7.4.2 Earth ONE Station: Orbit, Polar Docking, and Human Factors

7.4.2.1 Earth ONE in Low Earth Orbit vs. Higher Orbits (GEO, Lagrange)

7.4.2.1.1 Low Earth Orbit (LEO) The **Earth ONE** space station is located in a Low Earth Orbit (LEO) [1]. In LEO, it circles the Earth in about **90 minutes**, resulting in **16 sunrises and sunsets per day**. Proximity to Earth eases resupply and communication (minimal signal delay), but the environment is harsh:
– Residual atmosphere (drag) → regular orbital corrections required
– Increased risk from space debris
– The Earth's magnetic field offers some radiation protection by deflecting part of cosmic rays and solar particles

7.4.2.1.2 Geostationary Orbit (GEO) At roughly **36,000 km altitude**, a station moves synchronously with Earth's rotation, remaining over the same point on the surface. Advantages:
– Continuous line-of-sight to ground stations
– No atmospheric drag
Disadvantages:
– Higher radiation levels (outside dense magnetic field protection)
– Resupply and evacuation are more complex (more fuel, longer flight times)
– Artificial day-night regulation required (nearly constant sunlight)

7.4.2.1.3 Lagrange Points Stations at **Lagrange points** (e.g., Earth–Moon L1/L2 or Earth–Sun L2) remain in quasi-stable positions. Advantages:
– Favorable gravitational equilibrium
– Unobstructed deep space view
Disadvantages:
– Little to no natural radiation protection
– Large distance → long communication delays and return times
– Regular orbital station-keeping required

7.4.2.1.4 Distant Orbits (Asteroid Belt) Long-term plans include **Belt ONE** in the Asteroid Belt [2]. Challenges:
– High degree of self-sufficiency required
– Extreme radiation, no planetary gravity
– Reduced solar energy availability
– Very long travel times (decades)

7.4.2.2 "Bus Terminal" Polar Docking Concept **Earth ONE** (rotating spherical station, ~127 m diameter) features a **20 m wide central docking tunnel** along its rotational axis [3]. Concept:
– **Arrival pole** for incoming shuttles
– **Departure pole** for outbound shuttles
– Benefits: easy approach, separated traffic flow, energy efficiency

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[3] sphere-space-station-earth-one-and-beyond.pdf

Crew Logistics:
– Arrival and departure separated → operational relief
– Central unloading/loading on **Deck 000** [4][5], distribution via radial elevators [6]

7.4.2.3 Rotation Direction and Planetary Analogies – **Prograde rotation** (like Earth) preferred → gyroscopic stability, consistent approach patterns [7]
– **Retrograde rotation** (like Venus) possible, but rarely practical [8][9]
– **Axial tilt** affects solar exposure and stability, may require active attitude control [10]

7.4.2.4 Rotational Stability and Attitude Control – Spin rate: approx. **4–5 rpm** → ~1g on outer decks [11][12]
– Stabilization via reaction wheels, control moment gyros [13], electric thrusters [14]
– Docking along the rotation axis minimizes changes to angular momentum
– Orbital reboosts (in LEO) required periodically
– Navigation lights can be dynamically controlled to indicate correct orientation despite rotation

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7.4.2.5 Physical, Psychological, and Social Effects on the Crew

7.4.2.5.1 Physical Effects – Artificial gravity prevents bone and muscle loss
– Noticeable gravity gradient within the station
– Coriolis effects require adaptation (possible space motion sickness)
– Adaptation likely within a few days

7.4.2.5.2 Orientation and Perception – Clearly defined “up/down” (radial) direction
– Differences between spinward and counter-spinward movement
– Window placement and interior design must support orientation [15][16]

7.4.2.5.3 Psychological Aspects – Proximity to Earth → sense of connection
– Artificial day-night cycle to stabilize circadian rhythm
– Large communal spaces and varied leisure options to counter isolation

[4] sphere-space-station-earth-one-and-beyond.pdf
[5] sphere-space-station-earth-one-and-beyond.pdf
[6] sphere-space-station-earth-one-and-beyond.pdf
[7] *The Architecture of Artificial-Gravity Environments for Long-Duration Space Habitation*, http://www.artificial-gravity.com/Dissertation/1_3.htm
[8] *Venus and Earth Compared* (ESA), https://sci.esa.int/web/venus-express/-/34067-venus-vs-earth
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[15] *paper.doc*, http://www.artificial-gravity.com/AIAA-99-4524.pdf
[16] *The Architecture of Artificial-Gravity Environments for Long-Duration Space Habitation*, http://www.artificial-gravity.com/Dissertation/1_3.htm

7.4.2.5.4 Social Dynamics – Up to 700 inhabitants [17] → small-town-like structure
– Language and culture adapt to rotational environment
– Integration through shared activities and rituals

Summary:
Earth ONE combines innovative orbital and docking strategies with human-centered interior and operational design. The choice of orbit, polar docking architecture, rotational configuration, and psychological as well as social design are key to making the long-term operation of a large rotating space station a success.

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