Investigation of Revised AS4324.1 Partial Load Factors for Steel Bulk Materials Handling Structures

RICHARD MORGAN & GRACE GO
ASPEC ENGINEERING PTY LTD
AS 4324.1-1995 : Mobile equipment for continuous handling of bulk materials - General requirements for the design of steel structures
CHANGES IN 2017 REVISION TO AS 4324.1

- Boom collision on non-slewing machines
- Travel device obstructed on bridge machines
- Digging cut-off settings and protection systems
- Permanent Dynamics
- Redundancy of stays, ropes and hydraulic cylinders
- Loss of bucket wheel
- Wind loads
- Plate buckling
- Partial load factors and limit states code calibration
Case Study Objectives

• Check compliance with AS 4100 with the revised partial load factors

• Quantify the effect of changing the partial load factors
150t Radial Stacker
1500t Bucket-wheel Reclaimer
Radial Stacker

**Five Load combinations: I, II/1, III/6, III/8 and III/10**

<table>
<thead>
<tr>
<th>LSD method / Load multiplying factor</th>
<th>Considered load combination numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>1995 All load components</td>
<td>1.33</td>
</tr>
<tr>
<td>2017 Varying</td>
<td>1.35</td>
</tr>
</tbody>
</table>

Safety factors for load combinations in AS 4324.1-1995

- **Operational loads used for strength design**
  - e.g. Dead weight, Conveyor, Digging, Dynamics

- **Abnormal operation strength design**
  - e.g. High digging loads, Slew bearing jacking

- **Rare loads and accidents – strength design**
  - e.g. Blocked chutes, Flooded belt

- **Rare loads and accidents – strength design**
  - e.g. Collisions

- **Rare loads and accidents – strength design**
  - e.g. storm wind
## Radial Stacker – Five Load combinations

<table>
<thead>
<tr>
<th>Load combination number</th>
<th>Load table version</th>
<th>Load Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I:</strong></td>
<td></td>
<td>1.33E + 1.33V + 1.33F + 1.33N + 1.33U + 1.33S + 1.33D + 1.33G</td>
</tr>
<tr>
<td></td>
<td>Proposed</td>
<td>1.35E + 1.35V + 1.35F + 1.35N + 1.35U + 1.35S + 1.35D + 1.35G</td>
</tr>
<tr>
<td><strong>II/1:</strong></td>
<td>1995</td>
<td>1.2E + 1.2V + 1.2F + 1.2D + 1.2G + 1.2W + 1.2UU + 1.2SS + 1.2DD + 1.2NN</td>
</tr>
<tr>
<td></td>
<td>Proposed</td>
<td>1.2E + 1.5V + 1.2F + 1.2D + 1.2G + 1.2W + 1.2UU + 1.2SS + 1.2DD + 1.2NN</td>
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<tr>
<td><strong>III/6:</strong></td>
<td>1995</td>
<td>1.1E + 1.1V + 1.1N + 1.1U + 1.1S + 1.1D + 1.1G + 1.1W + 1.1VV + 1.1FF</td>
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<tr>
<td></td>
<td>Proposed</td>
<td>1.2E + 1.5V + 1.2N + 1.2U + 1.2S + 1.2D + 1.2G + 1.2W + VV + FF</td>
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<td><strong>III/8:</strong></td>
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<td>1.1E + 1.1V + 1.1F + 1.1N + 1.1U + 1.1D + 1.1G + 1.1W + 1.1FS</td>
</tr>
<tr>
<td></td>
<td>Proposed</td>
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<tr>
<td><strong>III/10:</strong></td>
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<td>1.1E + 1.1V + 1.1G + 1.1WW</td>
</tr>
<tr>
<td></td>
<td>Proposed</td>
<td>1.2E + 1.5V + 1.2G + WW_u</td>
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<tr>
<td></td>
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<td>1.35E + 1.35V + 1.35F + 1.35N + 1.35U + 1.35S + 1.35D + 1.35G</td>
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LCR = Load to Capacity Ratio

LCR < 1.00 to comply
150t
Radial Stacker
Radial Stacker_1995 (envelope)

Note: All images show LCR results with the 1995 version of load factors.
Radial Stacker _1995 (LC I a)

0.62 / 0.63

0.63 / 0.64

0.43 / 0.43

0.07 / 0.07

0.58 / 0.59
Radial Stacker _1995 (LC III/10 envelope)
1500t Bucket-wheel Reclaimer
Bucketwheel Reclaimer_1995 (Envelope)

0.94 / 0.92

0.75 / 0.78

1.03 / 1.06

1.00 / 1.02

0.85 / 0.87

0.82 / 0.82

1.00 / 1.01
BW Reclaimer_1995 (LC I envelope)
BW Reclaimer_1995 (LC III/10 envelope)
Conclusion

Similar LCRs are produced with the 1995 and 2017 partial load factors.

✓ LC I and II

  *Almost no increase in LCR*

✓ LC III/6, 8 and 10

  *Approx. 4% higher with the new partial load factors*
Conclusion

- Cost implications for this change are expected to be minimal.

- Safety is improved.

- Can directly use AS 4324.1-2017 LSD wheel reactions for design of supporting structures.
Thank You

Questions?