Capability Statement

Bulk Materials Handling Machines

aspec engineering pty ltd

Introduction to Aspec Engineering

Aspec Engineering Pty Ltd (ASPEC) is a multi-disciplinary engineering company from Australia founded in 2003 that provides services to mining companies, ports, heavy industries and government organisations. We are a specialist firm with a national footprint, with a long-term experienced staff and a large database of corporate knowledge.

ASPEC is the leading independent consultant in Australia for bulk materials handling machines (shiploaders, stackers, reclaimers, stacker reclaimers), and is experienced in engineering safe and sustainable systems for bulk materials handling. Bulk materials handling machines constitute over 50% of ASPEC's business, with asset management and maintenance related engineering forming the focus of our work in this field.

Clients recognise ASPEC for providing value added solutions and having a flexible approach to our work. We have a strong commitment to quality, safety and environment with well-developed design tools and systems certified to ISO 9001. Over 90% of our workload is repeat business from existing clients.

Major clients include:

Our Team and Locations

ASPEC employs 40 highly qualified, multi-discipline, professional staff, operating from various office locations around Australia including Brisbane, Newcastle, Perth and Wollongong. With our diverse team, we can respond quickly and efficiently to clients' requirements, irrespective of the location of the project.

ASPEC maintains a panel of highly regarded industry experts who are referred to regularly for specialist advice. We also have alliance partners to provide additional expertise and resources for projects and have completed projects nationally and internationally in 8 countries.

Quality, Safety and Environment

ASPEC operates a Management System designed to provide the necessary controls to all our business activities. The Management System applies to all elements of our business, including quality, safety and environment.

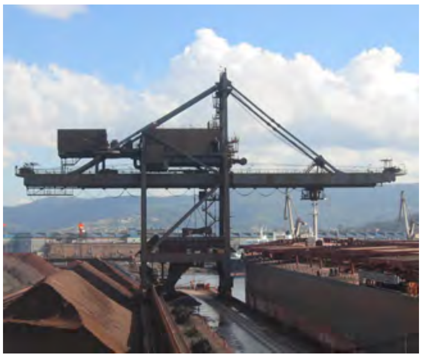
ASPEC is ISO 9001 certified.

Background

Bulk materials handling machines such as shiploaders, stackers, reclaimers and car dumpers have a higher risk profile than static structures. These large mechanical structures weigh hundreds of tonnes and continually move. They can have collisions, become unstable, become out of control due to high wind, corrode and develop structural fatigue. This is a key difference compared to other static structures such as wharves and buildings. Owners and operators and other parties involved have significant responsibilities for risk management of this equipment to prevent accidents and injuries. ASPEC provides engineering services for bulk materials handling machines across the life cycle from initial procurement to replacement or de-commissioning.

Machine Types

Shiploaders are used to load bulk materials into ships' holds at a port and are the last link in the loading chain from mine to ship. Ship unloaders unload bulk materials from the ship at the receiving port. High reliability is essential to maintain throughput.



Ship Unloader (Left), Slewing Shiploader (Right)

Stacking machines are used to stack bulk materials onto a stockpile. The material is later dug up with a reclaiming machine for further transport.

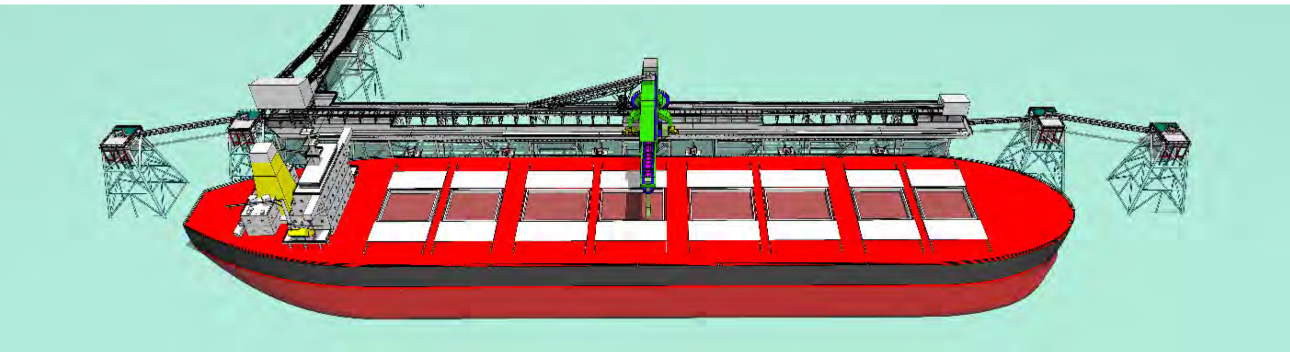
Stacker (Left), Reclaimer (Right)

A stacker reclaimer is a combined machine which has dual functions of stacking and reclaiming. A car dumper is used for unloading rail cars. It rotates the rail car to dump out the contents.

Stacker Reclaimer (Left), Car Dumper (Right)

Machine Work Areas

Bulk materials handling machines require engineering support throughout their whole life span. This is critical to reduce the risk of failure and maintain high productivity. This lifecycle diagram shows the services ASPEC provides throughout the life span of bulk materials handling machines. Having comprehensive digital twins is critical to simulating the real-world performance of complex machinery like these machines. As part of its processes, ASPEC builds digital models to predict structural and mechanical behaviour. In this way, scenarios such as wind response, earthquakes, abnormal loading conditions, collisions, deterioration, throughput upgrades, methods of operation etc. can be looked at efficiently in all stages of the machine's life cycle.



Berth and Shiploader Model

New Machines

- Feasibility studies
- Port and mine planning
- Machine configuration
- Technical specifications and scope of work
- Environmental performance enhancements
- AS4324.1 structural audit
- Mechanical audit
- Fabrication assistance and construction support
- Machine weighing
- Transport assistance
- Commissioning assistance
- Non-machine infrastructure
- RAMBOs and HAZOPs

Mid-Life

- Asset integrity inspection and assessment
- Plant Integrity Review (PIR)
- Monitoring of machine balance and stability
- Safety upgrades
- Storm wind tie down assessments
- Sustaining capital estimates
- Throughput upgrades and performance improvement
- On-site shutdown support

End-of-Life

- Refurbish or replace
- Fatigue Useful Life Simulation (FULS)
- Fatigue and fracture assessment and repair
- Machine replacement studies

Machine Failures

- Failure investigations
- Recovery projects

New Machines

Feasibility Studies

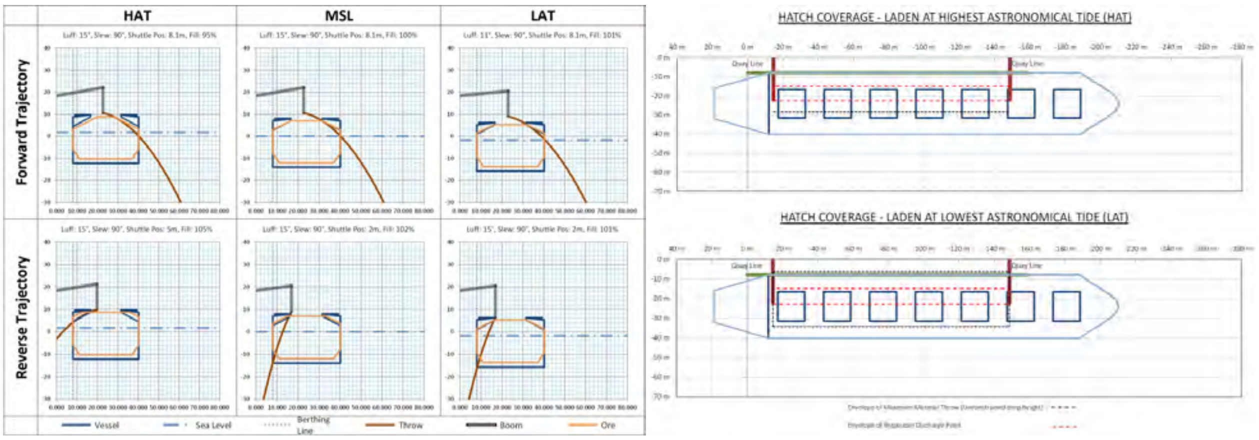
A feasibility study will provide the information on the bulk material sources, types and volumes, infrastructure, and handling system designs which will serve as a basis for an investment decision and support for project financing. As machines are high cost long lead time assets, determining the right configuration is an important part of mine and port planning during the feasibility stage. Machines and infrastructure (e.g. wharves and stockpile areas) also need to be considered together for the particular site and throughput to determine the optimum layout. ASPEC assists clients with feasibility studies for port and mine layout including machines and infrastructure.

Port and Mine Planning

In addition to initial port and mine planning, these facilities will grow and adapt to the evolution of demand and other factors such as product types. The planning process will incorporate the development and evaluation of options for a staging plan for long term growth. Effective staging is carried out in increments to suit the capacity and configuration of materials handling machines such as shiploaders, reclaimers and stackers. ASPEC assists clients with both initial port and mine planning as well as effective staging for future developments.

Machine Configuration

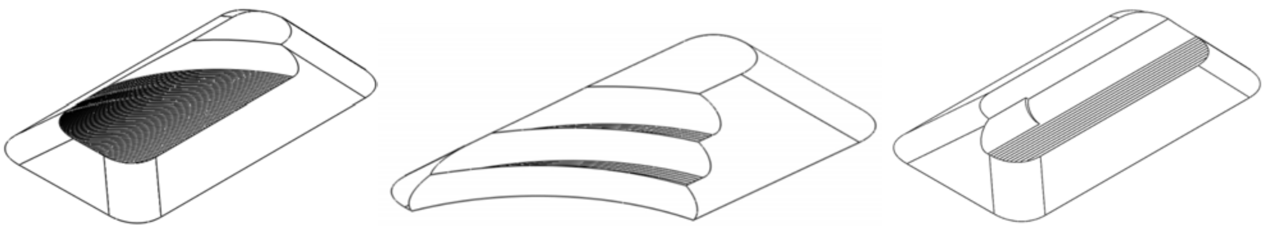
ASPEC has developed specialist tools for machine configuration including hatch filling and clearance assessment for shiploaders. This provides assurance that the shiploader geometry will be capable of servicing the full range of ships using the terminal.



Ship Cross Section and Ship Plan for Hatch Coverage

Another tool developed by ASPEC is simulation software for reclaimer operation including three-dimensional stockpile geometry. This allows ASPEC to:

- Model stockpile shapes from small cone stockpiles to large rectangular stockpiles 20,000 to 200,000 cum
- Replicate reclaim methods including Terrace, Pilgrim, Long Travelling and Waltz Stepping
- Consider all machine sizes and configurations
- Calibrate against machine SCADA (Supervisory Computer And Data Analysis) data



Slew Terrace Reclaiming, Pilgrim Step Reclaiming and Long Travel Terrace Reclaiming

The software is used to:

- Confirm average reclaim rate and overall efficiency
- Compare different stockpile lengths and geometries
- Optimise bench heights
- Compare different reclaim methods
- Compare machine parameters (e.g. slew speeds, boom length, bucketwheel size, throughput)
- Investigate inefficiency (e.g. time to change slew direction, effect of angle of repose)

Specifications, Scope of Work and Cost Estimates

ASPEC has experience with Design, Supply, Install and Commission contracts for various machine types and can quickly and efficiently produce cost estimates and tender documentation for new machine projects. This will typically include:

- Basis of design
- Battery Limits
- Scope of work
- Technical specification including stakeholder requirements
- Technical datasheets
- Engineering interface drawings showing machine envelopes
- Functional description
- Standard specifications
- Preferred equipment list
- Tender evaluation
- Project budget

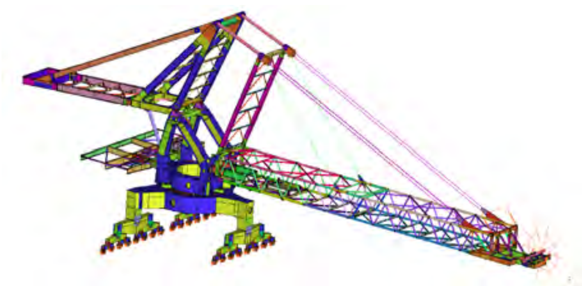
Environmental Performance Enhancements

The solid bulk handling industry has evolved towards not only efficiency and safety, but also environmental awareness. For example, best practice design criteria involve dust control or transport system enclosures. This is often driven by developers not being able to obtain financial backing unless high environmental standards are applied. The same philosophy applies regarding noise, effluent pollution and other environmental and social impacts. Stringent environmental license conditions in many ports mean zero spillage to the environment is a requirement. An example is ASPEC's expertise with loading chutes for shiploaders to assist clients in meeting their environmental obligations.

AS4324.1 Structural Audit

Following a major accident with a bulk handling machine in 1993, the Western Australian Coroner's court recommended bulk materials handling machines be subject to an independent design audit, as is the case in Germany, and an Australian Standard be implemented. In response to this, the Australian Standard *AS 4324.1-1995: Mobile equipment for continuous handling of bulk materials – Part 1: General requirements for the design of steel structures* was implemented, and later revised in 2017. AS 4324.1 contains the scope of work for machine design audits.

ASPEC has undertaken over 70 AS 4324.1 design audits for shiploaders, stackers, reclaimers, and stacker reclaimers for a range of clients in Australia and overseas. ASPEC has developed calculation and simulation methods which ensure the quality and consistent presentation of these audits. ASPEC maintains excellent relationships with machine suppliers (OEMs). As ASPEC is not a competitor to OEMs, they collaborate freely with ASPEC when developing suitable machine configurations and details. The figure below shows a digital simulation model for a reclaimer used in the AS 4324.1 design audit.



Reclaimer Simulation Model

Mechanical Audit

A mechanical design audit involves review of the machine designer's selection of mechanical equipment as well as review of manufacturer's data and specifications to assess the validity of the related loading assumptions and compliance with the technical specification and standards e.g. FEM II and AS 1418. The mechanical audit covers components including:

- Long Travel Drives
- Slew Drives
- Slew Bearing
- Boom Conveyor Drive
- Luff Hydraulics
- Winches

Fabrication Assistance and Construction Support

ASPEC assists clients to resolve requests for information (RFI) from the machine supplier (OEM), and review of contract variations. Services also include technical review and support for weld procedure specifications, inspection and test plans and non-conformance reports for fabrication and manufacture. ASPEC also responds to technical queries from contractors on design issues during construction as well as structural, mechanical and the functional operation of the machine. Where necessary, ASPEC prepares site instructions to resolve interface issues.

Machine Weighing

Machine weighing is recommended in AS 4324.1 to establish the as constructed dead load of the machine. ASPEC has experience with different methods of weighing including use of jacks and strain gauging. As design audit engineer, ASPEC witnesses the machine weighing, analyses the as-built mass distributions, checks compliance with AS 4324.1 and updates digital models to the as constructed condition.

Transport Assistance

During the transportation by road and sea, machine components are subject to wind and motion induced forces. The support arrangements of the modules on trailers for road transport are different to that on a vessel for sea transport. Hence, the load paths through the structures for the wind and motion-induced forces will be different during road and sea transport and also as compared to the service condition once installed. ASPEC carries out the following simulations and checks:

- Land transportation of major components between manufacturing facilities and port of preassembly prior to loading for shipment
- Lifting for loading and unloading of the pre-assembled machine to and from a heavy lift vessel including assessment of lifting points and lifting configuration
- Shipment of the fully assembled machine or modules from port of pre-assembly to the site. During sea transportation, the machine structures are subjected to forces induced by the motion of the vessel. The structures are checked for these motion induced forces.

Shiploader being lifted onto heavy lift ship

Commissioning Assistance

ASPEC's role in commissioning is to review machine commissioning documents and to witness the following steps in the commissioning process.

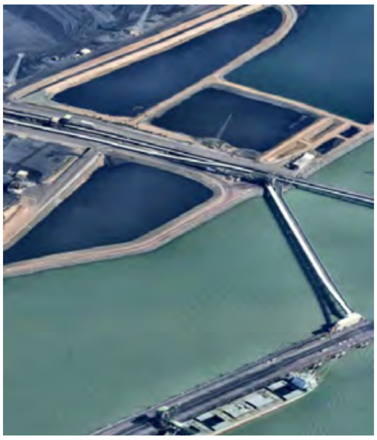
- Pre-Commissioning
- No Load Commissioning
- Load Commissioning
- Ramp Up
- Performance Testing
- Handover and Acceptance

Non-machine Infrastructure

ASPEC provides the following services for supporting infrastructure for machine projects:

- Configuration and design of wharf and marine structures
- Layouts and designs for stockyards, rail unloading stations, conveyors, road access and services
- Layouts and designs for rail foundations, maintenance bay, buffers, dust suppression systems, and turnover pits
- Design and layouts for earthen structures and construction yard for transporting of machines onto the rails and lifting

Rail Beam



Civil Works

Conveyor

RAMBOs and HAZOPs

ASPEC facilitates or participates in risk studies for new and existing machine projects including HAZOP and RAMBO. These studies involve an expert group meeting to "tease out" hazards, issues and risks for the project.

A HAZOP (HAZard and OPerability) is a systematic examination of potential hazards and operability issues with the design. This involves identifying the potential for unwanted energy releases from specific sources.

- Discrete parts of the system are identified and considered
- A series of specific guidewords are used to prompt identification of hazards from energy sources
- Other guidewords are then used for hazards which relate to the whole machine

RAMBO stands for Reliability, Accessibility, Maintainability, Buildability and Operability. A RAMBO study is conducted in a similar way to a HAZOP as a facilitated workshop using guidewords as prompts to identify hazards.

Selection of New Machine Projects

Shiploader 3
Hay Point Coal Terminal

Stacker Reclaimer 6/7
BHP Hay Point Coal Terminal

Stacker 3
Rio Tinto - East Intercourse Island

12,500 TPH Reclaimer
Rio Tinto Alcan – Amrun Project

Stacker 6
Port Kembla Coal Terminal

Groote Eylandt Stacker
South32

Ship Unloader
Port of Newcastle

Reclaimer
Rio Tinto – Cape Lambert Port B

Reclaimer 3
Port Kembla Coal Terminal

Stacker ST14
Rio Tinto - Cape Lambert Port B

Bridge Reclaimer
BMA Caval Ridge Mine

Radial Stacker
BMA Blackwater Mine

Reclaimer RC821
BMA Caval Ridge Mine

Shiploader SL12
Rio Tinto - Cape Lambert Port B

Berth 8 Shiploader
Port of Townsville

Mid-Life

Asset Integrity Inspection and Assessment

ASPEC has an inspection system for rail mounted machines. The purpose of this system is to:

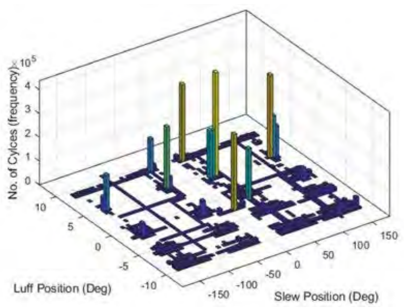
- Allow recording of asset condition in a systematic and repeatable manner
- Provide a better understanding of the risks and criticality of various components
- Provide a planned approach to remediation and maintenance.

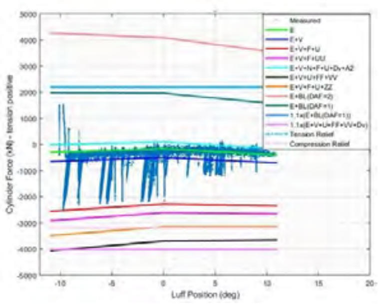
Below is a listing of inspection and assessments recommended for rail mounted machines.

Type	Inspection and Assessments	Frequency
Plant Integrity Review	Plant Integrity Review (PIR)	6Y
Structural Inspection	Engineering Inspection (EI)	2Y
	Structural Pin Inspection (SPI)	2Y
	Rail Engineering Inspection (REI)	2Y
	Fatigue Inspection (FI)	Varies
	Hydraulic System Inspection (HSI)	2Y
	Winch System Inspection (WSI)	2Y
	Long Travel System Inspection (LTSI)	2Y
	Machine Running Inspection (MRI)	2Y
	Shaft and Axles Inspection (SAI)	6Y
	Working Rope Inspection (WRI)	1Y
Electrical and Controls Inspection	Protective Device Audits (PDA)	1Y
	Anti-Collision System Moving Inspections (ACSMI)	1Y
	Critical PLC/Safety Systems Audits (PLC)	1Y
	Electrical Infrastructure and Protection Inspection (EIPI)	1Y
	Emergency Backup Systems Verification (EBSV)	1Y
Other Inspection	Protective Coating Inspection (PCI)	6Y
	Machine Tie Down Verification (MTDV)	1Y
	Access and Guarding Inspection (AGI)	2Y

Plant Integrity Review (PIR)

This review is carried out 6 yearly and is a comprehensive assessment of the condition of the machine and how it is operating compared to its design envelope. Operating data is obtained from the machine's SCADA (supervisory control and data acquisition) system. This is used to validate that the machine is operating within its safe design envelope. The review also includes an update of the fatigue life simulation for the machine based on the actual and projected usage.





Output from SCADA data review of machine, and comparison to AS4324.1 load cases

Monitoring of Machine Balance and Stability

Machine balance assessments ensure the continued stability of bulk materials handling machines. ASPEC services include:

- Reviewing drawings, calculation reports, and existing weighing and balance reports
- Developing load assumptions to AS4324.1
- Preparing scope of work documents for machine weighing and balance measurements
- Reviewing machine weighing and balance measurement results
- Preparing balance model for current condition and as-built condition including slew bearing stability, global stability, wheel loads and luff cylinder loads under load combinations to AS4324.1

Safety Upgrades

Typical safety upgrade checks and designs for machines carried out by ASPEC include:

- Design of replacement bogies, drives, wheels and rails to alleviate overloading
- Upgrading of long travel buffers
- Checking wharf piles and girders for increased shiploader loads
- Replacement of winches and suspension ropes to comply with current standards
- Upgrading brakes to comply with current standards
- Structural upgrades to comply with current standards

Storm Wind Tie Down Assessments

Standard design is for machines to relocate to a storm tie down position and have anchor pins inserted before the operational relocation wind speed is exceeded. However, in the event of thunderstorms where wind velocities increase very quickly with minimal warning, relocation may not be possible due to lack of time to respond. A number of serious machine failures have occurred due to such conditions. Sites prone to thunderstorm events should upgrade brakes and rail clamps to resist these wind events at any location along the rail track. ASPEC's services include reviewing existing designs and providing recommendations for brake and rail clamp upgrades.

Sustaining Capital Estimates

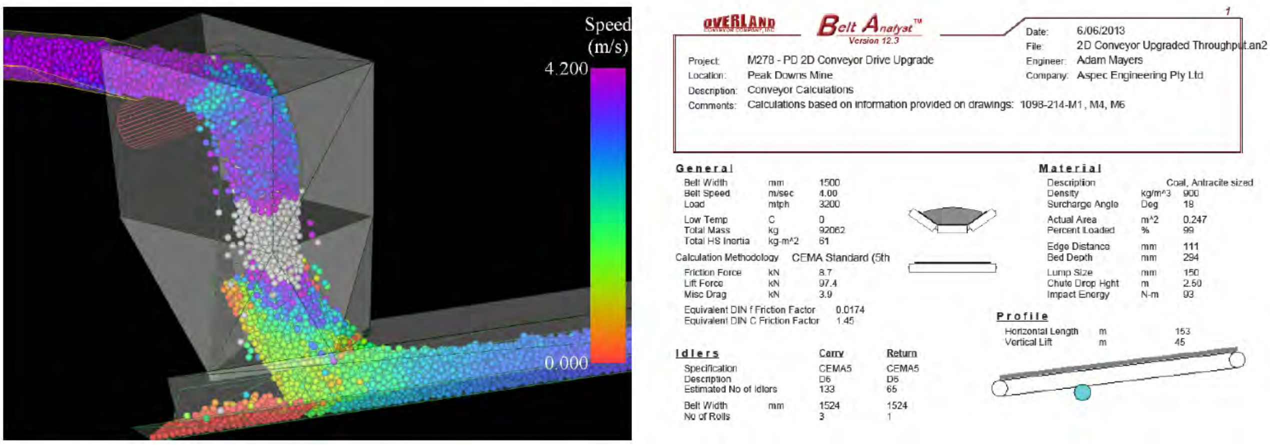
Ongoing works are required on machines to extend their operational life, to increase throughputs and to support strategic planning of future operations. ASPEC's services include ongoing (sustaining) capital cost estimates for a range of operating throughputs for machines. This covers:

- Service life assessment identifying timing (trigger points) for major component replacement and life extension work
- Scope of work associated with trigger points
- Planned asset replacement timing and costs

Throughput Upgrades and Performance Improvement

In addition to ensuring bulk materials handling machines remain compliant and safe throughout their design life, the continuing pressure on existing terminals for increased throughput sparks the need for machine performance improvement, such as throughput upgrades. ASPEC uses specialist conveyor belt analysis software to calculate conveyor capacity and upgrading requirements.

ASPEC conducts chute flow simulations to better understand chute flow and capacity restrictions. ASPEC uses both continuum modelling and discrete element modelling (DEM) to replicate the existing flow conditions and analyse modifications to increase capacity and improve performance. ASPEC also develops structural Finite Element Analysis (FEA) models of part or all of the supporting structures associated with conveyors and transfer chutes.



Example of ASPEC Materials Handling Upgrade Simulations

On-site Shutdown Engineering Support

On-site engineering support services offered by ASPEC include:

- Engineering technical support prior to, during and following the shutdown
- Answering of technical requests for information (RFI)
- Site supervision and inspection
- Site instructions for repairs
- Attendance at site risk assessment and coordination meetings
- Witness of commissioning
- Review of commissioning data
- Additional clash checks / drafting support
- Update of ASPEC reports

Selection of Mid-Life Machine Projects

Raw Coal Reclaimer
BMA – Goonyella Riverside Mine

Shiploader SL1
BHP – Hay Point Coal Terminal

Shiploader SL2
BHP – Hay Point Coal Terminal

Stacker Reclaimer SR0
BMA Hay Point Coal Terminal

Shiploader SL2
Gladstone Ports Corporation

Stacker Reclaimer SR5
Darlymple Bay Coal Terminal

Product Stacker
New Hope Group QBH

Ripios Stacker
Spence Mine Chile

Steaming Coal Stacker
Coronado Curragh

Shiploader
New Hope Group QBH

Reclaimer RL2
Darlymple Bay Coal Terminal

Ore Unloader 3
BlueScope Steel

Ship Unloader 2
Queensland Alumina Limited

Bauxite Shiploader
Rio Tinto Alcan Gove

Bridge Reclaimer
Rio Tinto Iron Ore Paraburdoo

End-of-Life

Refurbish or Replace

At many existing bulk material handling facilities, equipment such as stackers, reclaimers and ore car dumpers are nearing the end of their design lives. Owners are faced with the decision on whether to refurbish existing or procure replacement machines. There are also continuing pressures for increased throughput and in the case of ports, to accept larger ships.

Traditionally, owners would carry out a refurbishment to allow the life of their equipment to be extended. However, due to the continuing strong demand for commodity exports and high equipment utilisation levels, downtime is critical. Thus, decisions between refurbishment and replacement equipment can have a big impact on plant availability, cost and revenue.

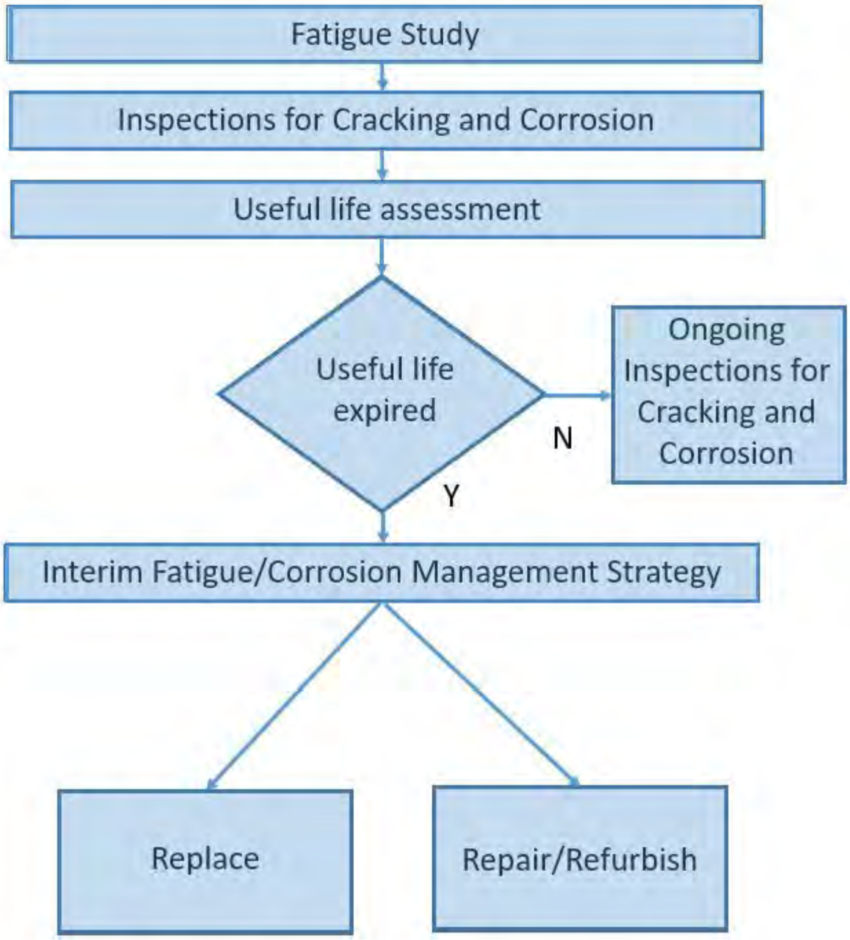
A survey of some typical machines in Australia found that the average replacement age for each machine type was:

- Reclaimers 29 years
- Stacker-reclaimers 36 years
- Stackers 40 years
- Shiploaders 42 years

Main reasons for major refurbishment or replacement are:

- Metal fatigue - structural fatigue occurs when cyclic stresses cause progressive failure of the material. Fatigue damage is typically greatest at welded joints or other discontinuities. Repairs to fatigue cracks have a limited life and re-crack in a shorter time interval.
- Corrosion - most materials handling machines operate in a corrosive environment. Severe corrosion will reduce the strength and fatigue resistance of the structure.
- Obsolescence of equipment – items of mechanical and electrical equipment can become outdated such that they are no longer supported by the manufacturer. Hence, it may be necessary to replace this equipment within the life of the machine.
- Configuration changes such as the need to accommodate larger ships may be required as the shipping mix and terminal throughput changes over time.

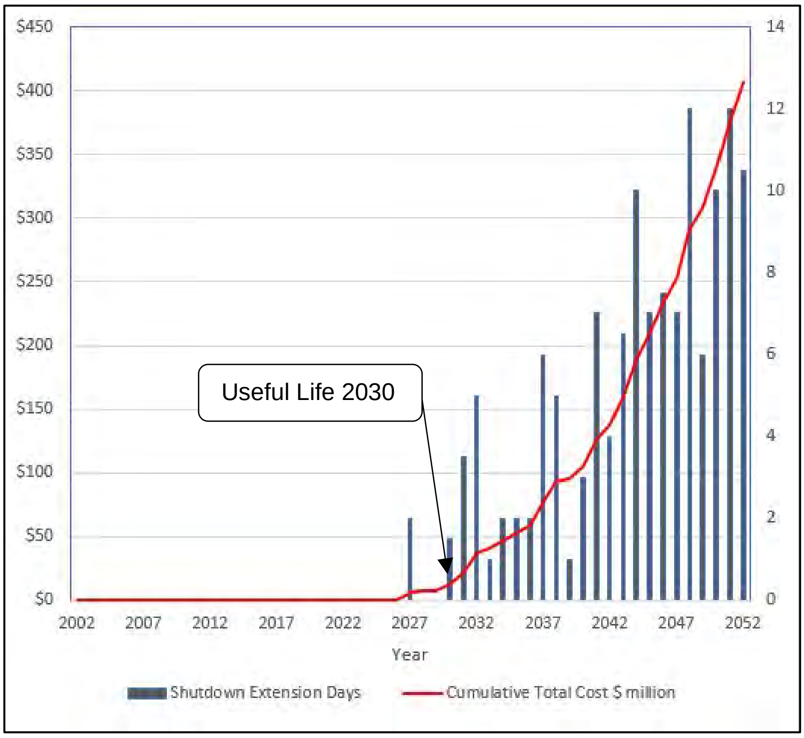
ASPEC has a process to assist owners making decisions on when to carry out machine replacement or major refurbishment as shown below.



Flowchart for Refurbish or Replace

Fatigue Useful Life Simulation (FULS)

ASPEC has developed a fatigue useful life simulation which estimates the number of cracks that should occur each year in the future and calculates the repair time and cost based on the quantity of cracks and difficulty of repair. Crack repair cost inputs include: (1) fixed cost per crack, (2) variable cost per crack, and (3) production loss, which is triggered when total repair time exceeds the available shutdown time. This approach illustrates that there will be a time when the available shutdown time for a machine is exceeded, which causes high production losses which means machine replacement is more economic at this time.



FULS Simulation

Fatigue and Fracture Assessment and Repair

Operating machines go through stress cycles with load fluctuations as they stop and start. These cyclical stresses cause fatigue damage in steel resulting in cracking. Once cracking initiates, crack growth occurs exponentially. The extent of fatigue damage will be different on different components of the machine as some parts are more heavily utilised than others. Such locations must be inspected periodically to ensure that actual crack size is smaller than critical crack size, otherwise the structure will fail.

The benefit of fatigue and fracture assessments is knowledge of how the risk (e.g. crack) will grow, and if so, the risk growth rate.

In general, the ability to repair structures with fatigue cracking is quite limited. Some of the issues with crack repairs are below.

- A weld repair on parent metal can reduce the fatigue life of the original component by a factor of ten.
- Corrosion repairs using cover plates typically reduce the fatigue life by a factor of ten.
- Repairs to existing welds can have a fatigue life of about one-quarter to one-half of the original component.
- Repairs at the same location will further degrade the fatigue life. It is only practical to repair a weld at the same location 3 or 4 times.
- Welds repaired under stress will have a reduced fatigue life – steel should be destressed to less than 20MPa prior to repairs being carried out.

ASPEC's services include:

- Fracture mechanics assessment to determine inspection intervals
- Crack repair procedures
- Onsite inspections
- Repair cost estimates

Machine Replacement Studies

The purpose of machine replacement studies is to establish the scope, cost and feasibility of life extension scenarios so that they can be compared to machine replacement in order to establish a business case.

The study includes:

- Structural and mechanical upgrade scopes
- Electrical and control system upgrade scopes
- Cost estimates and construction schedules

Selection of End-of-Life Machine Projects

Stacker 1
Rio Tinto – East Intercourse Island

Car Dumper CD1
Rio Tinto Iron Ore EII

Shiploader SL2
BHP – Hay Point Coal Terminal

Stacker
PWCS Kooragang

Stacker Reclaimer SR1
BMA – Hay Point Coal Terminal

Shiploader 2
PWCS Carrington

Reclaimer
PWCS Kooragang

Stacker 2
Port Kembla Coal Terminal

Reclaimer 2
Port Kembla Coal Terminal

Stacker
Rio Tinto Iron Ore Paraburdoo

Stacker Reclaimer SR1
Darlymple Bay Coal Terminal

Radial Stacker
BMA Goonyella Riverside Mine

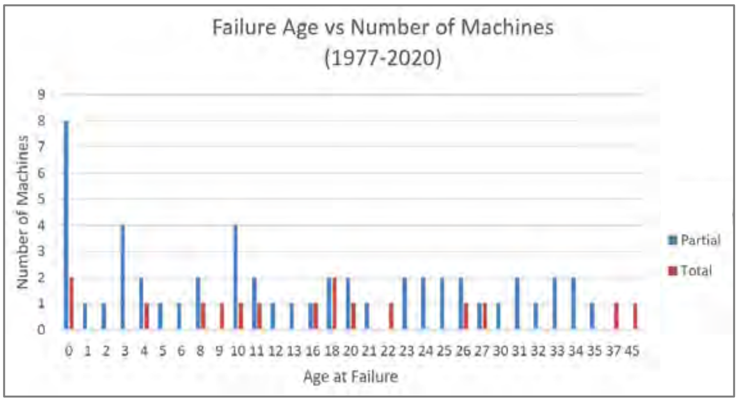
Stacker Reclaimer SR2
Abbot Point Coal Terminal

Radial Stacker
Peak Downs Mine

Reclaimer 1
Rio Tinto Iron Ore Parker Point

Machine Failures

Bulk materials handling machines are larger moving structures with dynamic loads and have shown failure rates higher than standard static structures such as buildings.



Number of Failures vs. Machine Age

Collapsed Machine

ASPEC has collected details on 68 bulk materials handling machine failures that have occurred in Australia since 1977. The types of machines considered in the study include stackers, reclaimers, stacker/reclaimers, shiploaders and ship unloaders. The figure above shows the number of machine failures versus age of the machine. Partial failures are defined as failures requiring major repairs. Total failures are defined as the total collapse of the machine. There were a significant number of partial failures on new machines and a more even spread for mid-life and end-of-life machines. The spread of total failures was fairly even over the full lifecycle of the machines considered.

The data shows that 25% of machine failures were due to wind events which occurred throughout the lifecycle of the machines. Apart from wind, new machine failures (years 1 to 3) tended to be due to overloads, design deficiencies and collisions; mid-life machine failures (years 4 to 25) tended to be due to fatigue, overload and maintenance management; end-of-life machine failures (years 26+) tended to be due to maintenance management, fatigue and corrosion.

Failure Investigations

ASPEC has been involved in a number of failure investigations for bulk materials handling machines ranging from partial failures to total collapse. The following investigations are carried out by ASPEC to determine the root cause of the failure:

- Site inspections
- Testing of components
- Structural and mechanical analysis and checking

ASPEC can prepare independent expert reports for such investigations. ASPEC also participates in ICAM (Incident Cause Analysis Method) investigations as part of the client team.

ASPEC has experience with the following types of failures and recommendations for immediate corrective action and long-term mitigation strategies:

- Major structural damage to machine booms due to impact or high winds
- Fatigue cracking of materials handling machines resulting in immediate crack repairs or ongoing management with regular NDT inspections
- Slew bearing failures and failures of other critical bearings
- Major mechanical failures such as loss of brakes or drive systems
- Major structural damage due to corrosion
- Shaft and pin failures

Having high level machine expertise in each of ASPEC's offices (QLD, NSW and WA) allows ASPEC to respond quickly and efficiently to clients' requirements for failure investigations, irrespective of the location of the project.

Recovery Projects

Following an incident, ASPEC works closely with the client team, legal and insurance representatives for the recovery project which may involve repairs, investigations and modifications to an existing machine or engineering for replacement machine. These projects typically involve detailed risk assessments to avoid future failures. APSEC's experience includes:

- Third party review of contractor's methodology
- Design of repairs and upgrades
- Verification of contractor's designs
- Checking of lifting plans
- Witnessing of critical operations and re-commissioning on site
- Participation in risk reviews
- Review of cost estimates and schedules
- Assistance with documentation and change management

Aspec Engineering Pty Ltd
ABN 22 105 267 016

www.aspec.com.au

T +61 7 3193 0400
F +61 7 3607 2252
admin@aspec.com.au

Queensland

Level 1, 99 Melbourne St
South Brisbane, QLD 4101

Postal Address:
PO Box 3075
South Brisbane, QLD 4101
Australia

New South Wales

Unit 3, 166 Hannell St
Wickham NSW 2293

20 Beach St
Wollongong, NSW 2500

Western Australia

Level 12, 28 The Esplanade
Perth WA 6000