

# 2024 AIST Korea Caster Study Tour

AIST Study Tours have become highly anticipated and attended events. Originally planned for March 2020, the AIST Korea Caster Study Tour was finally held four years later, during the week of 18 March 2024. This Study Tour was the third one organized by the Continuous Casting Technology Committee.

The steel industry footprint in South Korea is large and contains some of the largest recently built steelmaking facilities (POSCO and Hyundai Steel).

The planning process for the Study Tour needed to consider the variety of casting processes available in South Korea that would offer participants valuable experiences to take back home to their companies. The high value of collected knowledge comes from not only plant tours but also technical exchanges with personnel and among the tour participants themselves. The number of plants visited was limited to five, allowing enough time for plant tours and technical exchanges.

The itinerary included visits to POSCO, Hyundai Steel and SeAH. In total, 12 participants attended the tour. Attendees were from United States Steel Corporation, ArcelorMittal, Cleveland-Cliffs Inc., Stelco Inc., Saarstahl, Dillinger Hütte AG, ThermoFisher Scientific and the Missouri University of Science and Technology.

On Sunday, 17 March, the Study Tour participants met for the first time during an official dinner. Sponsor SMS group, represented by local deputy managing director Kieun Hong, arranged a traditional Korean barbecue dinner. The first night allowed the delegates to get to know each other and begin friendships which will last a lifetime.



Study Tour map.



## Author

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Monday morning, 18 March, members of the tour traveled two hours to Hyundai Steel Dangjin Plant.

The initial meeting point was at the research center, where introductions were held. Hyundai Steel is part of Hyundai Motor Group, which is the third-largest automaker in the world. Hyundai Steel's production capability is around 24 million metric tons/year produced at three plants. Dangjin Works construction started in 2010 as a new integrated complex with flat and long production portfolios. The basic oxygen furnace (BOF) route (flat) steelmaking capability is 12 million metric tons/year and the electric arc furnace (EAF) route (long) steelmaking capability is 2 million metric tons/year.

The group visited the casting floor, where casters #1, #2 and #3 are located. The tour included observation



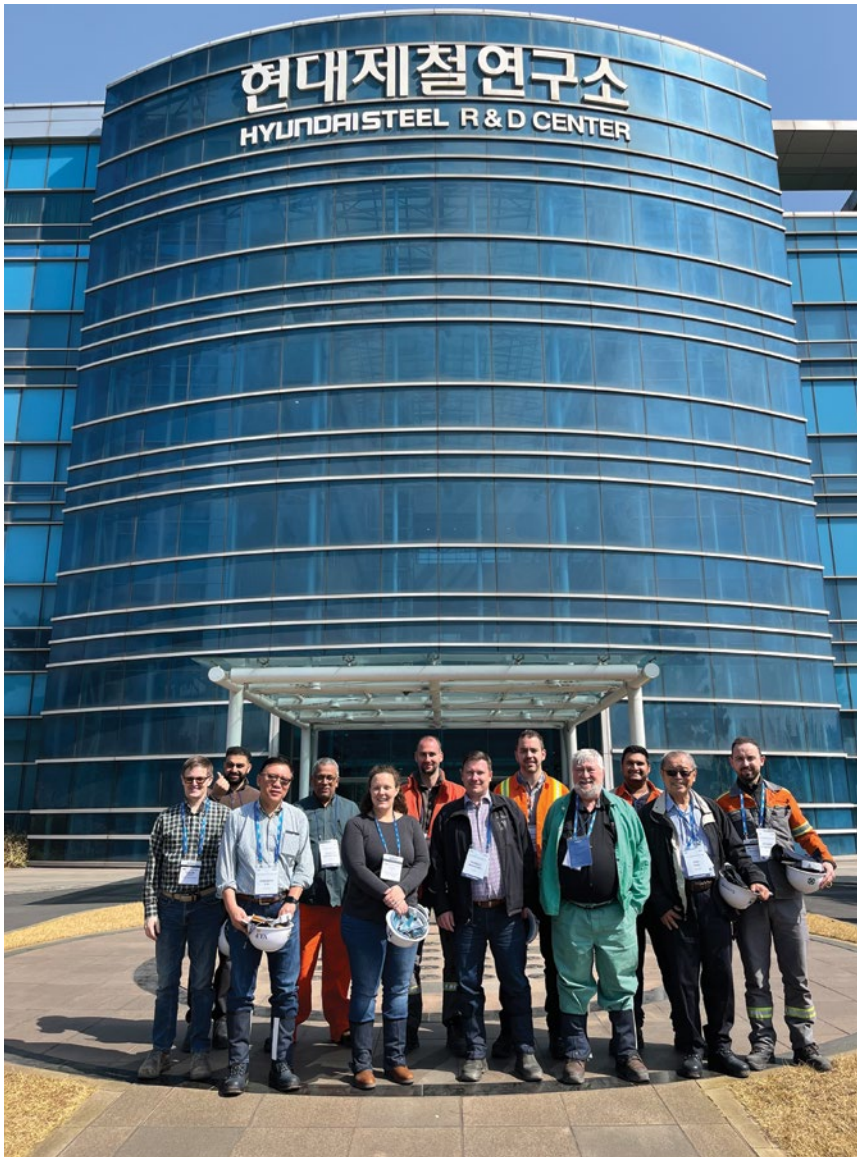
Hyundai Steel Dangjin Works overview.

of caster deck operation, a walkthrough into the runoff area and also the grinding/scarfing facility. The entire steelmaking facility includes five BOF vessels, four ladle furnaces, four RH degassing units and five dual-strand slab casters. Highlights for the caster operation were observation of robotics which allow for an almost



The delegates visited Hyundai Steel Dangjin Plant. Ronald O'Malley (right) presented Hyeongjin Kim (left) with a plaque of appreciation.





The delegates' visit to Hyundai Steel Dangjin Plant began at its R&D center.



Rudolf Moravec (right) presented a plaque of appreciation to Sungwon Hong (left) for hosting the delegates' tour of SeAH Besteel Corp.

“humanless” casting, a massive 100-ton tundish, and all strands have electromagnetic stirring capability. With such equipment, Hyundai Steel achieves the highest steel quality level required for automotive products, mostly for their own consumption within the Hyundai group. The next stop was a visit to the specialty steel plant where special bar quality (SBQ)-type products are produced. The steelmaking facility includes an AC EAF with a ladle metallurgy furnace (LMF) and RH secondary metallurgy units. The EAF is charged with up to 30% hot metal. A 4-strand bloom caster with slidegate system is available for casting. Following both tours, a technical exchange was held.

The first day concluded with a trip to the town close to the next plant on the tour. A classic Korean barbecue dinner was hosted by Roger Magdalena from ThermoFisher Scientific.

Tuesday morning, 19 March, the delegates took a short trip to SeAH BeSteel to their Gunsam Works. SeAH is the No. 1 SBQ manufacturer in South Korea with half of their 2.1-million-metric-tons/year production going into the automotive market. Two steel shops are located on Gunsam site. The delegates had opportunity to visit Steel Shop #1 where EAF, LMF, vacuum tank degasser (VTD) and RH units are located. A 2-strand bloom caster capable of casting 510 x 390 mm blooms is the main casting unit. The attendees had opportunity to not only visit the steelmaking facility but also the entire rolling and finishing facilities. Additionally, they toured the forging plant which is attached to Steel Shop #2. The forging plant contains a 13,000-ton press to manufacture parts for ships and includes the largest quench tank in the world. A Q&A session and technical exchange completed the tour.

A four-hour bus ride to POSCO followed. After arrival to the





POSCO Gwangyang Works overview.

POSCO hotel, dinner sponsored by VUHZ was hosted by Dong Cheol Shin.

The POSCO Gwangyang Works tour started on Wednesday morning, 20 March, at its visitor center. The center is located on top of the hill overlooking the entire plant. Inside is a complete scale model of the plant. It is used to demonstrate the material flow from one site to another (iron ore to finished product). The plant was initially built in 1986 and has continued to expand. Currently, the site includes five blast furnaces (including the biggest one in the world with a production

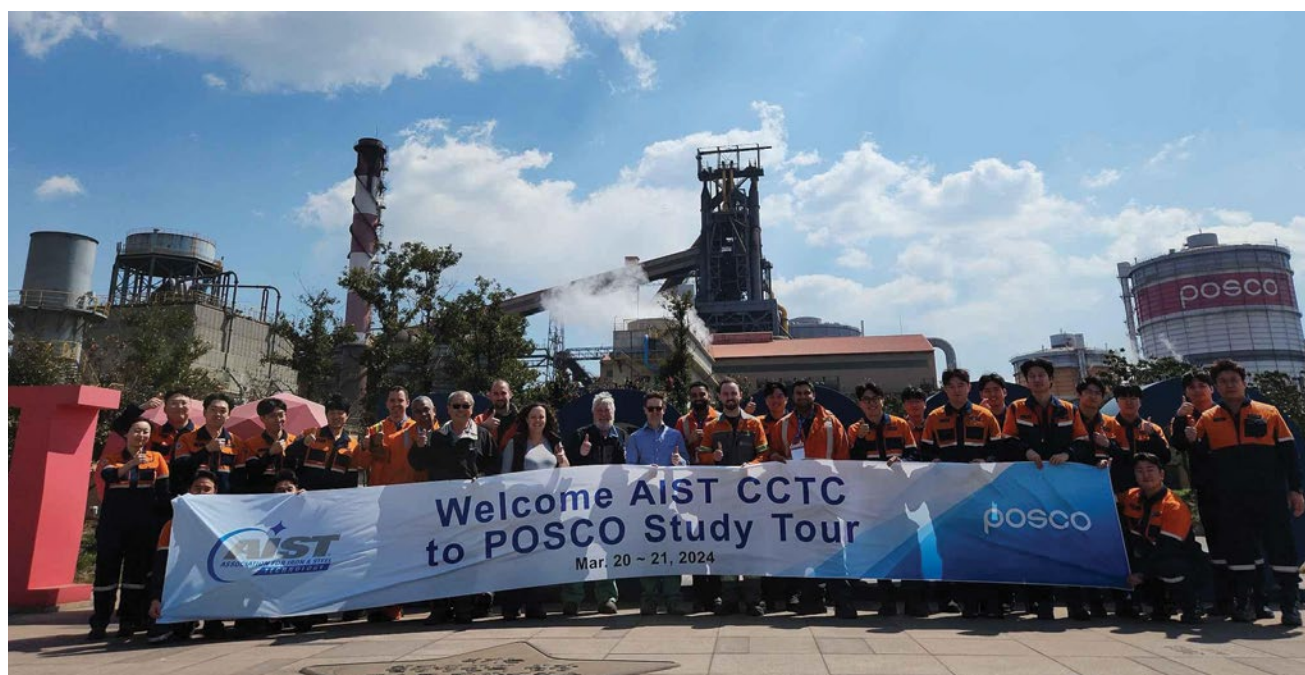
capability of 15,000 metric tons/day), three steelmaking and casting facilities, and a complete portfolio of hot rolling mills and downstream facilities, including a non-grain oriented (NGO)/grain oriented (GO) line currently under construction.

The plant's steelmaking capability is 22 million metric tons/year.

Steelmaking Plants #1 and #2 include four dual-strand slab casters, and Steelmaking Plant #3 has two dual-strand slab casters. In total, 10 dual-strand slab

casters are available for casting. The casting capability is designed to produce automotive exposed, plate/pipe, advanced high-strength steel or NGO. The tour group visited Hot Strip Mill #3 first and then Casting Plant #1 (part of Steelmaking Plant #1). The casting plant includes four dual-strand slab casters on one casting floor.

The plant and the surrounding community were built on land reclaimed from the sea. POSCO plans to develop a hydrogen reduction steel plant in the coming



POSCO Gwangyang Works features the biggest blast furnace in the world.



The delegates visited POSCO Pohang Works.

years. The expected completion date is 2041 with full operation by 2050.

A technical exchange was held, followed by lunch in a local restaurant, which allowed the group to continue their networking and discussions.

Next, the delegates took a four-hour bus ride to the town of Gyeongju. A dinner reception was hosted by POSCO, followed by a visit to the historical site of Donggung.

Thursday, 21 March, started with a visit to the POSCO historic museum where the Study Tour attendees experienced the rich history of POSCO, from its creation up to the latest enhancements. As part of the museum visit, they were able to see the entire plant from the road. The plant is close to the city, and POSCO ensures that they are a good neighbor. In fact, all of the visited plants are in close proximity to cities. This puts the steelmaking operations under intense scrutiny. They operate well within all environmental requirements.

POSCO Pohang was built in 1973. They currently have three blast furnaces in operation (with available hot metal capacity of 13.5 million metric tons/year) and two FINEX units capable of producing 3.3 million metric tons/year of iron. Three steelmaking facilities are within the plant with the capability to produce

16.6 million metric tons/year. There is also a stainless steel steelmaking facility with a production capability of 2 million metric tons/year. The continuous casting process is divided into four casting plants. Four dual-strand slab casters are in Casting Plants #2 and #3. One dual-strand slab caster and one 8-strand bloom caster are in Casting Plant #3. A 6-strand billet caster and a newly constructed PosMC jumbo caster are in Casting Plant #1. The delegates visited Continuous Casting Facility #3, which was a highlight of the trip. Close-up observations of submerged ladle exchange, caster start-up, pulpit setup and much more were highly appreciated by the group.

The day ended with a dinner sponsored by Vesuvius at the Yosukgung 1779 restaurant. The group dined in a typical Korean sit-down setting.

On the last day of the tour, 22 March, the delegates visited Hyundai Steel Pohang Works. The Pohang plant has two steelmaking facilities with a combined capacity of 3 million metric tons/year. Their product portfolio includes rails, H beams, bars and rebar. Steelmaking Plant #2, which the group visited, is a 20-minute bus ride from the main office. The tour included process observation at EAF, LMF/VTD and finished at the 6-strand bloom caster. A technical discussion



followed. Topics included machine learning and models implementation, product quality issues and best practices to detect such issues, robotics experiences, and CO<sub>2</sub> reduction practices from small improvement projects to capital-intensive approach.

It was then time to say goodbye and start the last bus journey to the train station, where the group embarked on a three-hour high-speed train ride back to Seoul. Some members of tour group departed at the train station to explore Seoul, but the majority headed to the airport hotel. Once at the airport hotel, members of the tour gathered for the last time for a dinner sponsored by United States Steel Corporation. Conversations about valuable tour memories, technical details, cultural differences and lastly tips for gifts to bring home were neverending.

The AIST Caster Study Tour of South Korea was another milestone for domestic and overseas attendees to see some of the newest steel-producing and casting operations, run by highly qualified and skilled managers, engineers, and operators. Some of the highlights from the tour included:

- » Safety awareness and housekeeping in every visited plant was outstanding and it is difficult to find similar example in North America. Each item has a place to be stored, and the roadways are paved and clean.
- » In order to be a good neighbor to surrounding areas (cities and nature), all storage facilities were or are being transformed to covered arrangements, even for iron ore stockpiles.
- » Each company had a similar organizational structure which included operations, a technology department connected to various departments and research. Strategic teams were also present and they were leading the effort to improve every aspect of the process. They coordinated each team so that



During their visit to POSCO's museum, the delegates partook in an interactive presentation of the steelmaking process from liquid iron to finished product.

everyone was working toward the same goal and building the vision for the next 10 years and beyond.

- » A significant number of young professionals have been added to the workforce to be the next generation of steelmakers. To attract and retain young professionals, companies are providing significant living support to help maintain work/life balance, which is not easy in Korean society.
- » Tour organization always started with introductions of the plant and detailed information about steelmaking/casting operation followed by a well-planned tour — one of the key points of the tour was the use of radio for communication between tour guide and tour group.
- » Among modern Korean flat roll steelmaking operations where casting does not present a bottleneck, common underlying themes included:
  - Design of casting operations to produce best slab quality.
  - No operators around the strand during steady-state casting (fenced area).
  - Dual-strand slab casters.
  - Hydraulic oscillators.
  - Automated flux feeders and top-fed dummy bars.
  - Use of mold electromagnetic stirring in slab casters is more common.
  - Slab condition equipment located directly at the end of the casting building.

» Long product facilities have a couple common areas:

- The best possible steel cleanliness is the common goal of each plant — degassing equipment plays a crucial role.
  - Process optimization within secondary steelmaking was highlighted in every plant as key for sustainable operation and the best quality.
- » Decarbonization efforts were present in every plant, individually crafted and being prepared for implementation phase. No significant subsidy from the government is provided.

Study Tours are not only a great opportunity to visit manufacturing plants and learn different approaches to produce steel, but also to allow participants to interact among themselves. Another unique thing is seeing different cultures and exploring the country itself. Traveling throughout Korea via bus gave the attendees a unique perspective about urban development and countryside views.

The organizers and attendees would like to thank the dinner sponsors and Anna Voss of AIST, who kept the tour and discussion moving on time. The author would like to thank U. S. Steel management, especially Tony Faulds and Bill Schlichting, for their encouragement and trip support. ♦

