

Avoiding Nature's Big Drop
Sliding the Belle Tout Lighthouse to safety
from it's cliff edge

Presented by Gary Stewart of Abbey Pynford
on Tuesday 10th December 2002

Belle Tout Lighthouse was built in 1834 but decommissioned towards the end of the 19th century because of progressive cliff erosion. Erosion continued at an average annual rate of 150 mm a year until, by 1990, only 4m remained between the lighthouse and the cliff edge.

The talk was split into two halves. The first being a brief overview of Abbey Pynford and introducing the basic construction techniques frequently used in moving buildings. Examples of moving buildings vertically and horizontally were given.

The second half of the talk dealt specifically with the Belle Tout Lighthouse and included video footage of the move

(The following extract was provided by Abbey Pynford from there technical brochure on the project)

Last November another chunk of the 100m high chalk cliff of Beachy Head fell into the sea, leaving the 17m high stone turret of Belle Tout lighthouse only 4m from the edge. Two months later an even larger section, some 400,000m³, was lost from the cliffs to the east.

Even without any more spectacular falls, average annual erosion rates of 0.5m meant that Belle Tout would eventually topple over the cliff unless something was done. A £250,000 effort to save the historic lighthouse was due to culminate with the sliding of the 850t structure 17m to the north, to a position which should see it safe for the next half-century or more.

"We couldn't actually slide it any further without vastly increased costs," explains Abbey Pynford head of special contracts Tim Jolley. "Because the ground slopes down so steeply from the cliff edge we had to construct a concrete "ground floor" structure to the north and slide the existing structure onto that.

"We will leave the structure with the potential to be moved again in fifty years time, but the next move will be outwards and downwards."

Abbey Pynford became involved in the project to save Belle Tout back in 1997, when it was more than 14m from the cliff edge.

Even then the top priority was to devise a way of moving the structure without putting any significant horizontal loads into the ground close to the cliff face. The possibility that any attempt to jack the building northwards would actually just push the cliff face southwards into the sea became even more real when 10m disappeared in November 1998.

Before that fall Belle Tout was still inhabited and the move was planned for June 1999. Afterwards, with the building evacuated, the move was brought forward three months in the hope of completing it before any further falls put the lighthouse at ultimate risk.

"Actually, we felt safer working up here once the November fall had taken place," says Abbey Pynford contracts manager Andy Parks. "The rubble from that protects the toe of the cliff and what's left looks stable. "Really the main problem is the wind. When it's really strong, lumps of chalk fly around, and chalk we tip over the cliff comes back in our faces."

Jolley says the first operation, which began in early December 1998, was basically a conventional underpinning job. Sacrificial steel stools were slotted in under all the load bearing walls, then reinforced concrete beams cast between and around them. Extra beams linked the wall support beams to create a stiff load bearing grillage.

Beneath this grillage, some 4m below original ground levels, the contractor created four massive, heavily reinforced north/ south "slide

beams". Meanwhile, subcontractor Britin Construction was busy building the new concrete support structure to the north. Last week the final sections of the slide beams were cast, linking the existing and new structures.

Grillage and slide beams were in contact, separated only by a sheet of polyethylene, until 9 March. That afternoon, after delays caused mainly by the mob of spectators, press and TV cameramen swarming around the site, 22, 90t jacks began to separate the grillage from the slide beams, lifting the turret and its annex 650mm into the air.

Ensuring this lift was perfectly balanced was a major challenge, Jolley says. "There's always a tendency for structures to lift in sections. Our jacks are fitted with rheostats and monitored by computer, so we can adjust individual jacks to keep everything on an even keel."

The ultimate purpose of the lift was to create space for the installation of Abbey Pynford's specially adapted "grease skates" and inverted jacks. Before this could happen precast concrete "cheeses" were inserted between the building and the slide beams as a temporary measure until the contractor was ready to start the slide. "Grease skates don't like to be static under load for long, they begin to seize up, Jolley explains. "So we inserted the cheeses and lowered the building back down onto those for a week."

This interval was used to fix 3mm steel plate slide surfaces to the tops of the slide beams, which had to be constructed to very tight tolerances. The contractor calculated that a lateral force of 85t would be needed to overcome Belle Tout's inertia. But once the building was moving on a cushion of grease a force of less than 20t would suffice, a figure perilously close to the total calculated wind load produced by a southerly gale.

"From the point of view of a south wind the turret is 90m high," says Jolley. "In those circumstances the pushing jacks would be acting as brakes rather than rams."

Six jacks were due to be deployed, acting between the grillage beams and temporary steel channels bolted onto the slide beams. Jolley explains: This way the jacking forces are transmitted to the ground under the length of the slide beams and through the foundations of the new structure, which are a lot further from the cliff edge."

Immediately before the slide began the whole structure had to be jacked back up off the cheeses and the grease skate assemblies inserted, 12 under the tower and 10 under the annexe. Inverted jacks link the skates to the structure, connected together in three groups to form a "three legged self-levelling hydraulic suspension system" during the move.

With the pushing jacks having a stroke of around 1,100mm, Abbey Pynford was planning for the final slide to take 17 jack cycles, each lasting around 30 minutes. Two days before that, however, a 1m trial slide was scheduled.

An elaborate system of guides and laser monitors was to keep the structure on track during its main move which was due to happen yesterday. The final stages were the transfer of load to the 22 reinserted jacks, the removal of the grease skates and the lowering of the structure onto a sand/cement bed on top of the new ground floor. A discrete application of mould oil should ensure that, when and if jacks are re-inserted preparatory to a second move sometime in the future they should have no difficulty in separating the sections.

Finally, the slide beams left sticking out behind the lighthouse will be cut off, the vast heap of excavated chalk used to landscape the old foundation void, and the building refurbished. By spring its owners will again be offering perhaps the most unusual bed and breakfast accommodation in the country.

And probably the best known. The operation was due to be shown live on BBC's Tomorrow's World programme this week, and it has featured on national TV and radio news, and in most national dailies. Some of the reports actually mentioned Abbey Pynford's name as well.