Massive spin-2 field in arbitrary spacetimes -- the detailed derivation

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We present the consistent theory of a free massive spin-2 field with 5 degrees of freedom propagating in spacetimes with an arbitrary geometry. We obtain this theory via linearizing the equations of the ghost-free massive gravity expressed in the tetrad formalism. The theory is parameterized by a *non-symmetric* rank-2 tensor whose 16 components fulfill 11 constraints implied by the equations. When restricted to Einstein spaces, the theory reproduces the standard description of massive gravitons. In generic spacetimes, the theory does not show the massless limit and always propagates five degrees of freedom, even for the vanishing mass parameter. We illustrate these features by an explicit calculation for a homogeneous and isotropic cosmological background. It turns out that the spin-2 particles are always stable if they are sufficiently massive, hence they may be a part of the Dark Matter.