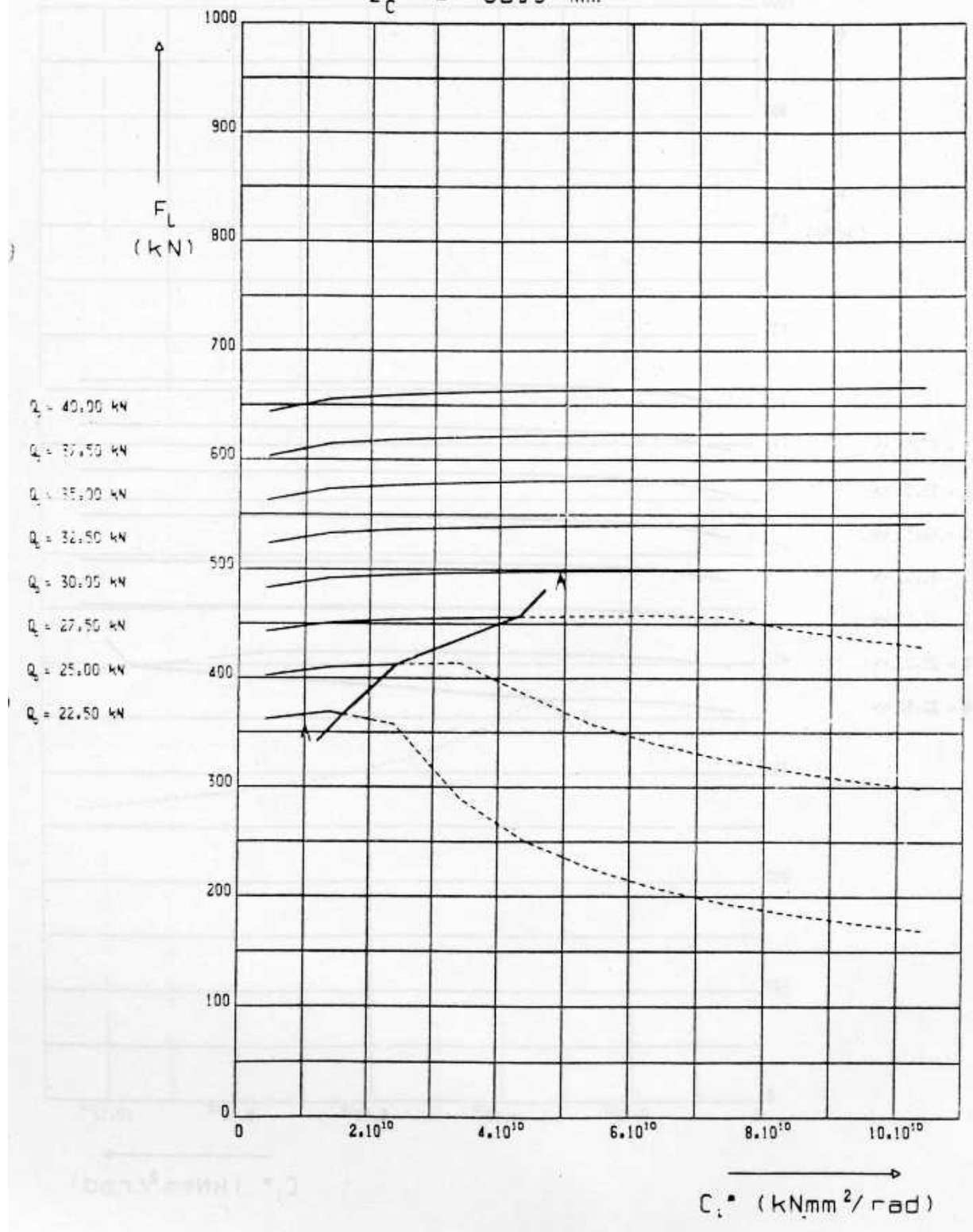
$b = 15000 \text{ mm}$   
 $2a^* = 10000 \text{ mm}$   
 $\Delta \sigma_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{cz} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$



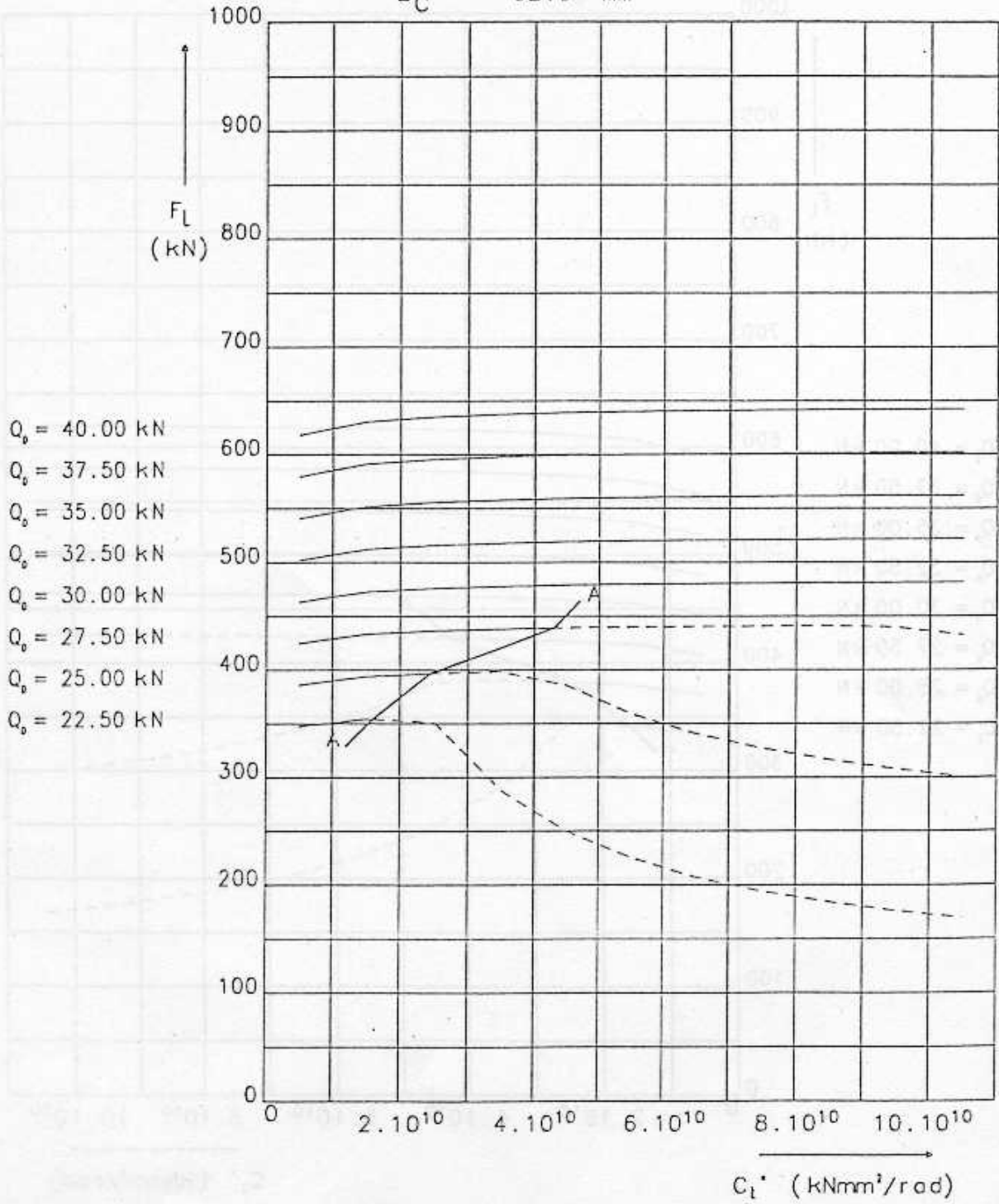

 $= 15500 \text{ mm}$   
 $2a^* = 9000 \text{ mm}$   
 $\Delta \sigma_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{CZ} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$

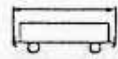


 = 15500. mm  
 $2a^* = 10000. mm$   
 $\Delta q_0 = 0.15$   
 $c_{z1} = 0.65 \text{ kN/mm}$   
 $c_{z2} = 1.82 \text{ kN/mm}$   
 $F_{cz} = 41.1 \text{ kN}$   
 $z_c = 62.9 \text{ mm}$



$2a^* = 16000. \text{ mm}$   
 $2a^* = 10000. \text{ mm}$   
 $\Delta q_0 = 0,15$   
 $C_{Z1} = 0.65 \text{ kN/mm}$   
 $C_{Z2} = 1.82 \text{ kN/mm}$   
 $F_{CZ} = 41.1 \text{ kN}$   
 $Z_C = 62.9 \text{ mm}$





$$= 16500. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

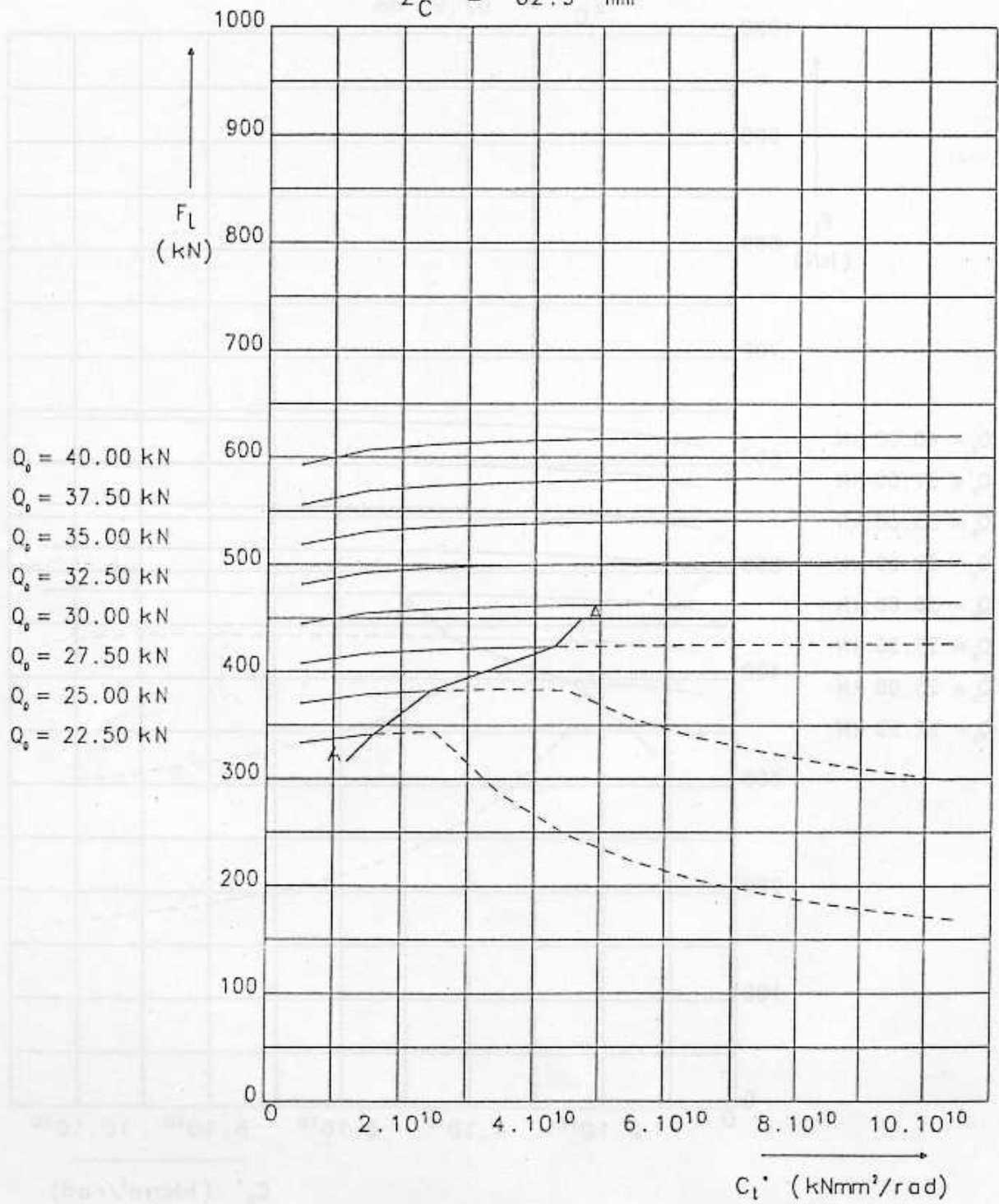
$$\Delta q_0 = 0,15$$

$$C_{Z1} = 0.65 \text{ kN/mm}$$

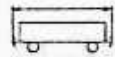
$$C_{Z2} = 1.82 \text{ kN/mm}$$

$$F_{CZ} = 41.1 \text{ kN}$$

$$Z_C = 62.9 \text{ mm}$$







$$= 17000. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

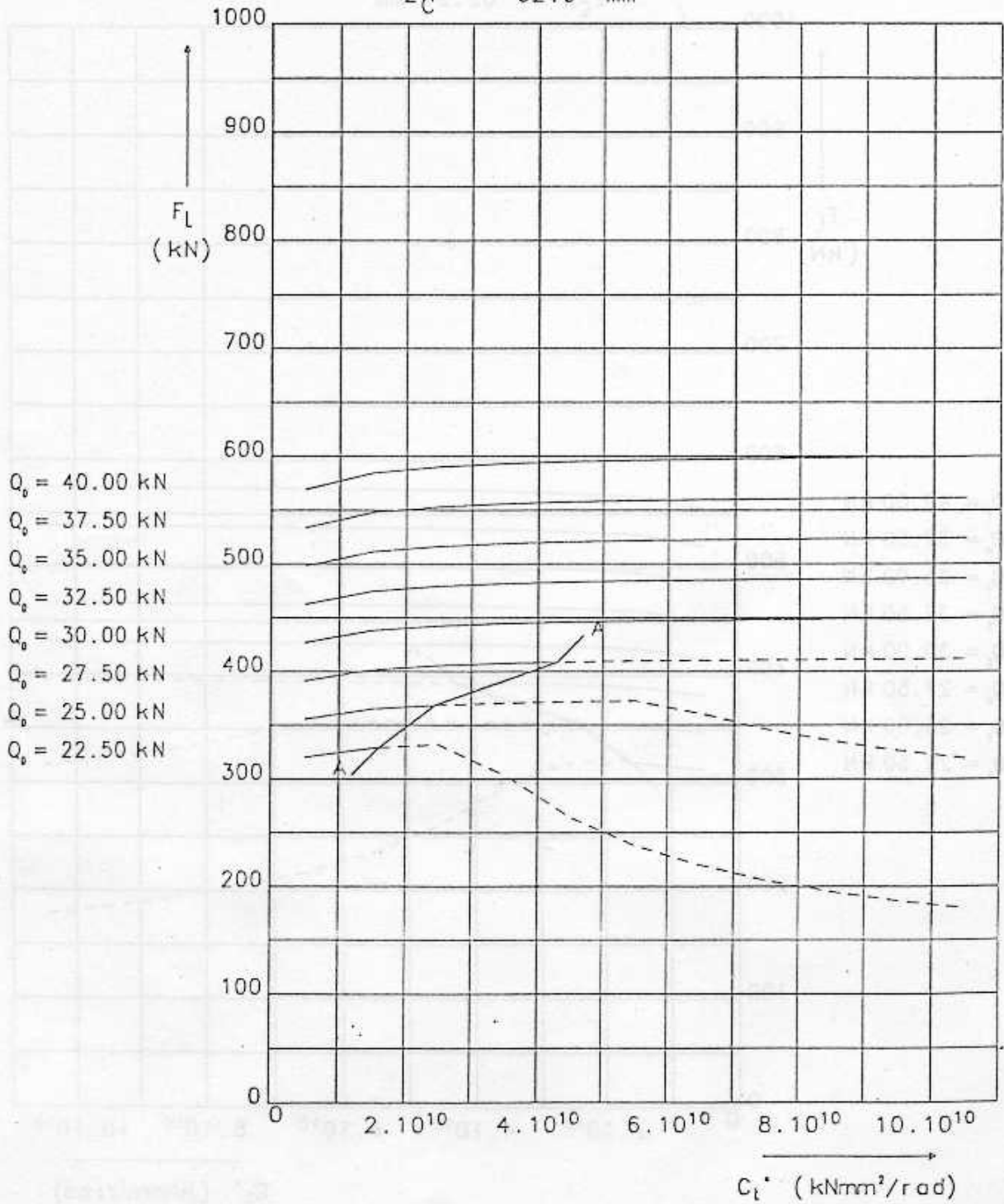
$$\Delta q_0 = 0,15$$

$$C_{Z1} = 0.65 \text{ kN/mm}$$

$$C_{Z2} = 1.82 \text{ kN/mm}$$

$$F_{CZ} = 41.1 \text{ kN}$$

$$Z_C = 62.9 \text{ mm}$$



$$\text{---} = 17300. \text{ mm}$$

$$2a^* = 10000. \text{ mm}$$

$$\Delta q_0 = 0,15$$

$$C_{Z1} = 0.65 \text{ kN/mm}$$

$$C_{Z2} = 1.82 \text{ kN/mm}$$

$$F_{CZ} = 41.1 \text{ kN}$$

$$Z_C = 62.9 \text{ mm}$$

