How LMLA is distributing loads in supports

Vertical supports - ULS

1. Group elements, represented by a set, into contact surface(s) and compute the contact area(s), $\boldsymbol{A_{Con}}$ (can be multiple contact surfaces)
2. For each contact surface, get from cargo hold model
    i. Vertical reaction force, $\boldsymbol{F_v}$ = maximum vertical reaction force among all load cases in truss element(s)
3. For each contact surface, for each load case, *i*, compute the horizontal friction force
    i. Transverse friction force for each load case, *i*, $\boldsymbol{F_{t,f,i}} = \mu_{max} \times F_v \times \overrightarrow{u_{t,i}}$
    ii. Longitudinal friction force for each load case, *i*, $\boldsymbol{F_{l,f,i}} = \mu_{max} \times F_v \times \overrightarrow{u_{l,i}}$
4. The unit vector, $\overrightarrow{u_{t(l),i}}$, in transverse (longitudinal) direction, for each load case, *i*,
    i. 30° heeled damage load case: $\overrightarrow{u_t}$ = 1, and $\overrightarrow{u_l}$= 0 (covering maximum transverse friction force)
    ii. 0.5g collision load case: $\overrightarrow{u_t}$ = 0, and $\overrightarrow{u_l}$ = 1 (covering maximum longitudinal friction force)
    iii. For other load cases (with various EDWs) $0 \leq \overrightarrow{u_t} \leq 1$ and $0 \leq \overrightarrow{u_l} \leq 1$
5. For each contact surface, for each load case, *i*,
    i. Lateral pressure $P_{lat} = \frac{F_v}{A_{Con}}$ (same for all load cases)
    ii. Traction pressure $P_{trac,i} = \frac{\mu_{max} \times F_v \times \overrightarrow{ui}}{A_{Con}}$ (magnitude same for all load cases, direction load case dependent)

Vertical supports - FLS

1. Group elements, represented by a set, into contact surface(s) and compute the contact area(s), $\boldsymbol{A_{Con}}$ (can be multiple contact surfaces)
2. For each contact surface, for each load case, *i*, get from cargo hold model
    i. Vertical reaction force, $\boldsymbol{F_{v,i}}$ = vertical reaction force in truss element(s)
    ii. Friction force, $\boldsymbol{F_{f,i}}$ = horizontal friction force(s)
3. For each contact surface, for each load case, *i*
    i. Lateral pressure $P_{lat,i} = \frac{F_{v,i}}{A_{Con}}$ (magnitude load case dependent)
    ii. Traction pressure $P_{trac,i} = \frac{F_{f,i} \times \overrightarrow{ui}}{A_{Con}}$ (magnitude and direction load case dependent)

Anti-flotation supports - ULS

1. Group elements, represented by a set, into contact surface(s) and compute the contact area(s), $\boldsymbol{A_{Con}}$ (can be multiple contact surfaces)
2. For each contact surface, for each load case, *i*, get from cargo hold model
   i. Vertical reaction force, $\boldsymbol{F_{v,i}}$ = vertical reaction force in beam element(s)
3. For each contact surface, for each load case, *i*, compute the horizontal friction force
   i. Transverse friction force for each load case, *i*, $\boldsymbol{F_{t,f,i}} = \mu_{max} \times F_{V,i} \times \overrightarrow{u_{t,i}}$
   ii. Longitudinal friction force for each load case, *i*, $\boldsymbol{F_{l,f,i}} = \mu_{max} \times F_{V,i} \times \overrightarrow{u_{l,i}}$
4. For each contact surface, for each load case, *i*
   i. Lateral pressure $P_{lat,i} = \frac{F_{V,i}}{A_{Con}}$ ($F_{V,i} \neq 0$ only for flooded load cases, magnitude load case dependent)
   ii. Traction pressure $P_{trac,i} = \frac{\mu_{max} \times F_{V,i} \times \overrightarrow{ui}}{A_{Con}}$ ($F_{V,i} \neq 0$ only for flooded load cases, magnitude and direction load case dependent)

Anti-roll(pitch) supports - ULS

1. Group elements, represented by a set, into contact surface(s) and compute the contact area(s), $\boldsymbol{A_{Con}}$ (can be multiple contact surfaces)
2. For each contact surface, get from cargo hold model
   i. Longitudinal (transverse) reaction force, $\boldsymbol{F_{l(t)}}$ = maximum longitudinal (transverse) reaction force among all load cases in beam element(s)
3. For each contact surface, for each load case, *i*, compute the horizontal friction force
   i. For Anti-pitch support: Transverse friction force for each load case, *i*, $\boldsymbol{F_{t,f,i}} = \mu_{min} \times F_l \times \overrightarrow{u_{t,i}}$
   ii. For Anti-roll support: Longitudinal friction force for each load case, *i*, $\boldsymbol{F_{l,f,i}} = \mu_{min} \times F_t \times \overrightarrow{u_{l,i}}$
4. The unit vector, $\overrightarrow{u_{t(l),i}}$, in transverse (longitudinal) direction, for each load case, *i*,
   i. For Anti-pitch support: 30° heeled damage load case: $\overrightarrow{u_t} = 1$, and $\overrightarrow{u_l} = 0$ (covering maximum transverse friction force)
   ii. For Anti-roll support: 0.5g collision load case: $\overrightarrow{u_t} = 0$, and $\overrightarrow{u_l} = 1$ (covering maximum longitudinal friction force)
   iii. For other load cases (with various EDWs) $0 \leq \overrightarrow{u_t} \leq 1$ and $0 \leq \overrightarrow{u_l} \leq 1$
5. For each contact surface, for each load case, *i*
   i. Lateral pressure $P_{lat} = \frac{F_{l(t)}}{A_{Con}}$ (same for all load cases)

Traction pressure $P_{trac,i} = \frac{\mu_{max} \times F_{l(t)} \times \overrightarrow{u_{t(l)}}}{A_{Con}}$ (magnitude load case dependent)