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Thornton**
consultants

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Masterton District Council

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Attention: Peter Whisker & Tania Madden

Dear Peter & Tania

Masterton Town Hall Redevelopment Review Outline Peer Review and Options Evaluation

As per our proposal 29th November 2016 our review of the LGE report (Revision A 27th September 2016) is provided below. We also append the proposed “one-page” summary of the issues to assist with the understanding of the complex detail of the assessment and options to assist with your internal and public communications.

Peer Review:

General Aspects:

We agree assessing the code (NZS 1170.5) site seismic subsoil category as D. We note that the report does not consider other geotechnical aspects: where these may possibly be significant structurally, we have noted in our review below.

We note there is good correlation between LGE’s calculations, our approximate checks as part of this Peer Review, and the work previously undertaken by Spencer Holmes (given site subsoil category as above). We believe this should give you the client and the public good confidence in the conclusions regarding the current status of the building.

We have not carried out any review of the “Civil Defence” areas of the site (2 buildings): though structurally separate they are somewhat continuous from a user’s point of view especially with the Municipal Building at the upper floor. As such any strengthening/redevelopment scheme should consider how the buildings interrelate to get their most efficient use. We also note the Chapel St Civil Defence building is quite unusual in structure and may benefit further assessment if appropriate as part of an overall site master planning exercise.

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Both the Town Hall and Municipal Building are irregular in the distribution of mass/seismic resistance in plan. This has been accounted for in LGE's analysis by acknowledgement of the weakest element. In many cases there is torsional stability sufficient to redistribute this mass to other areas. This will make available additional capacity and damping to the structure, but is likely to cause greater damage as this occurs which may include localised falling hazards from small sections of concrete or masonry. The differences in strength by taking this alternative approach are not sufficient to change the conclusions of the report, and these localised damage hazards may not be considered appropriate for a "public" building such as this.

The LGE report identifies areas where there is low confidence in the ability of the floor-carrying gravity structure to continue to perform dependably when subject to large displacements. We commend this as it picks up the sentiments in the new draft of the NZSEE assessment guidelines, and the recent amendment to the loadings code for new buildings.

The target retrofit level of *80%NBS* is reasonable: our experience of similar projects is 70% as a minimum. We suggest any detailed design targets as near as practical without significant cost penalties, with the agreed percentage (80%?) as a minimum.

Importance Level for the whole complex needs to be considered carefully. Firstly it is our assumption that the "Civil Defence" buildings are just offices, and are not intended to perform dependably in any post-disaster recovery other than any regular structure. Secondly and more importantly the classification of the Town Hall as Importance Level 3 (having a capacity for more than 300 people in one space) implies the egress paths from this must also be IL3: this involves the area to the south of the Town Hall in the Municipal Building. As the buildings interact, it will be important that any loss of stability of the lesser IL2 sections do not cause life safety issues in the IL3 sections and the egress paths. To this end, any scheme should carefully consider the interaction/interrelation between the two zones of the complex, including whether the Municipal Building warrants a greater than IL2 capacity in some aspects to ensure this.

Town Hall:

Assessment -

We agree with the general findings of the LGE report for the existing capacity of the Town Hall. We have two additional concerns not identified explicitly in the report.

Firstly is the stability of the heavy concrete Projection box for longitudinal loads supported laterally only at (the different levels of) the Municipal Building L1 ceiling/roof, the L1 seating tier in the hall, and the Hall roof. All of these are relatively weak and flexible with respect to the mass of the Projection Box. We do not however believe Projection Box is likely to become unstable at loads less than the transverse capacity of the Hall structure.

Secondly and less critically we believe it is unlikely that the fibrous plater lining to the walls to be secured back to the underlying structure with full code loadings capacity. Extrapolating from our experience with this type of structure it will have a

capacity greater than the transverse capacity of the Hall. This is considered critical due to the large height sections of plaster could fall from.

Retrofit Scheme-

The scheme involving demolition and replacement of the existing concrete portals is a practical baseline. We do not believe removal of brick in addition to these is worthwhile if the existing building is to be retained. The scheme is effectively a rebuild of the 1950's intervention and we agree it is likely to cost in the same order as rebuilding new. Significant use could be made of the more robust stage house structure, which could comprise more of a retrofit rather than re-build (refer options study).

Municipal Building:

Assessment-

We agree with the general conclusions for strength and robustness in the LGE report. We believe the capacity of the building may be a little lower than assessed as the rocking of the internal walls is typically at foundation level which is not quite as energy-absorbing and stiff as rocking at a bed-joint: depending on the underlying soil stiffness. However, provided there are stiff non-liquefying gravels under the foundations the effects should be very small.

We also believe the performance of the longitudinal wall on the hall side is likely to be poorer than has been (and can practically be) assessed due to the irregular arrangement of the openings. The panels are likely to break in to irregular shapes which change with the direction of loading, and as a result walking/ratchetting degradation is likely to occur.

Our assessment of the connections of the façade to L1 are slightly higher than LGE's, but slightly lower at roof level. Neither significantly changes the report conclusions.

The other geotechnical-critical aspect of the building is the existing small foundations under the north-east end internal columns. Their performance and the redistribution of loads in the case of settlement would warrant further investigation if the floor structure were to be retained as-is.

Retrofit Scheme-

The scheme assumes that open-plan area will be required: given the alterations that have occurred over time, and trends in modern offices, we believe this to be prudent. Refer to the alternatives section of this report for further discussion.

In general we agree with the structural form and choice of materials, and believe these are appropriate as a baseline. We would recommend the use of stiff EBF frames instead of CBF's as they are more seismically resilient for negligible additional cost.

The transverse frames rely on their base fixity to be stiff enough to keep the various areas of the building compatible: though not explicitly identified appropriate costs should be allowed for the connections of the frames to the foundation beams.

We query the benefit of retaining the rear 1950's concrete strengthening bands to support the roof: propping may be of a similar cost to the careful demolition that would be required to work around the retention of these.

Another "buildability" consideration may be offsetting the new frames from the existing truss lines to allow more working room inside the building during construction (if ceiling joists temporarily removed), and more ability to recess the upper floor beam into the ceiling space. Again this would have little effect on preliminary costings at this stage.

Options Evaluation:

The following alternatives to the baseline scheme presented by LGE provide some flavour of the extent the project could be changed to best suit different intended uses of the whole site. We note that given the extent of intervention required for both buildings, the non-structural component of any strengthening scheme is likely to be of the same order of cost as the structural component, or potentially more. As such, it is important that any scheme is based upon an efficient, future-looking masterplan of the site that makes most economic use of the facilities needed by the Council/Community.

The options presented below result from a strengths/weaknesses analysis of the existing fabric, and include a brief pros-and-cons appraisal to assist with understanding the option further.

Town Hall:

Traditional Hall/Theatre Strengthening: this would involve additional (likely sprayed concrete) walls to the stage house and foyer ends of the auditorium, with significant horizontal roof bracing through the auditorium ceiling. The intent of this option would be to keep as much of the existing fabric in place undisturbed as possible. However the new elements would be significantly expensive: installed within the constraints of the existing fabric. This would be especially so for foundations, as hold-down piles are likely to be required at the ends of the new wall elements. The heavy nature of the existing structure would make this more expensive relative to similar projects in other theatres/halls.

Strengthen the Current Elements: strengthening the existing portals would likely involve post-tensioning the existing roof beams and adding new columns alongside/integral with the old. The existing columns would be cut at the underside of the roof beams, and energy dissipation added at the connection between the new columns and the roof beam. Additional roof bracing would be required around the projection box. The rear stage house wall mullions would need to be strengthened for face loads with corresponding ties and bracing in the roof. This option has the advantage of retaining much of the existing fabric, but the costly result is of much of it being affected by strengthening work with high structural demand from the heavy weight existing structure.

Rebuild Retaining Useful Existing Elements: the useful existing elements we believe are the existing floor, the tiered seating, and the stage house. The cost savings of not having to re-build these items would be offset to a small degree by the costs of temporary protection and disturbing the sequence of works. The actual usefulness of these elements should also be interrogated, especially the suitability of the stage house geometry and flying system for future productions, and the seating tier geometry (noting the unit complete could be lowered or raised to suit the new building).

Re-building: many of the advantages of re-building relate to the sequence of works for the Municipal Offices, and the ability to create a purpose built venue to match the current needs of the community. Combining the two structures does provide more alternatives for the lateral bracing to the new hall. Tall frames are structurally inefficient, and it may be more economic to provide the lateral structure for both buildings on the two-storied portion as a “buttress”. Alternatively space for more efficient braced frames or walls may be able to be provided between the two structures (currently the old lightwell area). The disadvantage of combining the structures is that the whole building would need to be IL3.

Municipal Building:

Modifications to LGE Scheme: the current scheme has a clear span across the new office space: structurally it would be cheaper for the new seismic frames to be two-bay rather than single bay, leaving a column centrally in the space (for the lower floor). This obviously has future planning disadvantages but this may be acceptable balanced against cost (and the smaller beam/column depths).

The new structure could also be reinforced concrete rather than steel: frames across the buildings and walls substituting for the braced frames. The structure would be larger, heavier and more labour intensive to build, and in our experience of a similar cost/more expensive than steel.

Cellularisation: the building is rather large, and if in planning terms it could be considered as three to four planning “blocks”, bracing (likely k-bracing) could be introduced between these blocks. Bracing in our experience is more cost effective than moment frames. This may be seen as too great an architectural/planning flexibility compromise though.

Façade Retention: re-building new behind the existing façade has the appeal of cleaner planning and buildability, but it is our experience that the cost of temporary works to hold up the façade (lost investment) is significant. This may be able to be avoided by careful planning and sequencing, working in shorter lengths down the building demolishing and rebuilding in sequence (which re-introduces complexity).

Combined Building with New Hall: if the new hall is built first, and has its own lateral load resisting system the existing Municipal Building roof may be able to be re-supported off this new structure. This would allow cheap “façade retention” using the roof to brace the top of the façade while the building is demolished and re-built inside. The re-build would not have overhead crane access, but with modern telehandling equipment this is not seen as too significant a penalty.

Combined Building with Vertical Extension: if the buildings are to be a combined unit, the new hall is likely to be taller than the Municipal Building. Re-building the Municipal Building to three floors may significantly simplify access to the multiple levels of the auditorium and stage house, and would potentially be more economic than building the same space freestanding elsewhere. This assumes more functions/economic returns are available for a larger building.

In summary, we believe the LGE scheme provides a good baseline to understand the costings of a pure strengthening/replacement of the existing facilities like-with-like. However we stress again we believe it is essential to consider the future use of the whole complex before any scheme is undertaken. All strengthening schemes involve significant disruption of the existing building fabric: if many non-structural elements are to be removed and “put back” the form they should be “put back” in requires careful thought outside just structural engineering.

We trust that this provides you with a good understanding of the potential structural options associated with this complex redevelopment/retention proposal. We would be happy to talk via VC/Skype or meet with you should you wish to discuss this report further.

Yours faithfully



Alistair Cattanach
DIRECTOR
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Masterton Town Hall and Municipal Building: Structural Peer Review and Options Evaluation

Dunning Thornton have reviewed the seismic assessment and strengthening report prepared by LGE (Revision A 27th September 2016) and supporting documentation and generally concur with its findings. The buildings are approaching 100 years old, and the seismic strengthening carried out to them is over 50 years old.

The scope of seismic retrofit required to both buildings is very extensive and will affect much of the existing fabric, and hence in our experience carry a non-structural cost on the same order as the seismic strengthening cost. It is also expected that the seismic retrofit cost, with all make-good, disabled access and fire compliance requirements may be in the same order of cost as replacement with a new building (though unlikely to have a façade of the same quality as the existing). The LGE scheme for the strengthening of the Municipal Building we believe is a good baseline to assess this.

The only significant item we believe the report overlooks is the Importance Levels targeted for the buildings. If the hall is going to cater for more than 300, it becomes a place of assembly (Importance Level 3 – IL3) and has to be designed for 30% more seismic load than a “normal” building. If the Municipal Building is only going to be designed for IL2, the egress from the hall cannot go through this weaker portion which significantly affects the planning/orientation of the new hall. Alternatively the areas of the Municipal Building that contain egress or could affect the hall could be designed for IL3.

The scheme prepared by LGE will give a good baseline costing to understand the relative cost between the significant strengthening required, and a comparable new building provided the appropriate allowances are made for the non-structural aspects of the scheme. We believe there are several items of valuable fabric in the buildings (the façade, the roof trusses, the hall floor, stage house and seating tiers). We believe economic seismic strengthening is about creative re-use of high-value items, and efficient strengthening/re-building of the remainder. The sequence of how the project is carried out will play a big part in this, and consideration could be given to joining the buildings to assist this.

Most importantly we believe a master-planning exercise should be carried out to understand what the Council/Community want and can use from the complex, and creative solutions be generated from this using a combination of strengthening and new build.

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