Novel Installation Method of Conveyor Belt in Bangladesh

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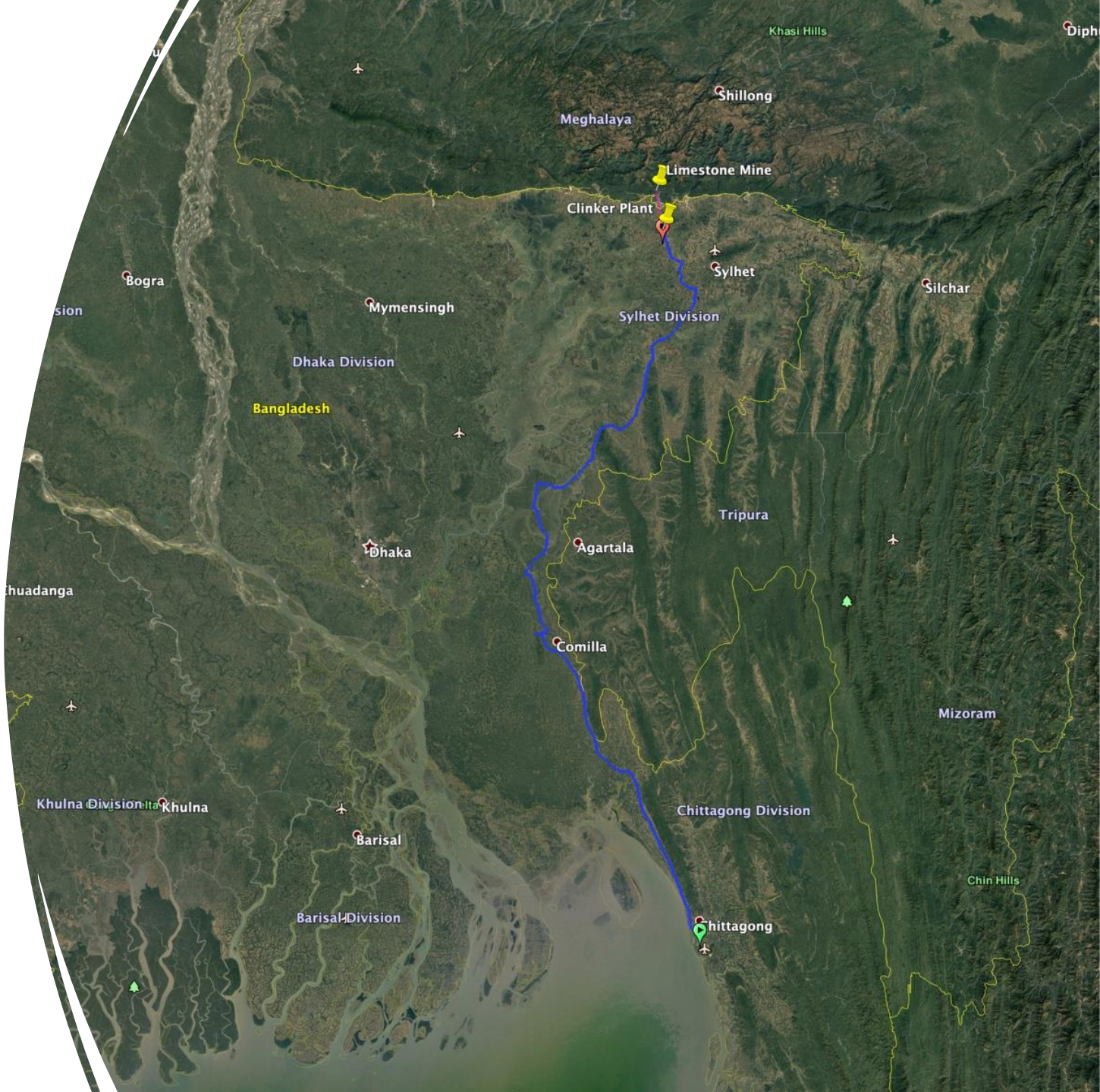
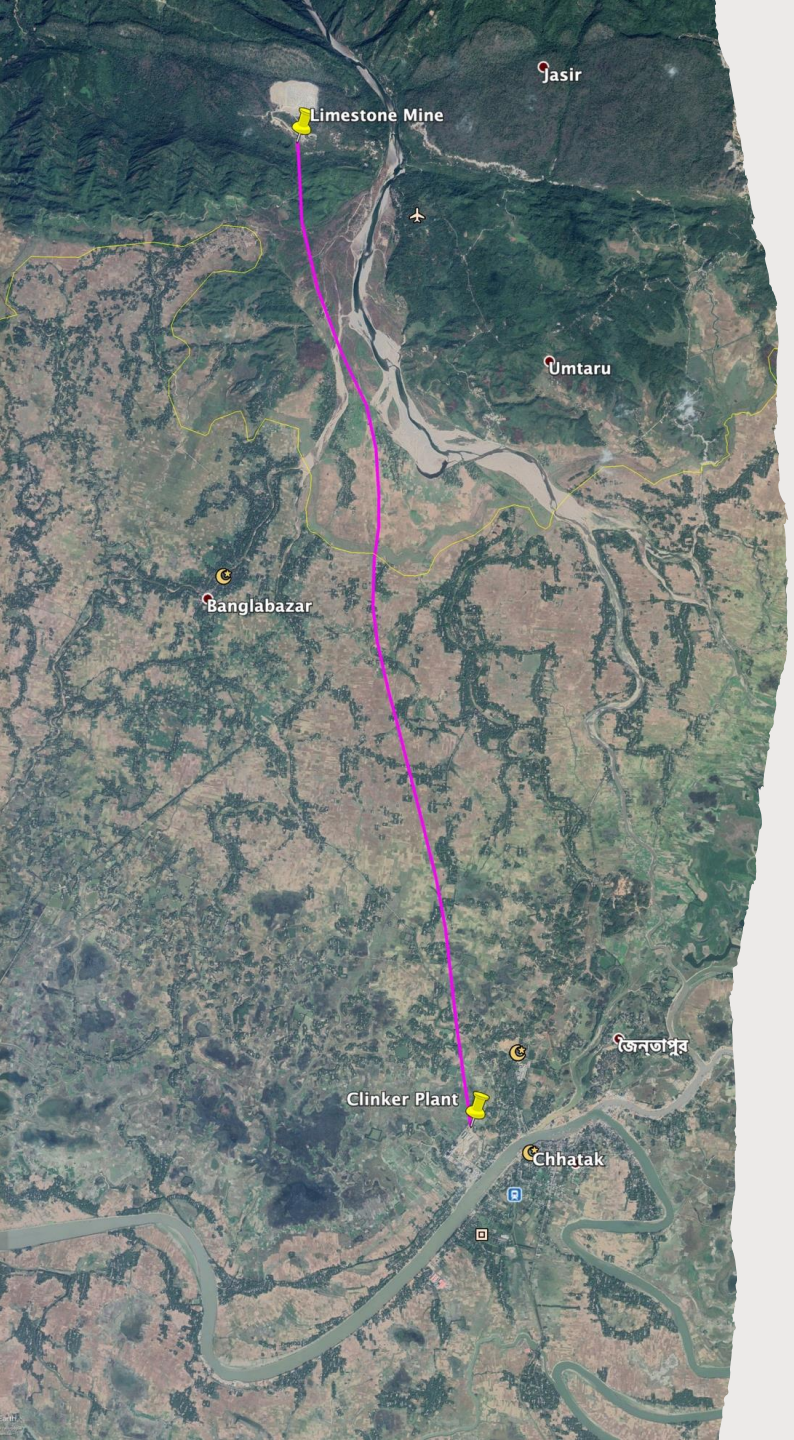
Geography

- Limestone is transported from a mine in the Kurmi deposit in the Meghalaya state, north-east India, across the border to the Lafarge Surma Cement Plant in Chhstak upazila in Northern Bangladesh.
- The conveyor was originally constructed in 2004 and is one of the longest trans-border conveyors in the world. It covers 10 km in Bangladesh and 7 km in India. The conveyor is appropriately known as the Long Belt Conveyor (LBC).
- After 11 years in operation the belt needed to be replaced and to minimize down time a novel approach was used to replace the 34 km of belting.





Conveyor Path

- The Indian portion of the site is very close to Cherrapunji and Mawsynram which are often cited as the highest rainfall areas in the world. The monsoon duration is from May to September with an average monthly rainfall of 1.5 m to 2 m and maximum rainfall in a day is around 500 mm. The natural ground level of the site in India is at a higher elevation than Bangladesh resulting flow of all rainwater to Bangladesh and submerging the conveyor corridor under water for four months.
- The Surma plant is the only clinker manufacturing plant in Bangladesh.

Annual Flooding

- To accommodate the annual flooding the entire conveyor is raised 5 m above the ground and only accessible by maintenance trolleys. The original annual tonnage for the conveyor system is 2.5 MTPA traveling at a belt speed of 4.0 m/s. At the onset of the project a review of increasing the annual tonnage of 5 MPTA through an increase in the belt speed to 6.5 m/s was considered. [1] The belt selection considered this increased capacity.

Original Installation

- The original ST 2500 steel cord belt was supplied by Phoenix in **300 m** rolls to the Meghalaya site and 500 m rolls to the Bangladesh site.
- The final belt splices were completed at the international border.
- With this approach **100 splices** were required and 80 days to complete the work with 2 splice work areas at each end. [2]

Replacement Belt

- The belt supplier, Sempertrans, was able to supply large belt rolls of **921 meters** in length from their factory in Belchatow, Poland to site reducing the number of splices in the belt from the original 100 down to **37**.
- While significantly improving the reliability of the conveyor and reducing the amount of splicing done onsite, getting the large belt rolls from the port to the site was a challenge. Many of the roads and river crossings in Bangladesh are not sized for such large loads. The belt rolls were shipped to the Chittagong port and then transported by truck the final 393 kms to the cement factory located near Chhatak, Bangladesh.
- Cranage for the safe handling of the large belt rolls was also a challenge.

Changeout Discussions

- Several methodologies for changing out the belt were evaluated. In addition to the conveyor crossing an international border and being elevated 5 meters above the ground, the conveyor has 7 horizontal curves with radii ranging from 4,000 to 30,000 m. There are also belt turnovers at both the head and tail of the conveyor. While pulling the belt over this long distance of 17 km there was a concern of the impact of any tension variations.
- To handle these challenges, it was decided to change the entire belt from only the head end in Bangladesh where the tensions are the lowest and in as long of sections as possible.
- The option of using the existing conveyor drives to assist with pulling the belt was dismissed due to the risk of damaging one of the drives or gearboxes which would leave the conveyor inoperable until a replacement could be brought to site and installed.

Almex Proposed Changeout Plan

- Pre-splice and flake out 12 km of belting at the head end of the conveyor.
- This work would be done while the conveyor was in normal operation, not impacting production.
- The conveyor would then be stopped, the new belt spliced to the old belt and in a matter of a few days, with powerful belt winders, 12 km of old belting would be removed from the system as the new belt was pulled on.
- The other end of the new belt would then be spliced to the old belt and the conveyor returned to operation.
- The initial plan was to repeat this process for a total of 3 times to replace the 34 km of belting.

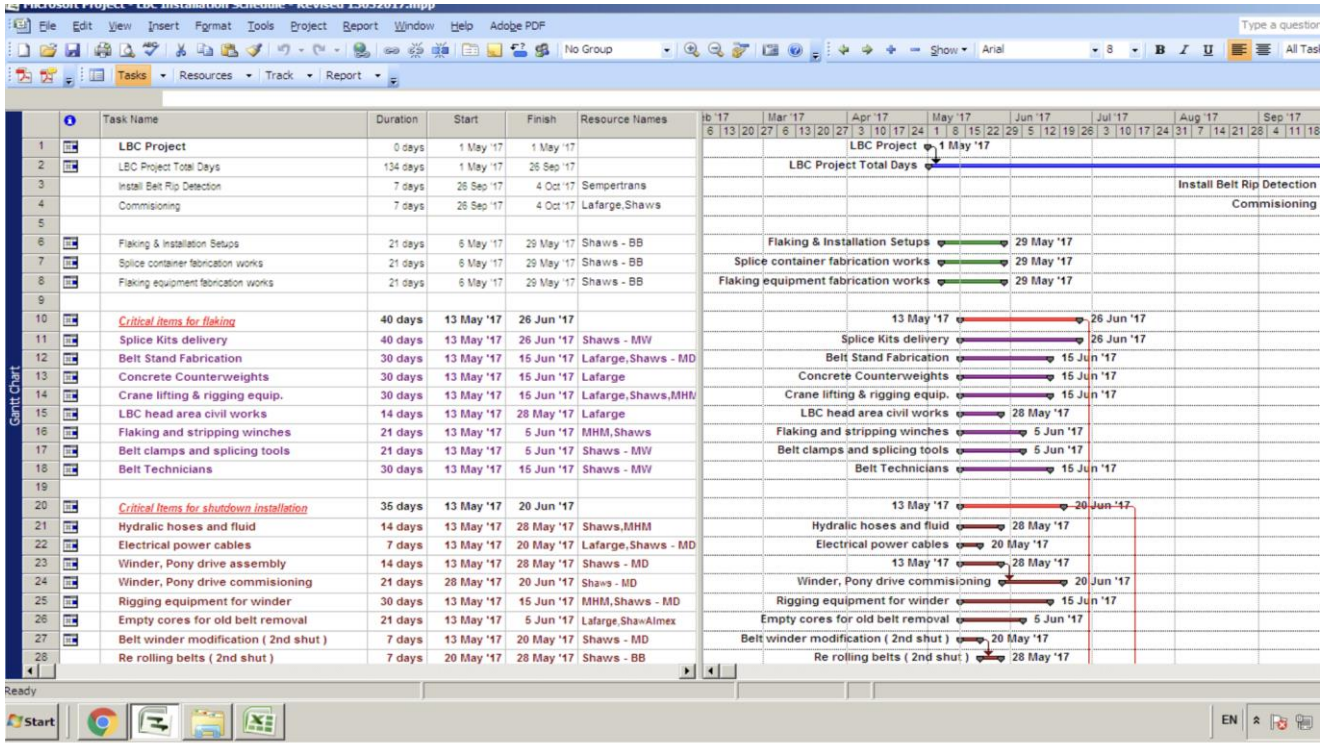
Required Pull Force

- A lot of discussion about the force required to pull the old belt off and the new belt off.
- Collaborative effort between the engineering team at Sempertrans and Almex
- The force required to pull the 34km of belting belt during the change out was calculated as 281 kN. With two, 150 kW, powerful belt winders designed and built by Almex the belt was able to be pulled at a controllable speed of 0 to 5 m/s.
- To minimize the variations in tension as the belt was pulled off the 100m long flaked piles a medium winder with 18.5 kW, configured as a booster drive, was utilized to pull the belt from the pile and keep the tension of the new belt at a constant, very low, tension.

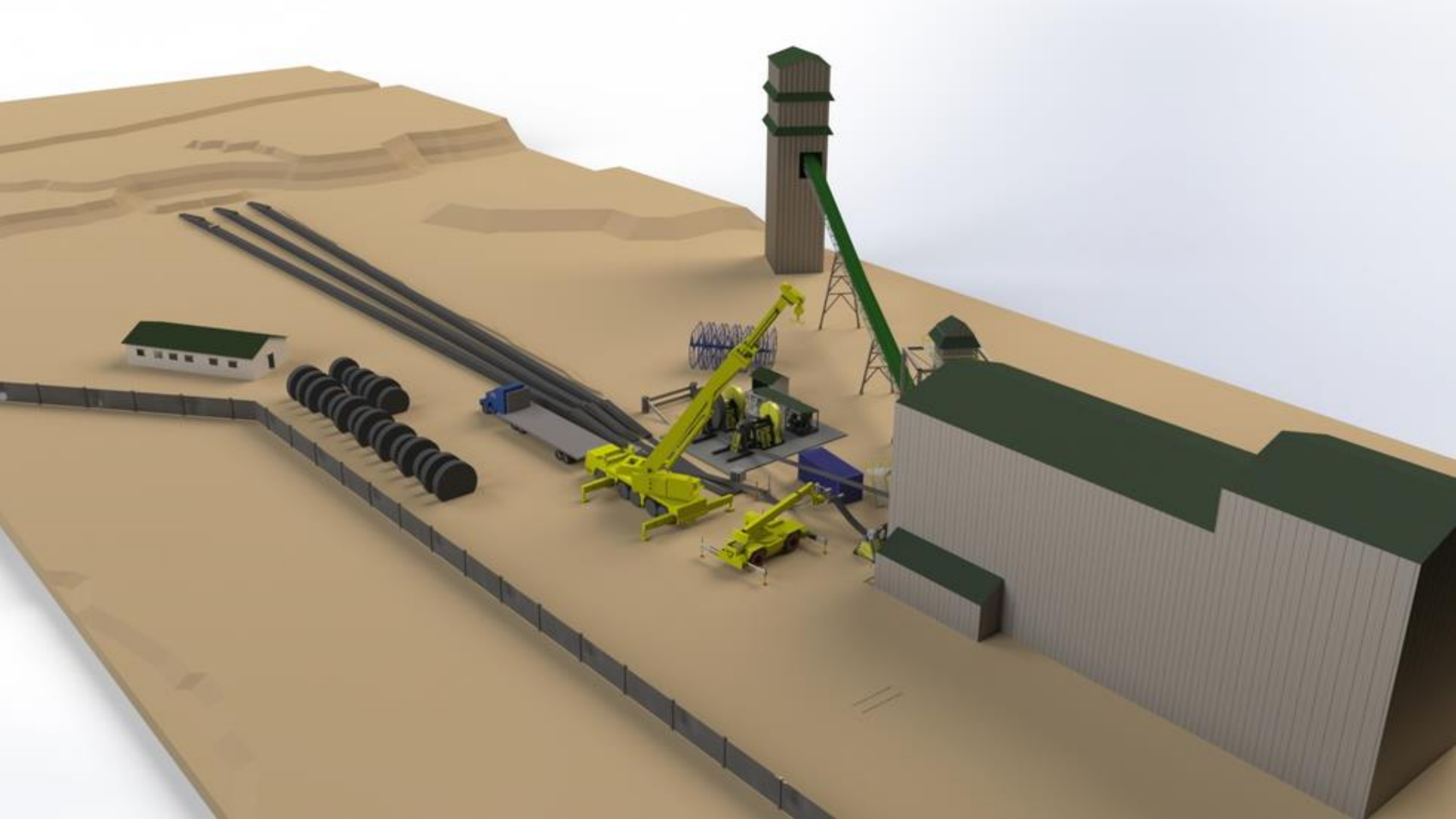
Project: Lafarge Bangladesh Overland

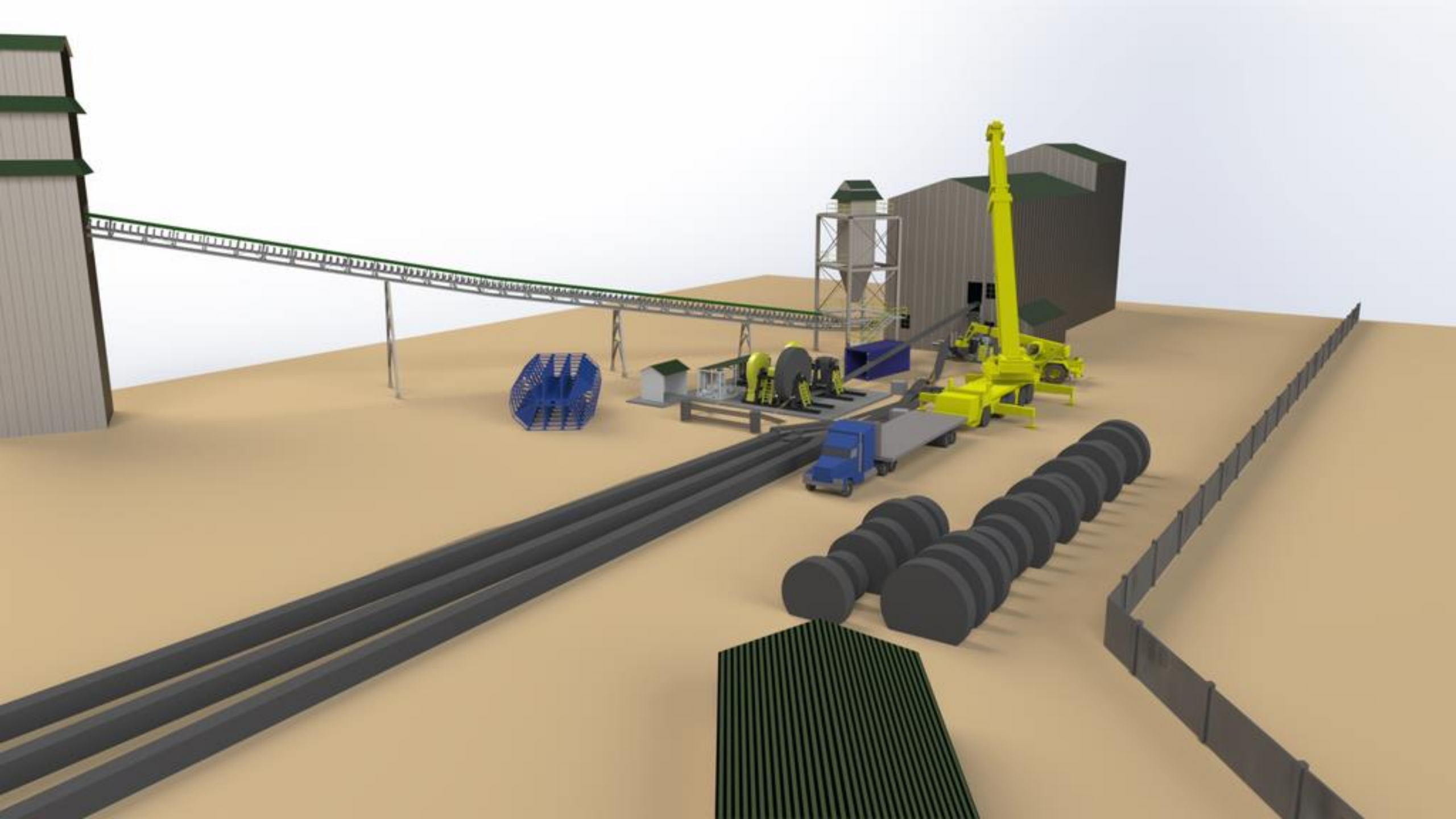
Section		**1**	
Lenght of section	L	16833	m
Height difference	H	-80	m
Belt weight	m_G	24,5	kg/m
Related idler wheight	m_{RO}	4,8	kg/m
	m_{RU}	2,8	kg/m
ficticious friction factor	f_O	0,03	-
	f_U	0,03	-
Pulling force (slope: -19,2 kN / -2 t)	T_O	125,9	kN (12,8 t)
	T_U	154,5	kN (15,7 t)
Total pull force	**T_{Ges}**	**280,4**	**kN (28,6 t)**
Total max pull force	**T_{Max}**	**280,4**	**kN (28,6 t)**
Section		**2**	
Lenght of section	L	0	m
Height difference	H	0	m
Belt weight	m_G	24,5	kg/m
Related idler wheight	m_{RO}	4,8	kg/m
	m_{RU}	2,8	kg/m
ficticious friction factor	f_O	0,03	-
	f_U	0,03	-
Pulling force (slope: -19,2 kN / -2 t)	T_O	0,0	kN (0 t)
	T_U	0,0	kN (0 t)
Total pull force	**T_{Ges}**	**0,0**	**kN (0 t)**
Total max pull force	**T_{Max}**	**0,0**	**kN (0 t)**
Overall total pull force	**$T_{1/2}$**	**280,4**	**kN (28,6 t)**
Overall max total pull force	**T_{Max}**	**280,4**	**kN (28,6 t)**

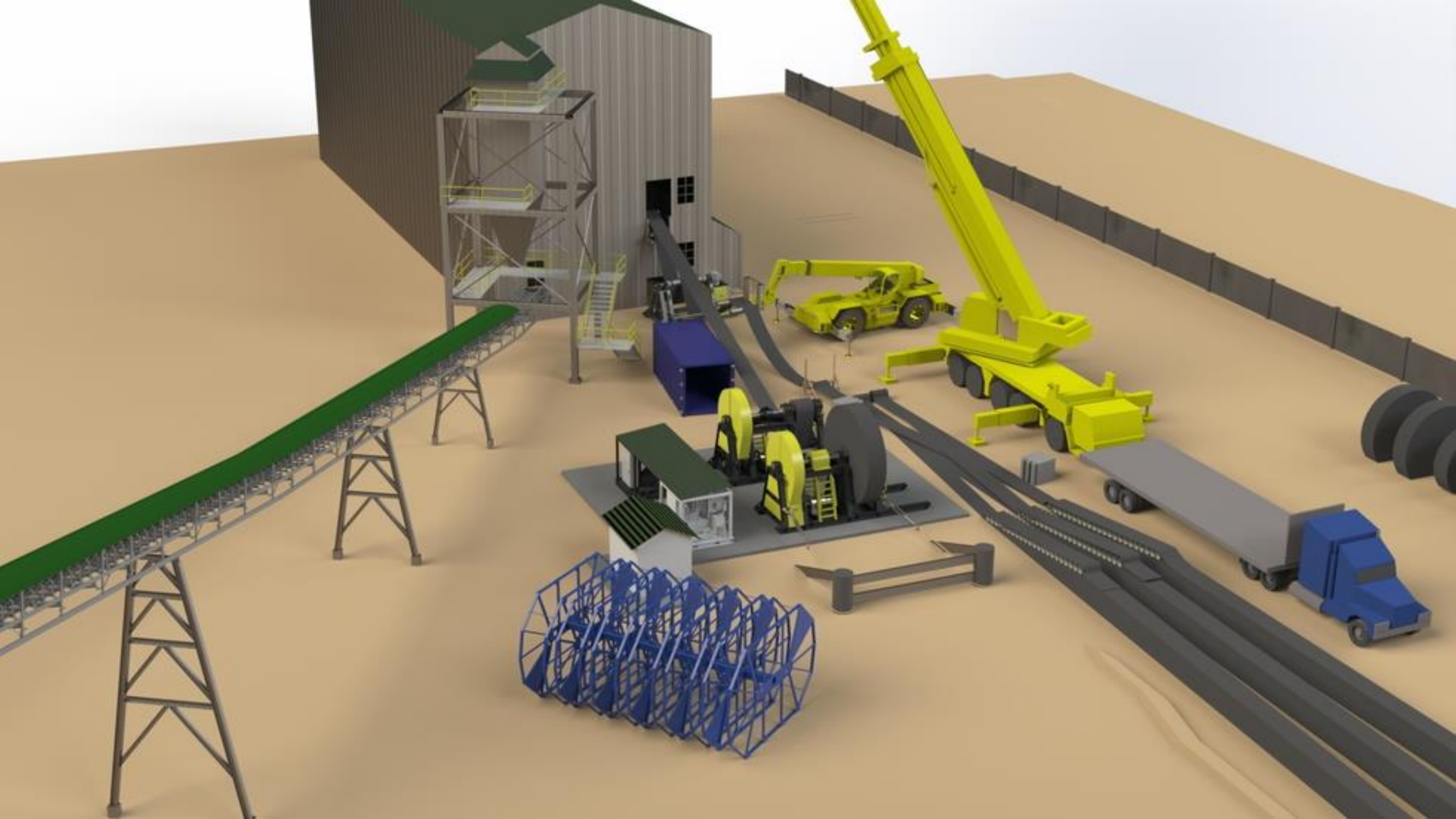
Project Scheduling -> AutoDesk Navisworks Simulate



	Task Name	Duration	Start	Finish	Resource Names
1	LBC Project	0 days	1 May '17	1 May '17	
2	LBC Project Total Days	134 days	1 May '17	26 Sep '17	
3	Install Belt Rip Detection	7 days	26 Sep '17	4 Oct '17	Sempertrans
4	Commisioning	7 days	26 Sep '17	4 Oct '17	Lafarge,Shaws
5					
6	Flaking & Installation Setups	21 days	6 May '17	29 May '17	Shaws - BB
7	Splice container fabrication works	21 days	6 May '17	29 May '17	Shaws - BB
8	Flaking equipment fabrication works	21 days	6 May '17	29 May '17	Shaws - BB
9					
10	Critical items for flaking	40 days	13 May '17	26 Jun '17	
11	Splice Kits delivery	40 days	13 May '17	26 Jun '17	Shaws - MW
12	Belt Stand Fabrication	30 days	13 May '17	15 Jun '17	Lafarge,Shaws - MD
13	Concrete Counterweights	30 days	13 May '17	15 Jun '17	Lafarge
14	Crane lifting & rigging equip.	30 days	13 May '17	15 Jun '17	Lafarge,Shaws,MHM
15	LBC head area civil works	14 days	13 May '17	28 May '17	Lafarge
16	Flaking and stripping winches	21 days	13 May '17	5 Jun '17	MHM,Shaws
17	Belt clamps and splicing tools	21 days	13 May '17	5 Jun '17	Shaws - MW
18	Belt Technicians	30 days	13 May '17	15 Jun '17	Shaws - MW
19					
20	Critical Items for shutdown installation	35 days	13 May '17	20 Jun '17	
21	Hydralic hoses and fluid	14 days	13 May '17	28 May '17	Shaws,MHM
22	Electrical power cables	7 days	13 May '17	20 May '17	Lafarge,Shaws - MD
23	Winder, Pony drive assembly	14 days	13 May '17	28 May '17	Shaws - MD
24	Winder, Pony drive commisioning	21 days	28 May '17	20 Jun '17	Shaws - MD
25	Rigging equipment for winder	30 days	13 May '17	15 Jun '17	MHM,Shaws - MD
26	Empty cores for old belt removal	21 days	13 May '17	5 Jun '17	Lafarge,ShawAlmex
27	Belt winder modification (2nd shut)	7 days	13 May '17	20 May '17	Shaws - MD
28	Re rolling belts (2nd shut)	7 days	20 May '17	28 May '17	Shaws - BB



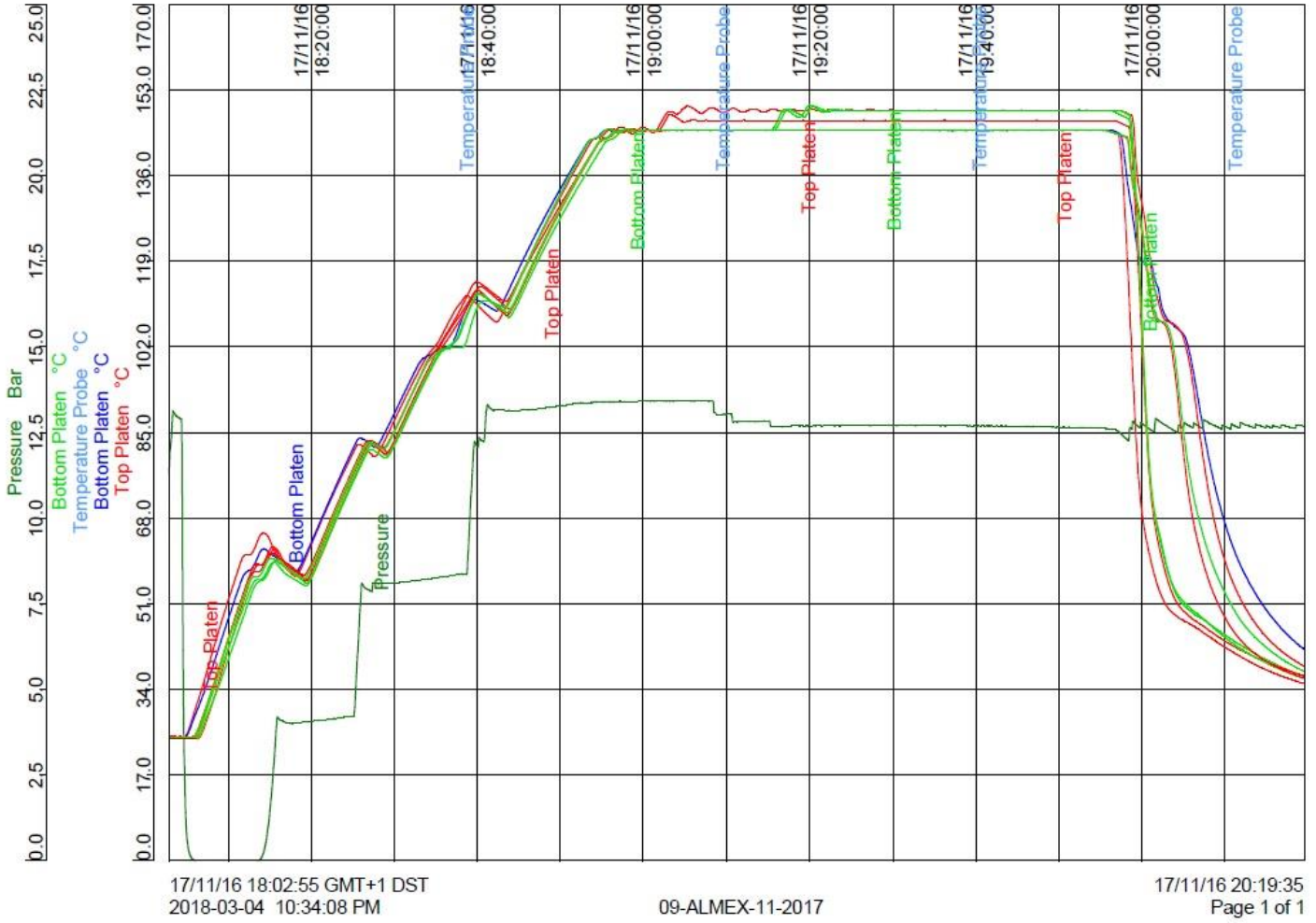




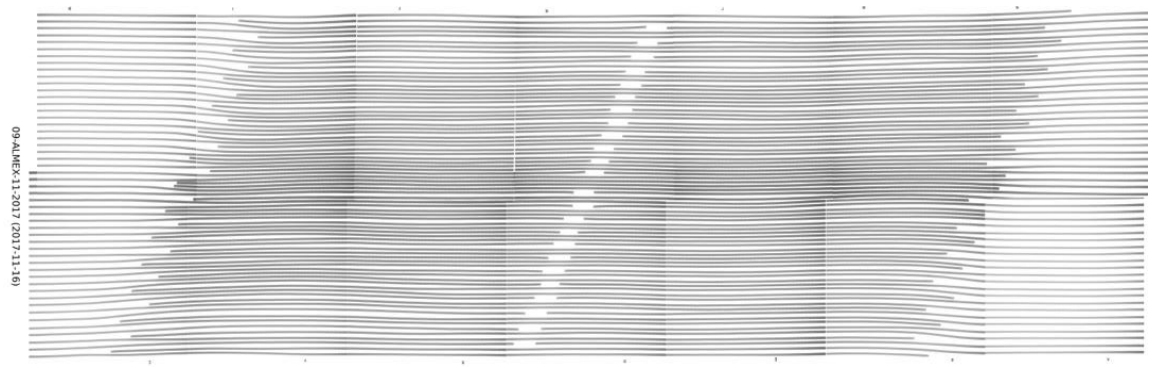
Start of Work

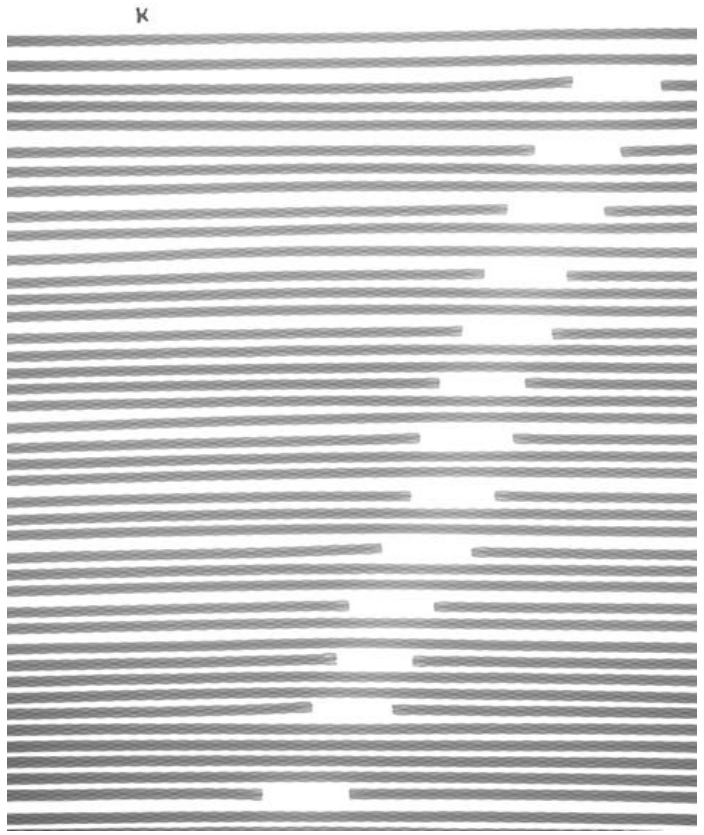
Quality Control

- By providing all the equipment, supervision, and labor on the change out Almex was able to provide a multiyear warranty on the splices. To ensure quality each splice was done in an airconditioned work area using the state-of-the-art Almex SG1 control system with pressure and temperature dataloggers monitoring the cure cycle of each splice.



X-Ray of Every Splice





Changing the Belt

Change of Plans

- The first round of splicing, flaking, and pulling the belt onto the system proceeded so well that for the second round all of the remaining 22 km of belting was spliced together and pulled onto the system.
- To accommodate the extra length the 3 continuous flaked piles of belting were extended to 130 m long. This eliminated the need for a third shutdown.
- At the start of the project there were concerns about changing such long lengths in a single shutdown. With proper planning, equipment, and onsite expertise any length conveyor can be changed out in a single shutdown. Typical system down times include 1-2 days for the initial splice of the new belt to the old belt, 1 to 5 days to change the entire belt, and 1-2 days for the final splice connecting the new belt ends.
- The belt was changed out in 2 phases with the project completed on April 18, 2018. “We have finished the replacement work one day ahead of the schedule.” Mr. Harpal Singh [3][4]

Drone Video

Completing such a large and highly technical belt change out in this part of the world was challenging. The logistics of getting the equipment, belting, and labor to site had both expected and unexpected hurdles.

For the supervisors that spent a significant time onsite they developed a good working relationship with the site personnel.

In the end the project was a success and three years later the belt and splices are operating without incident.

References

- [1] LafargeHolcim to raise limestone products from Nongrai mines, The Economic Times, Dec. 22, 2015, https://economictimes.indiatimes.com/industry/indl-goods/svs/cement/lafargeholcim-to-raise-limestone-products-from-nongtrai-mines/articleshow/50285461.cms?from=mdr
- [2] Vikram, Kumar and Pabak Mukhopadhyay. The Challenge of Creating a 17 km Belt Conveyor for the Lafarge Surma Cement Plant, Bulk Solids Handling, Vol. 26, No. 4, 2006. https://forum.bulk-online.com/attachment.php?attachmentid=47358&d=1537259693
- [3] LafarcgHolcim replaces 17km-long conveyor, CemNet.com, May 15, 2018. https://www.cemnet.com/News/story/164058/lafargeholcim-replaces-17km-long-conveyor.html
- [4]Rowland, John. LarfargeHolcim Bangladesh replaces transborder conveyor. World Cement, May 22, 2018. https://www.worldcement.com/indian-subcontinent/22052018/lafargeholcim-bangladesh-replace-transborder-conveyor/