# PRACTICAL LOOK
# TO
# DYNAMIC STABILITY

What means under “Dynamic stability”

Two practical ways “how to do” table for to build diagram of Dynamic stability

Which data we can get from our

# Dynamic stability

Sometimes happens vessel floats it smooth water and then unforeseen appears squally wind or big swell and vessel get a dynamic inclination, may be for a short time , but more exceeding then inclination which could appear during static action of same moment.

Let’s imagine that our vessel is upright and then unpredictable to she attached some moment under force of which vessel start heel with acceleration so as on initial period other moment which try to return vessel to initial position will be much slower.

After vessel reach certain position when heeling moment will be equal to moment trying to return vessel to initial position (Righting moment) and acceleration will be maximum, vessel continue to heel, but already she’s acceleration will be much less . That means that moment trying to return vessel to initial position “Righting moment” getting more then “Heeling moment”.

At certain moment acceleration of vessel becomes “0”, heeling angle reach its maximum (Angle of dynamic heel) and vessel stuck in this position. After this vessel return to its initial position.

# Dynamic stability

Under dynamic stability means ability of vessel to withstand dynamic impact of heeling moment.

The relative measure of dynamic stability is dynamic stability arm.

Lets build a diagram looks like transverse static stability, but on axis of ordinates Y we apply "Righting moments" which we calculate with simple formula

Righting moment = GZ x Displacement

Please see next page.

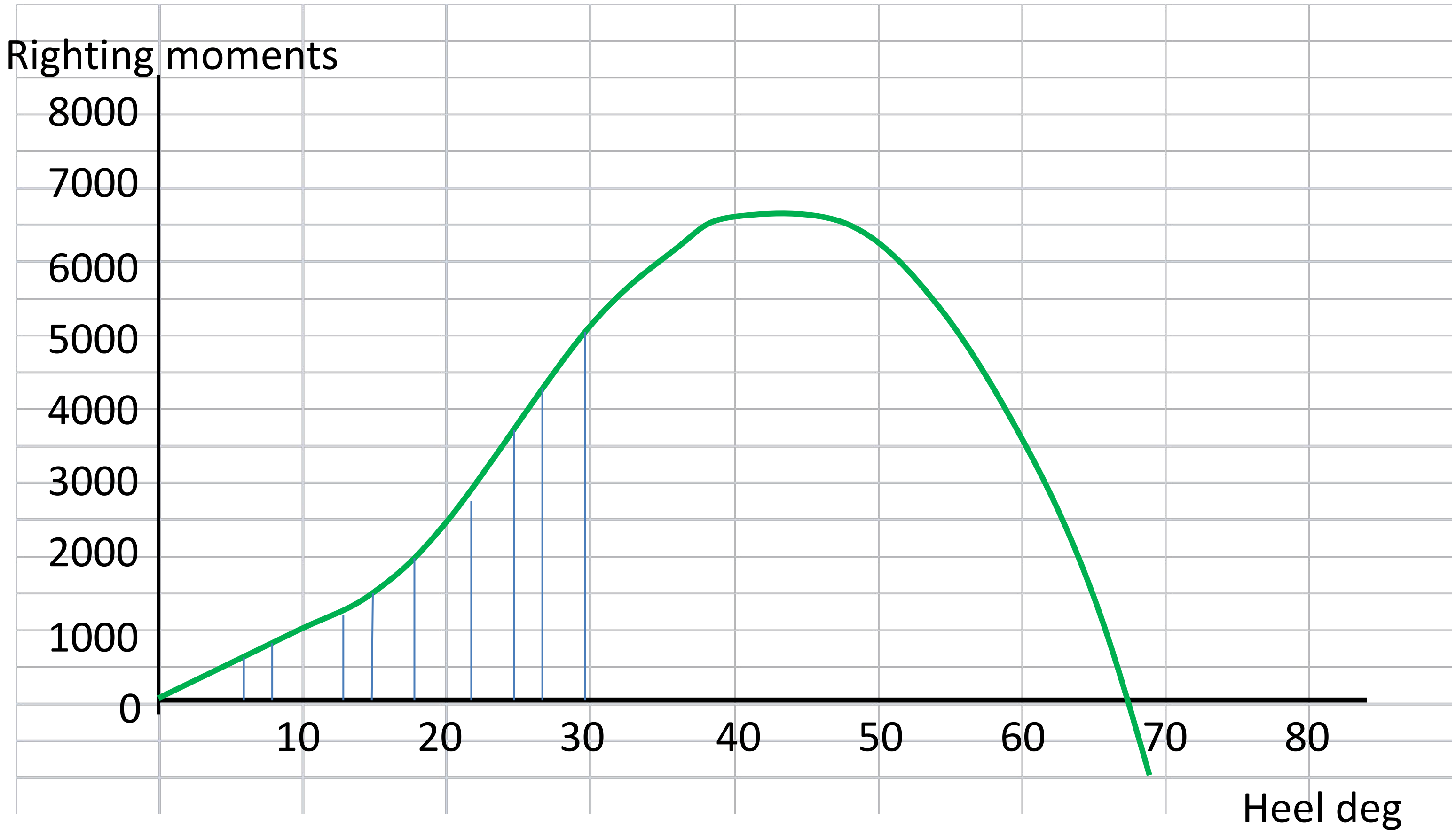
We expect that due to some external force vessel heels to 30 deg

Dynamical stability determined by area under the curve of righting moments, from "0" up to the heel

# Dynamic stability

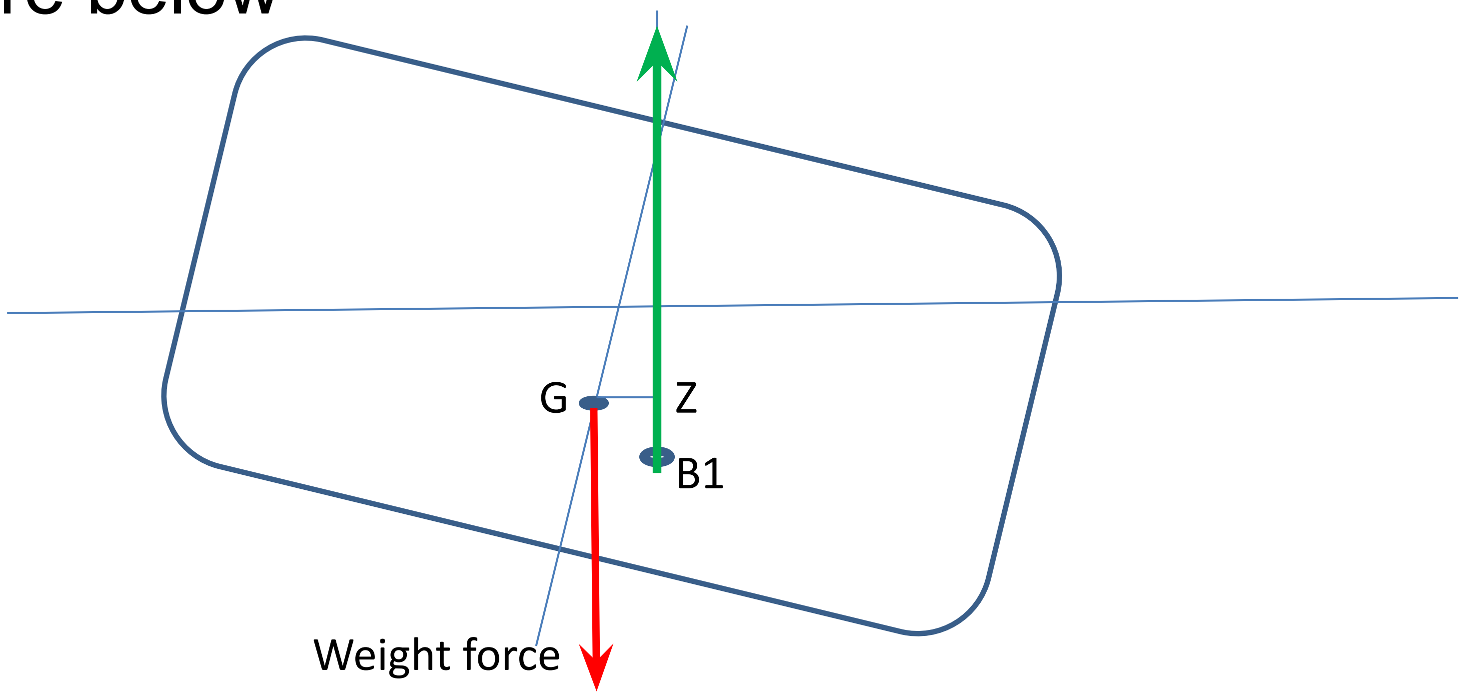
For to build DYNAMIC STABILITY diagram we will use formula

Righting moment = GZ x Displacement



# Dynamic stability

Just to remind you what is GZ please see picture below



# Dynamic stability

**In practice usually used not diagram which we build before for dynamic stability, but we build diagram of dynamic stability basing**

| ϴ | GZ (from static transverse stability) | SUM of GZ for different ϴ | GZ dynamic |
|---|---|---|---|
| 0 | GZ 0 | $\Sigma = 0$ | 0 |
| 10 | GZ 10 | $\Sigma_{10} = GZ_{10}$ | $0.0873 \times \Sigma_{10}$ |
| 20 | GZ 20 | $\Sigma_{20} = 2 \times GZ_{10} + GZ_{20}$ | $0.0873 \times \Sigma_{20}$ |
| 30 | GZ 30 | $\Sigma_{30} = 2GZ_{10} + 2GZ_{20} + GZ_{30}$ | $0.0873 \times \Sigma_{30}$ |
| 40 | GZ 40 | $\Sigma_{40} = 2GZ_{10} + 2GZ_{20} + 2GZ_{30} + GZ_{40}$ | $0.0873 \times \Sigma_{40}$ |
| 50 | GZ 50 | $\Sigma_{50} = 2GZ_{10} + 2GZ_{20} + 2GZ_{30} + 2GZ_{40} + GZ_{50}$ | $0.0873 \times \Sigma_{50}$ |
| 60 | GZ 60 | $\Sigma_{60} = 2GZ_{10} + 2GZ_{20} + 2GZ_{30} + 2GZ_{40} + 2GZ_{50} + GZ_{60}$ | $0.0873 \times \Sigma_{60}$ |
| 70 | GZ 70 | $\Sigma_{70} = 2GZ_{10} + 2GZ_{20} + 2GZ_{30} + 2GZ_{40} + 2GZ_{50} + 2GZ_{60} + GZ_{70}$ | $0.0873 \times \Sigma_{70}$ |
| 80 | GZ 80 | $\Sigma_{80} = 2GZ_{10} + 2GZ_{20} + 2GZ_{30} + 2GZ_{40} + 2GZ_{50} + 2GZ_{60} + 2GZ_{70} + GZ_{80}$ | $0.0873 \times \Sigma_{80}$ |
| 90 | GZ 90 | $\Sigma_{90} = 2GZ_{10} + 2GZ_{20} + 2GZ_{30} + 2GZ_{40} + 2GZ_{50} + 2GZ_{60} + 2GZ_{70} + 2GZ_{80} + GZ_{90}$ | $0.0873 \times \Sigma_{90}$ |

# Dynamic stability

## Other possible way for calculations (with digits)

| θ | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| GZ static | 0 | 0.16 | 0.28 | 0.48 | 0.47 | 0.3 | 0.21 | 0.1 | -0.10 |
| Σ | 0 | 0.16 | 0.60 | 1.36 | 2.31 | 3.08 | 3.59 | 3.9 | 3.9 |
| GZdin =0.0872 x Σ | 0 | 0.01 | 0.05 | 0.12 | 0.2 | 0.27 | 0.31 | 0.34 | 3.9 |

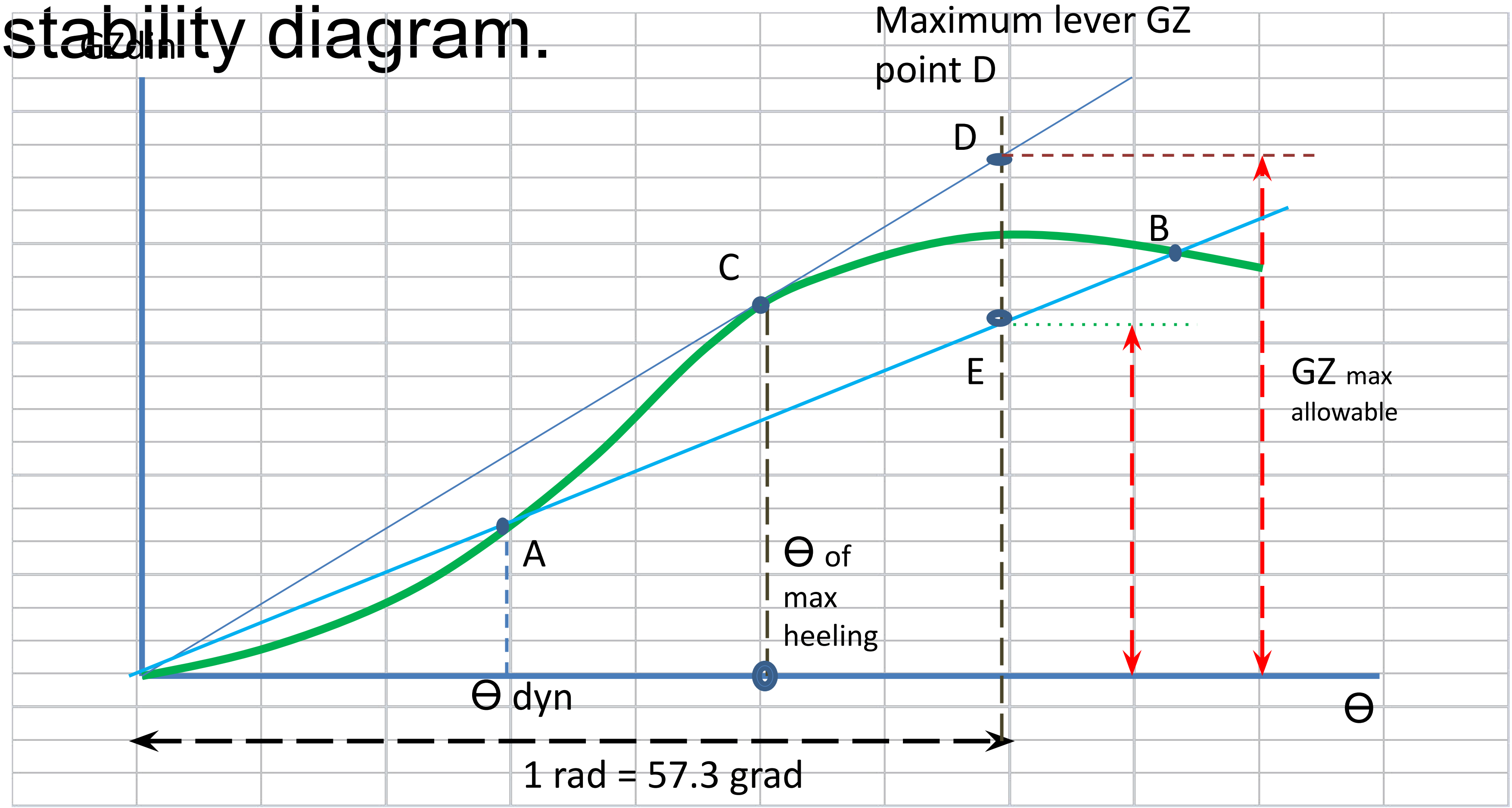
<u>Check</u>

Σ10= 0+0+0.16=0.16 GZdin10 = 0.16 x 0.0872 = 0.01

Σ20 = 0.16+0.16+0.28= 0.6 GZdin20 = 0.6 x 0.0872 = 0.05

# Dynamic stability

After completion of above table (one of shown before for your choice) we build dynamic stability diagram.



# Dynamic stability

After all this beautiful tables and pictures certainly appears question what we can do with it? Please see page 8

1. For to find Heeling moment during which vessel will not collapse.

   Measure 1 rad eg 57.3 deg on axis of inclination Ɵ

   From point 57.3 deg draw vertical line

   Draw tangent line touching dynamic stability curve from centre of coordinates

   Point in position where crossing your tangent line and vertical line from 1 rad give you lever GZ at which vessel collapse.

   Heeling moment at which vessel collapse could be found as GZ x weigh of vessel

   Point C give you limit of dynamic Ɵ

# Dynamic stability

When we build diagram of dynamic stability we expect dynamic heeling moment as permanent for different angles of inclination then it’s work

Will be in linear dependency from inclination and could be presented as a strait line passing through center of coordinates.

For to build it we install vertical line from point 1 rad=57,3 deg and mark on it given GZ (point E)

Strait line passing through center of coordinates and point E will be graph of work of Heeling moment related to force of weight of vessel.

This strait line cross diagram of dynamic stability in 2 points “A” and “B”.

Perpendicular from “A” to axis Ө give you angle Өdin in which work of Heeling moment and Upright moment will be equal.

Point “B” has no practical use.

If line NOT CROSS diagram of dynamic stability that

# After word

Here I am not talk about how to use Transverse static stability diagram for to solve questions of Dynamic stability.

Everything step by step and preferably attached to practice then will be more easy to understand “for what?”

I’ll be thankful to professionals who give me some feedback with own opinion about my articles.

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